Debt Decomposition and the Role of Inflation: A Security Level Analysis for India*

Piyali Das † Chetan Ghate ‡

December 13, 2021

Abstract

We assemble a novel data-set on Indian public debt with consistently defined aggregate annual components from 1951–2018, and Centre-State security level data from 2000–2018. Based on aggregate debt data, we quantify the contribution of inflation, real GDP growth, nominal interest rates and primary deficit/surplus towards India's debt-dynamics. We find that inflation is an important component in financing India's government debt historically. From the security level data, we find that nominal returns on the marketable and non-marketable portions of the Centre's debt account for the highest contribution towards changes in public debt. Our paper helps inform the debate on the adoption of flexible inflation targeting in India.

Keywords: Debt Decomposition, Fiscal Dominance, Indian Economy, Flexible Inflation Targeting, Public Debt in EMDEs.

JEL Codes: E62, E65, E52, G12, G28

*We are grateful to Viral Acharya, Etienne Wasmer, Jean Imbs, Gurbachan Singh, Kundan Kishor, Indira Rajaraman, Pinaki Chakraborty and seminar participants from Ashoka University (2018), the 14th Annual Conference on Economic Growth and Development at ISI Delhi (2018), Shiv Nadar University (2019), the Delhi Macroeconomics Workshop at ISI Delhi (2019), the Western Economic Association International (2021) meetings, the Finance and Macroeconomics Group, CAFRAL-RBI, and the 2021 IIPF-NIPFP Conference for useful comments. We thank Mikita Khurrana for outstanding research assistance. We also thank officials from the Department of Economic and Policy Research (DEPR), RBI, for several helpful conversations on the data. We are grateful to the PPRU (Policy and Planning Research Unit) for financial assistance related to this project. We thank the Co-Editor, Sushanta Mallick, the Associate Editor, and three anonymous referees for very helpful comments. An earlier working paper version was titled "Public Debt in India: A Security Level Analysis". The usual disclaimer applies.

†Corresponding Author: Independent Researcher, G-1350 Second floor C.R. Park, New Delhi-110019, India. E-mail: dasp@alumni.iu.edu. Fax: +91-11-41493981

‡Economics and Planning Unit, Indian Statistical Institute – Delhi Centre, 7 S.J.S Sansanwal Marg, New Delhi – 110016, India. E-mail: cghate@isid.ac.in. Fax: +91-11-41493981

1 INTRODUCTION

In 1951, Indian general (Centre plus State) debt was approximately 18.5% of GDP. Till 1972, general debt to GDP rose steadily to about 39%, and then fell sharply to 26% in 1975. It then stayed roughly constant till the mid–1990s averaging 32% between 1975–1996.[1] After 1996, general debt exploded reaching 57% in 2005, a rise of about 26% points in nine years. Debt-GDP in India then fell to about 50% in 2011 and then rose again to 57% in 2018.

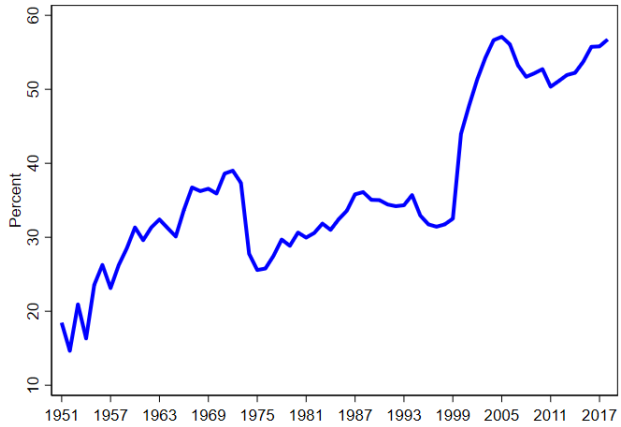

Figure 1: General Government Public Debt-GDP

What factors explain the historical evolution of public debt in India in Figure 1? How important, quantitatively, is inflation's role in debt liquidation in both the pre and post (1991) liberalization era? How did the enactment of major macroeconomic reforms, such as the dismantling of administered interest rates in 1998, the enactment of Flexible Inflation Targeting in 2016, and the implementation of the Fiscal Responsibility and Budgetary Management Act in 2003 in India influence its public debt trajectory? Were these reforms successful in achieving their macro-stabilization goals? What lessons can we learn from India's public debt management that are relevant for other EMEs ?

To address these questions, this paper undertakes a debt-decomposition analysis of Indian public debt between 1959–2018. We do this via two approaches. We first do an "accounting-

[1] In Indian fiscal year (1st April to 31st March) reporting, 1975–1996 means 1974–75 to 1995–96. We retain the shorter form throughout the paper.

decomposition" on a newly assembled and consistently defined annual time series of aggregate government debt between 1951–2018 and its components for India. Our analysis however uses data from 1959–2018 because we have data on all four components in the government budget constraint that drive debt dynamics over this period. These components are the nominal interest rate, inflation, the real GDP growth rate, and the primary deficit/surplus.[2] Between 1959–2018, we show that inflation's largest impact on eroding public debt (about 42%) happens in the sub-period 2008–2018, a period which includes the high inflation years of 2009–2014. Overall, inflation's impact on the change in public debt is also fairly large (30.5%) in the 1990–1999 sub-period suggesting that when both periods are taken together, inflation is the dominant component in reducing India's public debt in the post-liberalization (post 1991) period. Over the sixty year period that our sample covers, inflation's contribution to lowering public debt has successively become larger across time periods suggesting debt liquidation by inflation. Thus, inflation has been an important component in financing India's government debt.[3] Our analysis goes up to 2018 and therefore excludes the consequences for Indian public debt because of Covid-19. Since our focus is on long term trends in Indian public debt, we hope to address this important lacunae in the future.

Next, we assemble a novel granular security level data-set, and undertake a debt-decomposition analysis following the approach of Hall and Sargent (1997, 2011). The Hall-Sargent (HS, henceforth) approach to debt decomposition, importantly, involves the maturity structure of debt. The method accounts for interest payments in a way that differs from the typical official method of calculating interest payments. In addition to coupon payments, it includes the principal repayments and accounts for the capital gain/loss associated with the maturity structure of the debt. From the term structure of interest rate each security can be viewed as a zero-coupon bond and the HS methodology involves viewing the coupon bond as a bundle of pure discount bonds. Unbundling the coupon bond into constituent pure discount bonds, valuing these components, and

[2]Like many studies, we use gross public debt in this paper as it is more prudent and portrays a more accurate picture of debt sustainability. An alternative would be to use net debt, which adjusts for both the financial and non-financial assets of the government. These are typically seen as being hard to liquidate (see Robert et al. (2017)).

[3]Reinhart and Sbrancia (2015) find strong evidence of financial repression and debt liquidation for several advanced and emerging market economies in the post-WWII period. See Acharya (2020) for a discussion of fiscal dominance in the Indian context. See Leeper (1991) for a model of monetary-fiscal co-ordination under fiscal dominance.

finally adding up the values of the components gives the value of the bundle.

Following HS we use security level data on Centre-State securities between 2000–2018 and calculate the coupon and principal payments for both entities. Our security level data for the Centre is from 1999–2018. In order to consider general debt we collect all outstanding security level data for all Indian States from 2004–2018.[4] In contrast to aggregate debt data, the security level debt data is valued at market prices where the required prices are calculated from yield to maturity data. For both the Centre and States we track securities until their maturity and consider the outstanding face value for each security as of end March every year. This is done so that the face value outstanding is equal to the aggregate debt outstanding for that particular year. To the best of our knowledge, our paper is the first to collect security level data debt data for Centre and States and subsequently undertake a debt-decomposition analysis using the Hall-Sargent approach for a large EME such as India.

We find that our security level analysis is qualitatively similar to that from our aggregate debt analysis. Considering the security level decomposition from 2005 onwards, we find a lower contribution from inflation post adoption of Flexible Inflation Targeting (FIT) in India. While this is expected, our framework allows us to quantify the role of inflation after a major reform such as FIT. From the security level debt-decomposition analysis we show that during the entire period of 2005–2018, the change in debt-GDP is about 7%. Of this 7% change, the biggest contributing factor is the nominal returns on the marketable portion of the debt, at about 40%. Even the nominal return on the non-marketable portion is substantial at about 25%. This suggests that the nominal interest rate is the predominant component driving the change in the debt-GDP ratio during this period.

Our main insights using the Centre-State security level dataset highlight an important methodological contribution made by our paper. It should be pointed out that the debt decomposition analysis using aggregate debt suffers from a drawback. This is because any analysis with aggre-

[4]We obtain yield to maturity data from the Reserve Bank of India (RBI), HBS Table 187: Yield of SGL Transactions in Government Dated Securities for Various Maturities. We also adjust our data to accommodate the fact that particular States, like Bihar, Madhya Pradesh and Uttar Pradesh, were bifurcated. Details on the security level dataset are available from the authors upon request.

gate debt data typically leaves residuals that are unaccounted for (as in Abbas et al. (2011), Buiter et al. (1985)). We show that when we undertake the decomposition analysis with the security level data, the residuals are sharply reduced lending more precision to the accounting exercise. This reinforces the need to utilize more granular security level data to gain more robust policy insights rather than just using aggregate debt data when studying debt dynamics. This concern is especially relevant for EMEs whose national income accounts may be subject to frequent revisions and measurement errors.[5] In addition, using the Hall and Sargent (1997, 2011) methodology, we are able to correctly calculate the interest rate and interest rate costs associated with debt across the entire spectrum of maturities (in years). The availability of granular data also helps in calculating the interest burden on the non-marketable portion of the debt.

Other than accounting for the four components that affect government debt, we ask, how did India's debt-GDP dynamics change before and after the implementation of major macro-economic reforms? We consider three major reforms: the dismantling of the administered interest rate structure in 1997, the passing of the Fiscal Responsibility and Management Act (FRBM) in 2003, and the adoption of flexible inflation targeting (FIT) de-facto in 2014, and de-jure in 2016. In addition, we consider debt-sustainability and check for co-movements of inflation and growth components with important macroeconomic variables-household savings, real effective exchange rate (REER) and uncertainty index.

Till the 1980s the interest rate structure on bank loans was largely administered. On the same loan amount, borrowers were charged different rates. This distorted the structure of lending rates in the banking system. Since 1990, efforts were made to rationalize the interest rate structure to ensure better price discovery and transparency in the loan pricing system, with a near-complete deregulation of interest rates culminating in October 1994. While the dismantling of the administered interest rate occurred in a staggered manner, we take 1998 to be a year by which cumulatively, major changes had been undertaken. The first "test" of these reforms came in the early 2000s when

[5] See Buiter et al. (1985) for a discussion of the unexplained debt increases in the United Kingdom. Abbas et al. (2011) suggest that some of the drivers of the unexplained debt increases in advanced economies are the effects of exchange rate depreciation or absorbing implicit liabilities from financial sector recapitalization following banking crises.

large capital flows and a number of monetary easing measures by the RBI resulted in abundant liquidity in 2001–2004. However, the reduction in rates were generally not reflected in the lending rates across all banks, and for many banks, the actual lending rates were much higher than those prescribed by their PLRs (Reserve Bank of India, 2009, p.8). Monetary transmission was therefore limited leading to high interest rates in the economy even after the dismantling of administered interest rates. India's interest rate liberalization post 1998 would therefore have led to a higher contribution from the interest rate component to debt-dynamics. As expected, when we slice the data around 1998, we see that the nominal interest rate's contribution to the increase in public debt rises from 27.1% between 1959–1998 to 30.4% between 1998–2018.

In 2003, the government of India announced the Fiscal Responsibility and Management Act (FRBM), whose main goal was to establish financial discipline to reduce the fiscal deficit. The act announced a glide path to contain the fiscal deficit within 3–4% of GDP in the medium term, and by restricting the role of primary deficit in affecting debt-GDP dynamics.[6] In 2016, a committee under N.K. Singh was set up to suggest changes in the Act. This committee suggested using general government debt as the primary target for fiscal policy with a Centre-State government debt-GDP target of 60% to be achieved by 2023 (compromising 40% for the Centre and 20% for the States).[7] We show that the implementation of the FRBM in 2003 had a salubrious effect on India's debt trajectory: the primary deficit's contribution to the change in the debt-GDP ratio during 1991–2003 was 20.9% compared to the period after the implementation of the act (2003–2018) where it fell to 10.8%. Seen from a longer time perspective (from 1980 onwards) however, the contribution of the primary deficit in the rise of public debt-GDP in India fell till about 2008, but began to rise again in the 2008–2018 period suggesting a mixed record of the 2003 FRBM Act in the post-liberalization period.

India adopted flexible inflation targeting (FIT) in 2016, ensuring that the role played by inflation in affecting public debt also came down. The full institutional architecture for inflation targeting

[6] In 2013, the government introduced the concept of an effective revenue deficit, which adjusted the revenue deficit for grants to states for the creation of capital assets.

[7] See FRBM Review Committee (2017). We note that the movement from fiscal deficit targets to debt-targets recommended by the N.K. Singh Report highlights the salience of this paper.

in India was laid out in a monetary policy framework agreement (MPFA) between the RBI and Government of India in 2015. This framework set a medium term inflation target of 4 plus/minus 2 percent. However, starting in 2014, a bi-monthly policy review cycle was implemented with bi-annual (October and April) monetary policy reports (MPRs) starting in September 2014. We therefore consider the de-facto date for the adoption of inflation targeting to be April 2014 (see Ahmed and Ghate (2020)). This gives us a slightly longer phase for the presence of FIT in our sample (2014–2018). We show that over the roughly sixty year period that our sample covers, inflation's contribution to lowering public debt has become larger over time, although it has begun to diminish after the de-facto adoption of FIT in India in 2014. Inflation therefore seems to be a permanent feature of India's experience with debt sustainability. Even though FIT is relatively new in India, we show however that FIT has helped with debt sustainability. More generally, by quantifying the impact of inflation on India's debt dynamics, our paper helps feed the debate on the adoption of FIT in India.

To ensure that our results are robust, we check whether Indian debt dynamics are driven by when the reforms are actually adopted rather than "announcement-effects" surrounding reforms. We show that incorporating announcement effects does not alter our main results. With respect to FIT, we conduct additional robustness tests that quantify, counter-factually, what the nominal interest rate component of debt would have been if India had not adopted FIT. We find that the nominal interest rate component without FIT over 2014-2018 would have been substantially higher compared to the nominal interest component observed in the data under FIT between the same time period.

In our analysis, we also find that the level of volatility in variables that are typically associated with fiscal dominance: household savings, REER, and uncertainty fell in the post-FIT period (2014–2018).[8] From the co-movement analysis of growth and inflation components with household savings, REER and an uncertainty-index in the pre and post-FIT periods, we find that the uncertainty-index declines post-FIT and there is a negative (positive) correlation between growth

[8]The uncertainty index we use in the paper follows Baker et al. (2016) which is obtained from FRED (2020a).

(inflation) and the uncertainty index. There is positive co-movement between REER and growth and a negative one with inflation, suggesting inflation induced pressure on the Indian rupee to depreciate. Finally, no clear co-movement is observed between household savings and the two components.

1.1 Literature Review

How does our paper relate to the literature? Like us, Moharir (2020) conducts an accounting decomposition for India using aggregate debt data. There are several differences. First, his study uses data only from 1981–2017; ours is from 1951–2018. Second, he does not conduct a security-level analysis. Our innovation is to assemble a novel security level data-set, and apply the approach of Hall and Sargent (1997, 2011). To the best of our knowledge, utilizing the approach of Hall and Sargent (1997, 2011) to assess Indian public debt sustainability has never been done before, and is a far more accurate approach as shown by the low residuals. Third, he conducts a decomposition analysis for major Indian states, whereas we treat Indian states collectively, and over a longer time period. Fourth, his analysis does not identify the residual component. Finally, while both Moharir's and our paper highlights the role of "Fisher-dynamics", the combined effect of interest rates, growth, and inflation on debt dynamics, our focus is on the time trend of individual components, with comparisons of the drivers of debt before and after major fiscal-monetary reforms.

Buiter and Patel (1992) and Rangarajan and Srivastava (2003) also undertake a debt decomposition using aggregate Indian government debt data. Rangarajan and Srivastava (2003) however do not cover the inflation targeting period, and do not do a security level analysis. Papers such as Buiter and Patel (2006) take a time-series approach to check debt-sustainability in India using various criteria. Like us, these authors also check the sustainability of public debt using growth-interest rate differentials. There are several differences between Buiter and Patel (2006) and our paper. First, Buiter-Patel's aggregate debt series includes liabilities and is therefore not purely public debt. Our analysis excludes liabilities, and is consistent with the definition of public debt laid out in the Ministry Of Finance Department Of Economic Affairs (2010); Ministry of Finance

(2012, 2014, 2018). Second, Buiter-Patel include debt issued by public sector enterprises, whereas we don't. Given the small share of public sector enterprise debt (roughly 3 percent of GDP in the Buiter-Patel sample of 1971–2004), inclusion of this component will not make a substantial difference to our results. Third, our's and Buiter-Patel's series differ in their treatment of external debt. We value external debt at historical prices, as external debt at current prices for India is only available post 1971. In contrast, since Buiter-Patel's sample runs from 1971–2014, they value debt at current prices. Finally, our approach follows the status paper definition (published by the Ministry of Finance since 2010) in defining external debt to be the sum of multi-lateral debt and bi-lateral debt. Buiter-Patel consider external debt to be long-term debt plus short-term debt, where long-term debt includes multi-lateral debt, bi-lateral debt, IMF credit, trade credit, commercial borrowings, NRI (Non-resident Indian) deposits, and Rupee debt. Figure 18 in the Technical Appendix 8.2 plots the Buiter-Patel external debt series versus our series. The Technical Appendix 8.2 also presents results from a replication exercise on the Buiter-Patel public debt series, and provides a more detailed discussion comparing both analyses.

Abbas et al. (2011) compile a large comprehensive data-set on gross government-debt GDP ratios covering nearly the entire IMF membership (of 178 countries). Their analysis reveals a pattern of asymmetric contributions from the components in the government budget constraint to changes in public debt. However, these authors also do not do a security-level analysis. The focus of our paper compared to these papers is also different. Because major macroeconomic reforms can influence public debt dynamics, we examine how key macroeconomic reforms changed the relative importance of the components driving public debt dynamics in the period after these reforms were implemented. Since the nexus between government debt and monetary policy is key to central banking, our paper helps inform the debate on the adoption of inflation targeting in India. In particular, we show that flexible inflation targeting reduced the extent of public debt financing via inflation in India.

The recent debate on debt sustainability has moved beyond assessing the $r < g$ condition. For instance, (Furman and Summers, 2020, p. 3) argue that debt-GDP ratios are a "mis-leading metric

of fiscal sustainability" since the present value of GDP has risen and debt costs have fallen because of declining interest rates in the US and other advanced economies over the past 40 odd years. Moreover Summers and Furman argue that debt stocks should be compared with the present value of GDP (a stock) and interest rates flows with GDP flows. In similar spirit, Reis (2021) shows that if the marginal product of capital (m) exceeds the growth rate of the economy (g) by enough, then the government can run a perpetual deficit that is paid by bubble premium revenues, where a higher $g - r$ raises the value of the bubble. These arguments need to be interpreted with caution. We find that $r < g$, using both aggregate and security level data in India. For the security level decomposition however, we find that during the entire period 2005–2018, the biggest contributing factor was the nominal returns on the marketable portion of the debt at about 40%. Even the nominal return on the non-marketable portion was substantial at about 25%. We also find that the role of inflation in driving debt liquidation is an important feature in the Indian data. Further, the combined (State plus Centre) fiscal deficits in India in the last few years has been high (exceeding 9 percent of GDP), which exceeds the permissible upper bound on public spending ($g - r$) identified by Reis (2021). Aizenman and Ito (2020), using a sample of 57 countries that include both AEs (advanced economies) and EMEs between 1961-2019, find that the higher costs of servicing public debt dampens per capita real output growth. They also argue that higher debt costs may lead to a "snow-ball" effect which leads to financial fragility in EMEs, and multiple equilibria with a self-fulfilling debt crisis, aspects not considered in Furman and Summers (2020) and Reis (2021).

Other papers in the literature, such as Claeys et al. (2012), examine the crowding out effect of rising public debt. This is an important issue for an EME like India which faces a high interest rate burden. In the event that the fiscal authority fails to fully ensure the sustainability of public debt, the monetary authority can be faced with a trade-off between default and inflation as discussed in Sokolova (2015).

Fukunaga et al. (2019) examine how longer maturity debt could make the effects of an inflation shock larger by keeping the term interest rate lower even after an inflation shock. They show that a 1 percentage point shock to inflation reduces the public debt-GDP ratio by 0.7 percentage

points across 19 advanced economies. Their results help us think about the role that unanticipated inflation has had as a fiscal shock absorber. While our focus is different, we show that there has been a gradual decline in the maturity of the debt raised by the Centre, with most Central securities having a maturity of less than 15 years. The findings in Fukunaga et al. (2019) for our paper suggest that a declining maturity structure of Indian public debt is less likely to play the role of a consistent source in the financing of Indian public debt.

There are other important issues related to public debt that we do not consider. Policy regimes for instance, matter for the financing components from a public debt decomposition exercise. Using aggregate debt data from the US between 1953–2014 and a DSGE model with policy interactions, Das (2021) shows how the financing components look like under two distinct policy regimes-"active" fiscal and "passive" monetary policy and "passive" monetary and "active" fiscal policy. [9] The impact of debt on economic growth and the associated threshold level using evidence from 71 developing countries is discussed in Law et al. (2021). With a somewhat different focus, Combes et al. (2017) study the response of fiscal policy conditional on the stock of outstanding public debt for a broad set of countries including EMEs.

Eichengreen et al. (2019) consider long-term pubic debt from a two millenia historical perspective. These authors highlight that for high current account deficit economies, the question of debt-sustainability cannot be abstracted from the possibility of default. This is especially true since the adoption of FIT follows interest rate liberalization, which increases the contribution of nominal interest rates to the change in debt. While default risk is not explicitly incorporated in Hall and Sargent (1997, 2011), it is subsumed in the nominal interest rate component. India also has traditionally not been a high current account deficit economy. We hope to explicitly incorporate default risk into the Hall and Sargent (1997, 2011) framework in future work.

India is an important case-study for EMEs since in PPP terms (as of 2020), it is the third largest economy in the world. A study on its debt-drivers can offer important insights to other EMEs on debt management.

[9] "Active" and "passive" are in the sense of Leeper (1991).

2 Data and Stylized facts

Our analysis is based on two types of public debt data for India: aggregate and security level. On the aggregate debt data, we assemble a new and consistently defined annual time series of aggregate government debt between 1951–2018 and its components. These components are the nominal interest rate, inflation, the real GDP growth rate, and the primary deficit/surplus. At the security level, we assemble a novel granular government (Centre-State) securities data. To do that we consider securities outstanding and issued by the Central government from 1999–2018 and we track about 5600 such securities. For all 29 states we consider the securities issued by the States and track about 4400 such securities from 2004–2018. We consider all government securities outstanding from 1999 and 2004 onwards for Centre and State securities, respectively. Next we create principal and coupon matrices from each security's details related to coupon and principal payments. Using the yield curve data from the Central Bank (Reserve Bank of India-RBI) we then calculate prices and the market value of the debt and subsequently undertake the debt decomposition along the lines of Hall and Sargent (1997, 2011).

Government liabilities in India include debt issued against the Consolidated Fund of India (technically, defined as Public Debt) and liabilities in the Public Account (Other Liabilities). Thus total liabilities is a sum of public debt and other liabilities. As of end-March 2018, while general government public debt (Centre and States) as a share of GDP was 57%, general government total liabilities (the number commonly reported in the media) was 73%.[10] The time series plot of general government public debt (Centre and States) and general government total liabilities as a percentage of GDP in Figure 2 shows an upward trend in both specially post-1980s with a stark rise in both in the run-up to the enactment of FRBM in 2003.[11] Liabilities under the public account (Other Liabilities) of both Centre and State taken together, as of 2018, account for about 14% of GDP

[10] General government debt includes debt for Centre and States. General government total liabilities include, general government debt and other liabilities of the Centre and States.

[11] For our calculations of general debt-GDP we used external debt at historical prices. This is due to the lack of data on external debt at current prices. Our calculations of general government public debt to GDP therefore differs from that in Ministry of Finance (2018) for overlapping years. Specifically, for overlapping years (2009–2017) our general government debt-GDP is on an average lower than that in the Status Paper by about 2%.

with that of the Centre and State being about 10% and 5%, respectively.

Figure 2 suggests that in the decade after India's 1991 liberalization, the general debt to GDP ratio in India stayed constant till 2000 averaging 34%, not very different from the debt-GDP average (30%) between 1950–1990. In contrast, between 1996–2005, there is a sharp increase in the debt-GDP ratio rising to 57% in 2005, a rise commonly attributed to the Centre and State implementations of the 5th Pay Commission in 1995.[12] Post 2003, both because of the FRBM Act of 2003 and the high growth years that ensued between 2003–2009, the debt-GDP ratio declines marginally to 52% in 2009. While the share of the general debt-GDP from 2004–2018 has been relatively constant and has averaged 54%, there has been a larger decline in the total liabilities owing to a decline in the proportion of liabilities in the public account. Liabilities in the public account as a share of GDP declined from about 28% in 2004 to about 14% in 2009. Since the Great Financial Crisis, between 2009–2018, the general debt-GDP ratio has averaged 53%.

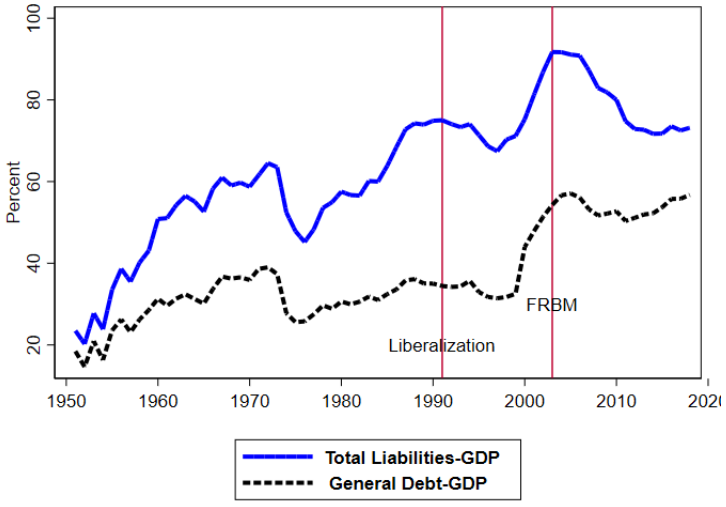

Figure 2: General Government Public Debt-GDP and General Government Total Liabilities-GDP

Public Debt is broadly divided into internal and external debt. The latter is debt raised from outside of the territory of India and is predominantly borrowed in three currencies, SDR, USD and Yen (about 96% of total external debt) and 4% is borrowed in Euros. States in India cannot issue external debt and therefore the distinction of debt into internal and external is only relevant for the

[12] See Mohanty and Panda (2019).

Centre. External debt as of end-March 2018 was 6% of total Centre liabilities and was about 1.5% as share of GDP. Internal debt in 2018 stood at 78% of total Central liabilities and about 38% of GDP.

Internal or domestic debt for both the Centre and States is further divided into marketable and non-marketable debt as shown in Figure 3.[13] The marketable debt for the Centre consists of dated securities and treasury bills. For States debt mostly consists of market loans (State Development Loans or SDLs in short).[14] Non-Marketable debt for the Centre consists of National Small Savings Fund (NSSF), special securities issued to international financial institutions, POLIF and RPOLIF, compensation and other bonds, and 14-day intermediate treasury bills issued to State governments and some other central banks.[15] As can be seen in Figure 3, the trajectory of the marketable share of general public debt illustrates a distinct U-shaped pattern since 1951. Since 2004, higher borrowing by the States from the market via SDLs due to higher GDP growth is one of the reasons why we see a U-shaped pattern. Also, since borrowing from the NSSF involves a higher cost (NSSF is the biggest component of non-marketable debt, see Technical Appendix 8.1.3 for more details), both the Centre and States have shifted towards market loans.

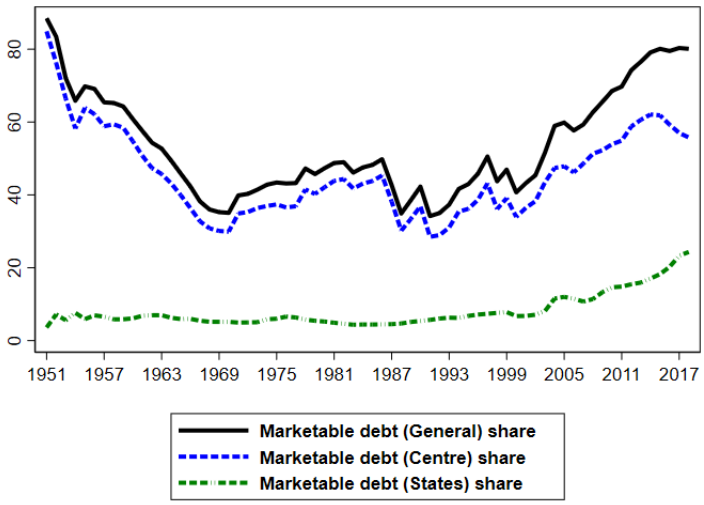

Figure 3: Share of Marketable debt to Total Debt

[13] Internal debt constituted 97% of Centre and States' public debt as of 2018.

[14] From our State security level data we find that these are typically auctioned in 10-years, 15-years, and 30-years maturity.

[15] POLIF is Post Office Life Insurance Fund (POLIF) and RPOLIF is Rural Post Office Life Insurance Fund.

Security level data lends itself to analysis pertaining to the market value of debt and the associated maturity structure. We therefore assemble a novel Centre and State security-level data-set from 1999–2018.[16] Unlike the Centre securities, State-level securities do not have much variation in terms of maturity structure. Therefore, using the Centre securities' data, Figure 4 shows the nominal payouts as a share of GDP by year and maturity from 2000–2018.[17] While there are standard ways of measuring debt maturity, we ask what is the quantity of debt outstanding under different maturity tranches? Figure 4 helps answer that question for Centre securities and shows that since 2010 there has been a gradual decline in the maturity of debt raised by the Centre. In 2018, the highest maturity for nominal payouts as a share of GDP is 15 years. One reason why the maturity is observed to shrink over time is due to the fact that there is an increased issuance of 10-year government securities which is the most traded government security in India.

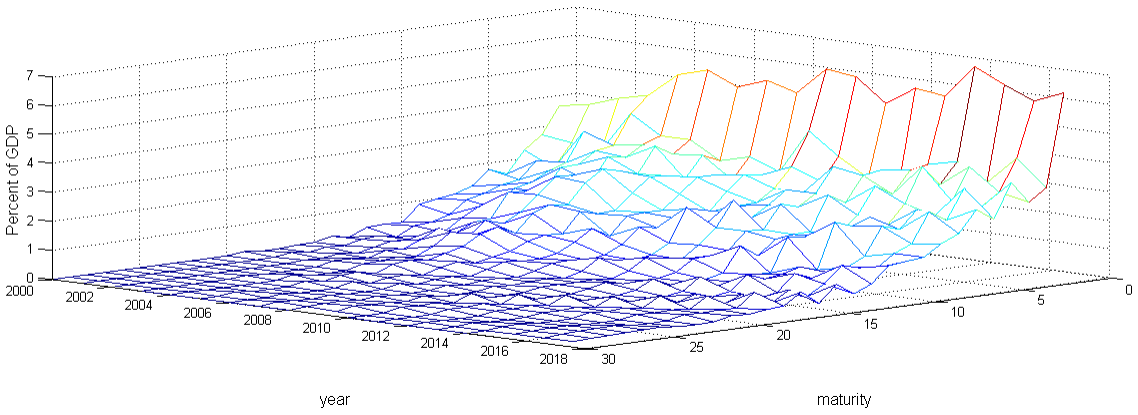

Figure 4: Nominal payouts as a share of GDP by year and maturity of debt for Centre[18]

In terms of the ownership pattern of dated securities, as of end March 2019 (see Ministry of Finance (2019)), commercial banks are the dominant holders (40.3%) followed by insurance companies (24.3%) and provident funds (5.3%).

[16]Data for State securities are from the Statement on State Government Market Loans from the 'State Finances: A Study of Budgets' for various years.

[17]Nominal payouts are calculated from security level data of the Centre using the price data calculated from yield to maturity and face value of debt for maturities 1 year to 30 years. Details of the method is discussed in Section 4.1.

[18]We generate Figures 4, 8, and Tables 1, 5, 6 using MATLAB R2019b.

3 DEBT DECOMPOSITION: AGGREGATE DEBT

3.1 Methodology

We first undertake a debt-decomposition of Indian public debt to account for the factors affecting the debt-GDP ratio over a long time series, 1959–2018. We consider debt raised by the Centre and States. From the period-by-period government budget constraint (GBC), the decomposition accounts for the factors that affect the difference in the debt-GDP ratio between any two time periods. Next, we undertake the debt-decomposition exercise around major macroeconomic reforms in the post-liberalization era, allowing us to assess the impact of these reforms on the evolving debt-dynamics.

Consider the following Government Budget Constraint (GBC):

$$b_t = (1 + r_{t-1} - \pi_t - g_t)b_{t-1} + \text{def}_t \tag{1}$$

where, b_t is debt-GDP ratio in period t, r_{t-1} is nominal interest rate between t and $t-1$, π_t is inflation rate at time t, g_t is growth rate at time t, and def_t is primary deficit to GDP at time t.

From the GBC we can then account for the change in debt-GDP ratio between any two arbitrary time periods (say t and τ) and obtain the following equation:

$$b_t - b_{t-\tau} = \sum_{i=0}^{\tau-1} \left[(r_{t-1-i} - \pi_{t-i} - g_{t-i})b_{t-1-i} + \text{def}_{t-i}\right]$$

Thus, each financing component can be indicated as follows:

$$b_t - b_{t-\tau} = \sum_{i=0}^{\tau-1} \Big[\underbrace{(r_{t-1-i}b_{t-1-i})}_{\text{Nominal return}} - \underbrace{(\pi_{t-i}b_{t-1-i})}_{\text{Inflation}} - \underbrace{(g_{t-i}b_{t-1-i})}_{\text{Growth rate}} + \underbrace{\text{def}_{t-i}}_{\text{Primary deficit/surplus}} \Big] \tag{2}$$

Equation (2) shows that there are four components affecting the debt-GDP ratio difference between periods t and τ: nominal return, inflation, real GDP growth rate and the primary deficit/surplus.[19]

[19] For details of the derivation of the decomposition equation please refer to Technical Appendix section 8.3.

We can now use our long time series data on the interest rate, inflation, growth rate and primary deficit/surplus to exploit equation (2) to calculate these components.[20] We begin by undertaking the decomposition for aggregate debt data available for general debt (Centre and States).[21]

3.2 Decomposition Results

Table 1 represents the debt-decomposition of general debt-GDP for India between 1959–2018 using equation (2) as the basis for our analysis.

There are several takeaways from the debt-decomposition exercise, as in numerically in Table 1, and it's visual counterpart, Figure 5. As can be seen from Table 1, apart from the first sub-period, 1959–1963, and the last sub-period, 2008–2018, the remaining sub-periods have been divided so that they have a duration of nine years. These sub-periods contain major economic events specific to those decades (for example, the wars and drought of the sixties, the lost decade of the seventies, the tentative liberalization of the eighties, and the two decades following the post-liberalization period). The last sub-period, 2008-2018, is extended to ten years arbitrarily to include the final year of the sample, 2018. Looking at the decomposition from 1963 onwards, the largest increase in public debt to GDP happens in the 1999–2008 sub-period, when it explodes from 33% to 52%, a roughly 19% point increase. This increase is primarily due to the 1995 5th Pay Commission awards which were implemented in staggered fashion by the States (Kaur et al., 2018). Throughout all sub-periods, inflation and growth both have a downward influence on the change in debt-GDP, while the nominal interest rate and the primary deficit exert an upward influence. This is confirmed by Figure 5 which plots each component over the sub-periods defined in Table 1, and Figure 6 which plots each of the components annually between 1959–2018.

Inflation's largest impact on eroding public debt (41.8%) happens in the 2008–2018 period because of the high inflation rates in India during the 2009–2014 sub-period averaging about 10%.

[20] Actual inflation could be separated between expected and unexpected inflation. We recognise that a part of nominal returns is driven by expected inflation from the Fisher equation. However, following Hall-Sargent, we use actual inflation in the decomposition and do not explicitly account for surprise inflation.

[21] General debt is defined as Centre debt + States debt - States investment in Treasury Bills of Centre - Loans from Centre to States. See Appendix 8.1 for details.

Table 1: Debt Decomposition (General Debt): 1959-2018

Period		Debt-GDP (LHS)			Components (RHS)					RHS
Start	**End**	**Start**	**End**	**Change**	**Nominal interest**	**Inflation**	**Growth**	**Deficit**	**Residual**	**Total**
1959	1963	28.5	32.4	3.9	0.8	-3.5	-5.0	3.6	7.9	3.9
1963	1972	32.4	39.0	6.6	2.2	-20.4	-12.5	7.1	30.1	6.6
1972	1981	39.0	30.0	-9.1	3.2	-24.6	-11.3	12.3	11.4	-9.0
1981	1990	30.0	35.0	5.1	7.5	-26.5	-15.1	27.3	11.8	5.1
1990	1999	35.0	32.5	-2.5	15.4	-30.5	-14.5	18.4	8.7	-2.5
1999	2008	32.5	51.7	19.2	16.2	-20.6	-33.2	7.9	48.9	19.2
2008	2018	51.7	56.7	5.1	12.2	-41.8	-24.3	9.4	49.6	5.1
Administered Interest Rate										
1959	1998	28.5	31.7	3.2	27.1	-101.2	-58	65.7	80.8	3.2
1998	2018	31.7	56.7	25	30.4	-66.6	-57.9	20.3	98.8	25
FRBM										
1991	2003	34.4	54.3	19.9	20.8	-34.6	-19.5	20.9	32.3	19.9
2003	2018	54.3	56.7	2.5	21.6	-55.1	-50.0	10.8	75.1	2.4
Inflation Targeting										
2009	2014	52.2	52.2	0.1	6.5	-26.9	-11.0	5.6	25.8	0.0
2014	2018	52.2	56.7	4.5	4.0	-10.6	-11.1	2.2	20.0	4.5

Notes:
[1.] LHS and RHS refers to those of equation 2.
[2.] The entries are all in percent.
[3.] The negative signs are in line with the debt decomposition equation 2. Thus, entries in columns 'Inflation' and 'Growth' enter as negative numbers representing the fact that inflation and growth rate help reduce the debt-GDP ratio. A negative entry in column 'Deficit' implies a surplus.
[4.] For the debt decomposition exercise with aggregate debt we use an "effective" interest rate that we calculate from interest payments data. The available data for interest payments pertains to total government liabilities and not exclusively related to public debt and therefore we make the following adjustment:

$$\text{Effective interest rate} = (\text{Interest payments}) * \frac{(\text{Other liabilities of Centre and States})}{\text{General debt}}$$

where, by "other liabilities" we mean Other Liabilities on the Public Account of the Centre and States, as the case may be.
[5.] 'Residual' is calculated by taking the difference between column 'Change' and the sum of columns 'Nominal interest', 'Inflation', 'Growth' and 'Deficit'.

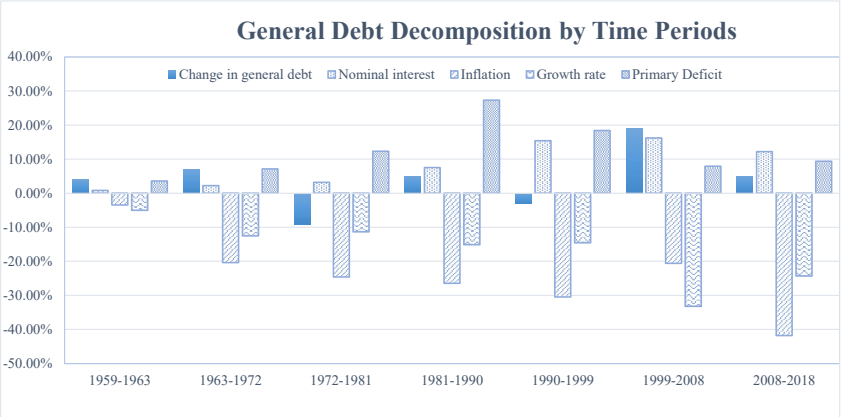

Figure 5: Bar plot of Decomposition for all Periods

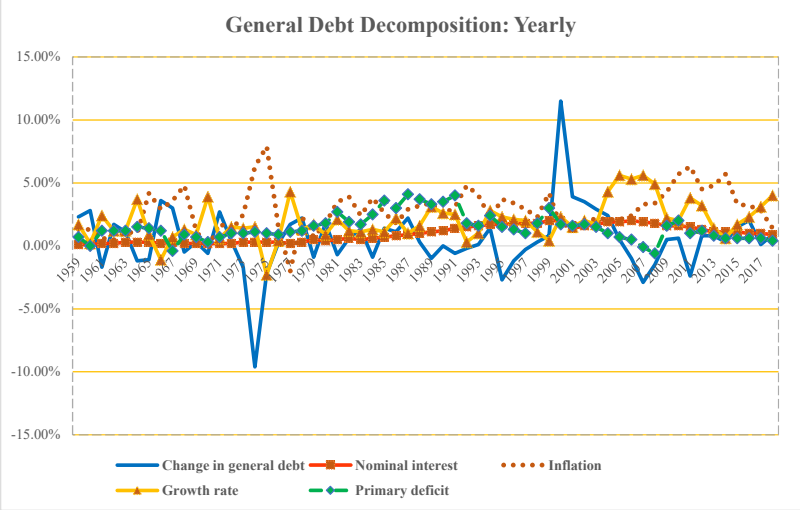

Figure 6: Time Series of Decomposition for all Years

Inflation's impact on the change in public debt is also fairly large (30.5%) in the 1990–1999 sub-period.

Figure 5 uses an annual decomposition to plot the evolution of each component from 1959–2018. It shows that over the sixty year period that our sample covers, inflation's contribution to lowering public debt (the grey bar) has successively become larger across time periods suggesting debt liquidation. GDP growth exerts a strong downward influence on public debt in both the 1999–2008 and 2008–2018 periods because of the high growth rates in India during the decade of 2003–2016 (notwithstanding the slump in growth to about 4% in 2009–2010 after the Great Financial Crisis (GFC)). The primary deficit's largest impact on the debt-GDP ratio happens in the 1981–1990 period. It is well known that towards the end of the decade of the eighties, fiscal policy was loose. While this had raised growth, it also contributed to the BoP crisis of 1991 (Acharyya, 2012).

Although informative, it should be pointed out that the debt decomposition using aggregate debt suffers from a drawback. This is because any analysis with aggregate debt data typically leaves residuals that are unaccounted for.[22]Total debt is a combination of debt with varying maturity and each maturity has a corresponding interest rate. One reason such residuals occur is due to the fact that we use an interest rate that is only representative of the total debt, i.e., an effective interest rate. This obscures knowing what the "true" interest rate is leading to the possibility of large residuals. Measurement errors in growth numbers as well as the deficit figures also add to the residual component.[23] A natural question to ask is whether the size of the residual changes when the decomposition is conducted individually on the Centre's and States' debt? We report this in Table 10 in Technical Appendix 8.5. We see from the separate decompositions that there is a reduction in the size of the residuals for both the Centre and States, although they continue to remain high for the Centre's decomposition between 1999–2008 and 2008–2018.

[22]The presence of residuals is common in such analysis (even for advanced economies) as pointed out in Buiter et al. (1985). See also Eichengreen et al. (2019).

[23]In the next section we undertake the same decomposition using security level data whereby the interest rate used in the calculations are the rates that correspond to a particular debt maturity. We find that the unexplained proportions are substantially reduced.

3.3 The Role of Reforms

In addition to different sub-periods, Table 1 also reports the decomposition around 1) the removal of administered interest rates by 1998, 2) the implementation of the FRBM Act in 2003, and 3) India's de-facto adoption of inflation targeting in 2014. In this section, we discuss the pre-post debt dynamics for each of these reforms. We also run the decomposition just using State-level data, since after 2004, loans from the Centre to the States fell and market borrowing by States increased substantially. We also check how the size of the residuals from the decomposition changes when the decomposition is performed on the Centre's debt and State's debt individually, compared to the aggregate decomposition in Table 1.

3.3.1 Administered interest rates

As mentioned in Section 1 the year 1998 saw the culmination of a series of steps taken to dismantle administered interest rates. When we slice the data around 1998, we see that nominal interest rate's contribution to the increase in public debt rises from 27.1% between 1959–1998 to 30.4% between 1998–2018. The dismantling of administered interest rates, ceteris paribus, should have contributed to a lower interest rate regime in the economy. This is however not borne out in Table 1 because of the lack of transmission between interest rates in financial markets and overall credit market rates.

3.3.2 FRBM Act

When we perform a similar exercise around the implementation of the FRBM Act (2003), Table 1 shows that the primary deficit's contribution to the change in the debt-GDP ratio during 1991–2003 is 20.9% compared to the period after the implementation of the Act (2003–2018) where it falls to 10.8%. The deficit's contribution to public debt during the 2003–2018 is also lower than any other component during the same period. This suggests some success by the FRBM Act to curtail the deficit's contribution to public debt after 2003. From a longer time perspective (post 1980) however, Figure 5 shows that the contribution of the primary deficit (the green bar) to the

rise of public debt-GDP in India fell till about 2008, but began to rise again in the 2008–2018 period. In 2009, the Central government's fiscal deficit was 6% of GDP, and most fiscal indicators deteriorated subsequently (Buiter and Patel, 2012).

3.3.3 Flexible Inflation Targeting

India adopted flexible inflation targeting de-facto in 2014 and de-jure in 2016, which led to a decline in inflation after 2014. The decomposition would predict that declining inflation in India after 2014 should lead to a lower contribution of inflation to the change in debt-GDP over 2014–2018. This is indeed borne out in Table 1 where the contribution of inflation to the change in debt-GDP ratio falls from 26.9% in 2009–2014 to 10.6% in 2014–2018. While this is expected, our analysis allows us to quantify the trade-offs between the requisite interest rate on debt that would ensure meeting a particular medium term debt target, given the growth rate, an inflation target dictated by FIT, and a primary deficit target dictated by a fiscal rule. Changing the target rate of inflation would change the interest rate required to reduce debt. The black solid line in Figure 7 plots the nominal interest rate component with FIT as per the data. The dashed red line in the Figure plots the nominal interest rate component between 2014–2018 without FIT, counterfactually assuming, that the growth rate, inflation, and primary deficit continuing as in the pre-FIT years with the debt-GDP varying as in the data for the post-FIT years. Figure 7 shows that the nominal interest rate component under FIT declines mildly throughout 2014–2018, and it lies below the nominal interest rate component without FIT. This suggests that with the adoption of FIT, the nominal interest rate component becomes lower, reflecting the lower inflation component in interest rates.

Our results are also consistent with other approaches in the literature on assessment of inflation targeting in India. For instance, Eichengreen et al. (2020) find that post adoption of inflation targeting, a number of inflation-related outcomes (the level and volatility of inflation, the stability of inflation expectations, the behavior of ancillary variables such as the exchange rate and equity markets) are more stable than before. The Reserve Bank of India (2021) finds that inflation targeting

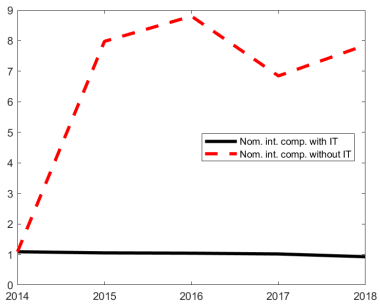

Figure 7: Nominal interest rate component with and without Adoption of IT

helped align inflation with the target of 4 percent on a durable basis.

3.3.4 Centre-State Borrowing

In the Indian context, loans from the Centre are a sizeable component in total State debt (between 1960–2000, on an average the share of loan from the Centre was about 78.5%). This is shown in Figure 21 in Technical Appendix 8.4. Post 2004 however, loans from the Centre fell and the market loans for the States picked up as States were encouraged to borrow more from the market, as seen in Figure 22 in the Technical Appendix. Following this, we undertook the debt-decomposition for the States between 1990–2018 with 2004 as the break year to see how the components line up. Table 2 documents these findings. As can be seen, post 2004, the nominal interest rate component in the States' decomposition falls to 7.2% between 2004–2018 compared to 10.5% in 1990 –2004. This happens because the implementation of the FRBM Act forced Indian States to follow strict deficit guidelines, leading the total change in debt between 2004–2018 to fall resulting in a lowered interest rate burden.

Table 2: Debt Decomposition for States for pre and post 2004

Period		Debt-GDP			Components				
Start	End	Start	End	Change	Nom. int. rt.	Inflation	Growth	Prim. Def.	Residual
1990	2004	16.0	23.6	7.6	10.5	-17.5	-11.4	7.3	18.7
2004	2018	23.6	19.3	-4.3	7.2	-18.6	-16.9	2.9	21.1

4 DEBT DECOMPOSITION: SECURITY LEVEL

4.1 Methodology

Following (Hall and Sargent, 1997, 2011), we now undertake the decomposition of debt-GDP ratio using security level data. There are certain advantages of undertaking a security level decomposition. First, it sheds light on the maturity structure of debt and the effect it has on the interest rate component of public debt. Second, it helps delineate the four above-mentioned factors on the marketable and non-marketable portion of the debt. Third, real returns on securities of different maturities can be easily calculated. Typically, the government interest cost consists of coupon payments that is due to debt holders. However, over time there are also capital gains/losses on securities held. Thus, other than the coupon payments one must take into account the capital gain/loss on the holding of such securities. This typically applies to the cases when the securities are longer in maturity (not just a one-period security). The Hall-Sargent way of looking at the security level data helps to accommodate the capital gain/loss that emerge due to the maturity structure of the debt. To see how this can be achieved consider the following variables.

Let s^t_{t+j} be the number of time $t+j$ rupees that the government has at time t promised to pay; q^t_{t+j} is the number of time t rupees it takes to buy a rupee at time $t+j$ such that:

$$q^t_{t+j} = \frac{1}{(1+\rho_{jt})^j}$$

where ρ^j_{jt} is the time t yield to maturity on securities with j periods to maturity. Also, let p_t be the price level in base year rupees and ν_t be the value of the currency measured in goods per rupee so that $\nu_t = \frac{1}{p_t}$.

The aggregate government debt is a sum of securities of different maturities so that in terms of the securities of different maturities equation (1) can be written as:

$$\frac{\tilde{B}_t}{Y_t} - \frac{\tilde{B}_{t-1}}{Y_{t-1}} = \sum_{j=1}^{n} (\tilde{r}^j_{t-1} - \pi_t - g_t)\frac{\tilde{B}^j_{t-1}}{Y_{t-1}} + \frac{G_t - T_t}{Y_t} \tag{3}$$

The decomposition equation after iterating back τ periods and defining $\text{Def}_t = G_t - T_t$ leads to:

$$\frac{\tilde{B}_t}{Y_t} - \frac{\tilde{B}_{t-\tau}}{Y_{t-\tau}} = \sum_{i=0}^{\tau-1} \left[\sum_{j=1}^{n} (\tilde{r}^j_{t-1-i} - \pi_{t-i} - g_{t-i}) \frac{\tilde{B}^j_{t-1-i}}{Y_{t-1-i}} + \frac{\text{Def}_{t-1-i}}{Y_{t-1-i}} \right] \tag{4}$$

Note that the aggregate government debt ($\tilde{B}_t$) is a sum of both marketable and non-marketable debt. Accordingly, the above equation would be modified to the following:

$$\frac{\tilde{B}^m_t + \tilde{B}^{nm}_t}{Y_t} - \frac{\tilde{B}^m_{t-\tau} + \tilde{B}^{nm}_{t-\tau}}{Y_{t-\tau}} = \sum_{i=0}^{\tau-1} \left[\sum_{j=1}^{n} \left\{ \tilde{r}^j_{m,t-1-i} \frac{\tilde{B}^{m,j}_{t-1-i}}{Y_{t-1-i}} + \tilde{r}^j_{nm,t-1-i} \frac{\tilde{B}^{nm,j}_{t-1-i}}{Y_{t-1-i}} \right.\right.$$

$$\left.\left. - (\pi_{t-i} + g_{t-i}) \left(\frac{\tilde{B}^{m,j}_{t-1-i} + \tilde{B}^{nm,j}_{t-1-i}}{Y_{t-1-i}} \right) \right\} + \frac{\text{Def}_{t-1-i}}{Y_{t-1-i}} \right] \tag{5}$$

where, $\tilde{B}^m_t, \tilde{B}^{nm}_t$ represents marketable debt and non-marketable debt, respectively, such that $\tilde{B}^m_t = \sum_{j=1}^{n} \tilde{B}^{m,j}_t$, and $\tilde{B}^{nm}_t = \sum_{j=1}^{n} \tilde{B}^{nm,j}_t$ $j = 1, 2, ..., n$. The interest rates $\tilde{r}^j_{m,t-1}, \tilde{r}^j_{nm,t-1}$ denotes the interest on the marketable and non-marketable portion of the debt, respectively, corresponding to the security of maturity j.

Using the above defined variables equation (1) can be re-written as:

$$\frac{\sum_{j=1}^{n} \nu_t q^t_{t+j} s^t_{t+j}}{Y_t} = \sum_{j=1}^{n} \left(\frac{\nu_t}{\nu_{t-1}} \frac{q^t_{t+j-1}}{q^{t-1}_{t+j-1}} \frac{Y_{t-1}}{Y_t} - 1 \right) \frac{\nu_{t-1} q^{t-1}_{t+j-1} s^{t-1}_{t+j-1}}{Y_{t-1}} +$$

$$\frac{\sum_{j=1}^{n} \nu_{t-1} q^{t-1}_{t+j-1} s^{t-1}_{t+j-1}}{Y_{t-1}} + def_t \tag{6}$$

Thus,

$$\nu_t q^t_{t+j} s^t_{t+j} = \tilde{B}^j_t \; ; \left(\frac{\nu_t}{\nu_{t-1}} \frac{q^t_{t+j-1}}{q^{t-1}_{t+j-1}} \frac{Y_{t-1}}{Y_t} \right) \approx \tilde{r}^j_{t-1} - \pi_t - g_t \; ; \text{def}_t = \frac{\text{Def}_t}{Y_t}$$

4.2 Decomposition Results

We analyze the debt decomposition from the security level data for Centre securities, States' securities and both Centre and States together. The results for the Centre and Centre and States taken

together are shown in Tables 3, and 5.[24] We also divide the components as per the maturity of debt and the results of that analyses are shown in Tables 4, and 6. Due to reasons pertaining to data availability debt decomposition for Centre securities start from 2000, that of the States' and general debt begin from 2005. We note that the security level decomposition helps reduce the residuals substantially suggesting a more accurate approach to track public debt dynamics.

Between 2000 and 2018 the change in Centre's debt-GDP was about 19% as shown in Table 3. Of this 19% change about 46% was due to nominal returns on the marketable portion of Centre's debt and about 28% was due to the non-marketable portion of the debt. Taken together the nominal return on marketable and non-marketable debt is higher than the other components between 2000–2018. The two other components that are important in affecting the change in debt-GDP are inflation at about 35% and growth at 31% (on the marketable portion of the debt). However, considering the fact that India adopted Inflation Targeting (IT) de-facto in 2014, the impact of inflation on the debt-GDP ratio is expected to be low in the years following IT. This is borne out in Table 3 where the contribution of inflation falls from 15.6% to 6.6% in the marketable portion of the Centre's debt. As in the aggregate analysis in Table 1 the primary deficit's contribution to change in the debt-GDP ratio falls markedly in 2014–2018 compared to 2009–2014 because of the renewed focus in 2014 on meeting the FRBM guidelines.

Dividing the whole period (2000–2018) into smaller sub-periods helps to understand the contribution of the different components over time and across important episodes. The first sub-period 2000–2005 highlights the explosive increase in public debt that came with the implementation of the 5th Pay Commission. The next sub-period 2005–2009 roughly captures the decline in public debt (-0.8%) due to the high growth phase of the Indian economy from 2003–2009. This was followed by the high inflationary phase when inflation clearly stands out as the main driver leading to lowering of the change in debt-GDP (0.1%) and also leading to negative real returns. During this period the real returns on the securities of maturity 1 year, 2-10 years and 10+ years are all negative

[24]The results of the debt decomposition exclusively for the States are qualitatively similar to those for the Centre and States taken together. Hence we do not present the relevant tables for the States here but they are available upon request.

at -1.6%, -3.4%, and -1.4%, respectively, as shown in Table 4. After the adoption of inflation targeting in 2014 the rise in public debt is about 3.7% reflecting a period when the decline in inflation contributed to an uptick in public debt.[25] The variability in nominal returns on various tranches of the marketable portion of Centre's debt (Figure 8) shows that the return on the 2-10 years maturity varied the most followed by the 10+ years tranche. This is partly due to the fact that much of the Centre's marketable debt has a maturity between 2-10 years as can be seen from Figure 4. In the final period, 2014–2018, real interest rates become positive with a flip in the contribution of real returns (from -5.8% to 6.6%) to the rise in debt-GDP of about 4%. This happened because of the move to a prolonged period of positive real interest rates that accompanied the transition to IT in India.

The decomposition results for Centre and States' securities taken together between 2005–2018 are reported in Table 5 and that with maturity breakouts are shown in Table 6.[26] During the entire period 2005–2018 the change in debt-GDP was about 7%. Of this 7% by far the biggest contributing factor was the nominal returns on the marketable portion of the debt at about 40%. Even the nominal return on the non-marketable portion was substantial at about 25%. This is not implausible given that this was also the period when the Centre was on a path to reducing its support in the form of loans to the States and the latter therefore started borrowing from the market. The next important component that positively affected the change in debt-GDP ratio was the primary deficit at about 23%. The other two components that not only helped reduce the debt-GDP ratio but also played important roles were inflation and growth rate at 37% and 29%, respectively. This result is expected given the fact that the economy experienced both high inflation (2009–2014) and high growth (2003–2009).

The high growth years is captured in the sub-period 2005–2009 whereby we observe the debt-GDP ratio decreasing by 0.7% brought about to a big extent by the high GDP growth rate. Although the nominal returns on both marketable and non-marketable debt were high (about 23% taken to-

[25]The nominal return for non-marketable debt is calculated as a residual component following Hall and Sargent (2011).

[26]Reliable State securities' data was only available from 2004 onwards hence the decomposition results begin from 2005 and not 2000 like in the case of Centre securities.

gether), the high growth rate (at about 16%) helped bring down the debt-GDP ratio in the presence of a weak response from the primary deficit at about 1.8%. The contribution of the primary deficit was especially low due to the fact that the FRBM Act was passed in 2003 and it required the Centre and States to restrict their deficits to about 3% of GDP over time.

In the next period, 2009–2014 the debt-GDP ratio falls by about 0.6% points. These were the high inflationary years. The decomposition exercise also reflects this as we find inflation plays the predominant role in affecting debt at about 25% in all. The high inflation in this period led to negative real interest rates which in turn contributed negatively to (about 7%) the change in the debt-GDP ratio. From Table 6 it is observed that the negative real returns for all three maturity tranches led to a downward change in the debt-GDP ratio. With a moderate growth rate of about 4.25% (average growth rate between 2009–2014) there could not have been a significant role played by growth rate. Also, to be noted during this period is the fact that the primary deficit was quite high (compared to the previous sub-period) contributing about 14%. As mentioned before, the fiscal deficit for the Centre rose from 2% before the Great Financial Crisis to about 6% in 2009. With non-negligible nominal returns during this period, it does not come as a surprise that debt-GDP did not fall by more than we observe.

The last period marks the adoption of Inflation Targeting by India and as a result the impact of inflation on bringing down the debt-GDP ratio was low. Also, the growth rate was high during this period. Despite the helpful contribution from inflation and growth, the contributions from the primary deficit (about 8%) and nominal returns (about 22% in all), the latter led to an eventual rise in the debt-GDP ratio of about 8%.

5 Robustness

To show that our results are robust, we note that the before/after dates of the reforms are not homogeneously defined from the point of view of the beginning of implementation, and the moment when the intensity of the reform it at it's maximum. This would mean that the responses of agents' behavior can happen before the peak of a reform's intensity if it is incorporated into expectations

Figure 8: Nominal returns by maturity tranches of the Centre

Table 3: Security Level Debt Decomposition for Centre Securities

		Period				
Start End		2000-2018	2000-2005	2005-2009	2009-2014	2014-2018
Debt-GDP						
	Start	19.3	19.3	35	34.2	34.3
	End	38	35	34.2	34.3	38
	Change	18.7	15.7	-0.8	0.1	3.7
Marketable debt						
	Nominal return	45.8	14.8	8.2	9.2	13.5
	Inflation	-34.7	-5.5	-7.1	-15.6	-6.6
	Real return	10.9	9	1	-5.8	6.6
	Growth rate	-31.4	-8.8	-9.4	-6.3	-6.9
Non-marketable debt						
	Nominal return	27.7	13	7.3	4	3.4
	Inflation	-4.2	-0.4	-1	-2.1	-0.7
	Growth rate	-3.8	-0.8	-1.3	-0.9	-0.8
Primary Deficit/GDP		17.8	3.3	1.9	10.5	2
Residuals		1.5	0	0.7	1	0.3

Notes:
[1.] Entries are all in percent.
[2.] For each column the entry for Change in Debt-GDP is approximately equal to the sum of rows 6, 7, 9, 11-14 following equation (4.1).
[3.] Real return for marketable debt is calculated by adding inflation component with the nominal return component.

as soon as the reform is announced.

In order to analyze the effect of announcements we looked at the decomposition $t \pm 5$ years for

Table 4: Security Level Debt Decomposition for Centre Securities by Maturity

			Period				
Start End			2000-2018	2000-2005	2005-2009	2009-2014	2014-2018
Debt-GDP							
	Start		19.3	19.3	35	34.2	34.3
	End		38	35	34.2	34.3	38
	Change		18.7	15.7	-0.8	0.1	3.7
Marketable debt							
	Nominal return		45.8	14.8	8.2	9.2	13.5
		1-2 years	11.7	2.9	2.6	3.1	3.1
		2-10 years	24.8	8.7	4.4	4.9	6.8
		10+ years	9.3	3.2	1.3	1.2	3.6
	Inflation		-34.7	-5.5	-7.1	-15.6	-6.6
		1-2 years	-10.3	-1.5	-2.2	-4.7	-1.9
		2-10 years	-18.2	-3	-3.6	-8.3	-3.4
		10+ years	-6.2	-1	-1.3	-2.6	-1.3
	Growth rate		-31.4	-8.8	-9.4	-6.3	-6.9
		1-2 years	-8.9	-2.3	-2.8	-1.8	-1.9
		2-10 years	-16.4	-4.7	-4.8	-3.4	-3.5
		10+ years	-6.1	-1.8	-1.9	-1.1	-1.4
Non-marketable debt							
	Nominal return		27.7	13	7.3	4	3.4
	Inflation		-4.2	-0.4	-1	-2.1	-0.7
	Growth rate		-3.8	-0.8	-1.3	-0.9	-0.8
Primary Deficit/GDP			17.8	3.3	1.9	10.5	2
Residuals			1.5	0	0.7	1	0.3

Notes:
[1.] Entries are all in percent.
[2.] For each column the entry for Change in Debt-GDP is approximately equal to the sum of rows 6, 10, 14, 19-22 following equation (4.1).
[3.] Entry in row 6 is equal to the sum of entries in 7-9. Entry in row 10 is the sum of entries in 11-13. Entry in row 14 is the sum of entries in 15-17.
[4.] The real returns on the various debt tranches can be calculated by adding the nominal return with the corresponding inflation component.
[5.] To find the market value of non-marketable debt we follow Hall-Sargent by undertaking the following adjustment:

$$\text{Non-marketable debt} = \frac{1}{\text{Price level}} * \text{Nonmarketable debt of Centre} * \frac{\text{Market value of Centre debt}}{\text{Par/Face value of Centre debt}}$$

'Administered interest rate' policy change and $t \pm 3$ years for 'FRBM' and 'Inflation Targeting' polices. Since we only had historical data prior to 1999 for aggregate level debt we used the

Table 5: Security Level Debt Decomposition for Centre & State

		Period			
Start End		2005-2018	2005-2009	2009-2014	2014-2018
Debt-GDP					
	Start	49.1	49.1	48.4	47.8
	End	55.9	48.4	47.8	55.9
	Change	6.7	-0.7	-0.6	8.1
Marketable debt					
	Nominal return	39.6	10.1	11.7	17.8
	Inflation	-37	-8.7	-19.7	-8.6
	Real interest rate	2.8	1.3	-7.2	8.7
	Growth rate	-28.7	-11.5	-7.9	-9.2
Non-marketable debt					
	Nominal return	24.7	13.2	7.5	4
	Inflation	-9.5	-2.7	-5.2	-1.6
	Growth rate	-7.5	-3.6	-2.2	-1.7
Primary Deficit/GDP		23.2	1.8	13.7	7.8
Residuals		1.9	0.8	1.6	0.4

Notes:
[1.] Entries are all in percent.
[2.] For each column the entry for Change in Debt-GDP is approximately equal to the sum of rows 6, 7, 9, 11-14 following equation (4.1).
[3.] Real return for marketable debt is calculated by adding inflation component with the nominal return component.

aggregate debt decomposition for announcement effect of 'Administered interest rate'. For the other two reforms, we use security level data and for all cases we use the Centre's debt data.

The results are reported in Tables 7 and 8. As we noted before, since many features of FIT were adopted in India de-facto in 2014, 2016 is a natural break point to compare drivers of debt dynamics pre-post de-jure adoption. Hence, we compare the decomposition results between 2014-2016 and 2016-2018. Consistent with the broader sample, both the inflation component and the the nominal interest rate component are lower in 2016-2018 compared to 2014-2016.

For administered interest rate reform, we do pre-post comparisons varying the break point one year at a time from 1998 to 1994. This allows for the fact that the initiation of these reforms precede the culmination of these reforms up to five years. As Table 7 shows, apart from 1998,

Table 6: Security Level Debt Decomposition for Centre & State by Maturity

			Period			
Start End			2005-2018	2005-2009	2009-2014	2014-2018
Debt-GDP						
	Start		49.1	49.1	48.4	47.8
	End		55.9	48.4	47.8	55.9
	Change		6.7	-0.7	-0.6	8.1
Marketable debt						
	Nominal return		39.6	10.1	11.7	17.8
		1-2 years	10.6	3	3.7	3.9
		2-10 years	22	5.6	6.6	9.8
		10+ years	6.9	1.5	1.4	4
	Inflation		-37	-8.7	-19.7	-8.6
		1-2 years	-10.5	-2.5	-5.6	-2.4
		2-10 years	-20.5	-4.6	-11.1	-4.8
		10+ years	-6	-1.5	-3	-1.5
	Growth rate		-28.7	-11.5	-7.9	-9.2
		1-2 years	-7.9	-3.2	-2.2	-2.4
		2-10 years	-15.8	-6.2	-4.5	-5.1
		10+ years	-5	-2.1	-1.2	-1.6
Non-marketable debt						
	Nominal return		24.7	13.2	7.5	4
	Inflation		-9.5	-2.7	-5.2	-1.6
	Growth rate		-7.5	-3.6	-2.2	-1.7
Primary Deficit/GDP			23.2	1.8	13.7	7.8
Residuals			1.9	0.8	1.6	0.4

Notes:
[1.] Entries are in percent.
[2.] For each column the entry for Change in Debt-GDP is approximately equal to the sum of rows 6,10,14, 19-22 following equation (4.1).
[3.] The entries for nominal returns for marketable debt is approximately equal to the sum of entries for 1 year, 2–10 years, and 10+ years.
[4.] Real returns on the maturity tranches can be calculated by adding the nominal returns component with the inflation component for the same maturity tranche.

the nominal interest component in the post break point period is higher compared to the pre-break point period, consistent with Table 1.

Table 7: Announcement Effect Of Administered Interest Rate Reform (Centre debt

Phase of Adoption	Period		Debt-GDP (%)			Nonimal int. rt. Component (%)
	Start	End	Start	End	Change	
Pre	1959	1998	26.2	28.0	1.8	24.4
Post	1998	2018	28.0	39.7	11.7	23.0
Pre	1959	1997	26.2	27.8	1.6	22.8
Post	1997	2018	27.8	39.7	11.9	24.6
Pre	1959	1996	26.2	28.2	2.0	21.2
Post	1996	2018	28.2	39.7	11.5	26.3
Pre	1959	1995	26.2	29.5	3.3	19.6
Post	1995	2018	29.5	39.7	10.2	27.8
Pre	1959	1994	26.2	32.2	6.0	18.0
Post	1994	2018	32.2	39.7	7.5	29.4

Table 8: Announcement Effect of FRBM & FIT

Security level Debt of Centre					
		FRBM		Inflation Targeting	
Start		2000-	2003-	2014-	2016-
End		2003	2006	2016	2018
Debt-GDP					
	Start	19.3	37.7	34.3	38.6
	End	37.7	32.6	38.6	38
	Change	18.3	-5	4.3	-0.6
Marketable debt					
	Nominal return	11.6	4.1	7.9	5.7
	Inflation	-2.8	-4	-4	-2.6
	Real return	8.5	0.2	3.7	3
	Growth rate	-2.5	-9.2	-2.5	-4.4
Non-marketable debt					
	Nominal return	9.5	4.4	2.2	1.1
	Inflation	-0.1	-0.4	-0.4	-0.3
	Growth rate	-0.1	-1	-0.2	-0.5
Primary	Deficit/GDP	3.4	0.3	1.5	0.5
Total		18.9	-5.8	4.5	-0.5

6 Is Public Debt Sustainable?

We now take a closer look at the issue of debt sustainability for general government debt in India.[27] The standard criterion for assessing the sustainability of public debt is to compare the nominal interest rate (r) with the nominal growth rate, g (see Buiter and Patel (1992); Blanchard (2019)). Debt-GDP is sustainable if $r < g$, and not sustainable if $r > g$. As noted earlier to obtain a proxy for r using the aggregate data, we first calculate the "effective" interest rate. The data on interest payments from the Ministry of Finance (Expenditure Budget), NIPFP (Long Term Fiscal Trends), and RBI pertains to combined interest payments on all liabilities. The effective interest corresponding to the general public debt is then obtained by multiplying the interest payments with the ratio of other government liabilities (Centre plus States) to general debt.

Figure 9 plots the effective interest rate against the nominal growth rate, g, between 1950–2018. As the Figure shows, nominal growth rates in India have been an order of magnitude higher than the effective interest rate on India's public debt consistently throughout 1959–2018, i.e., $r < g$.

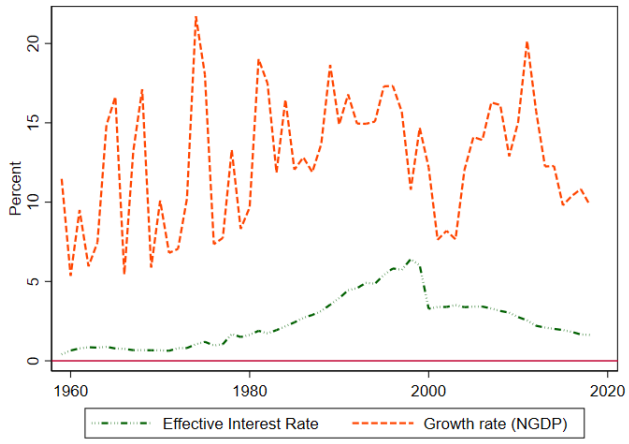

Figure 9: Effective Interest Rate Vs. Nominal Growth Rate

Figure 10 undertakes a similar exercise using the Centre-State security level debt decomposition. For this, we consider three maturity tranches (1 year, 2-10 years, and 10+ years) to obtain a weighted average interest rate for Indian public debt over 2005–2018 a period during which both

[27] Since our data goes up to 2018, we do not extrapolate implications for debt-GDP sustainability in the Covid-19 period (post March 2020) in India. We leave this for future work.

Centre and State security level data are available.[28] Between 2005–2018, we find that the weighted average interest, r, continues to be lower than g, apart from a single year 2015. This exercise confirms the debt sustainability result over the overlapping time period (2005–2018) using the aggregate data in Figure 9.

Figure 10: Weighted Average Interest Rate Vs. Nominal Growth Rate

Since we have precise security level Centre-State interest rate data, the weighted average interest rate is possibly a better proxy for the "true" interest rate burden of public debt compared to the effective interest rate from the aggregate data. We find that the sustainability of public debt in India ($r < g$) over the last 15 years or so is re-confirmed by the granular Centre-State security level data. These results suggest that while public debt in India has been stable when seen both from a historical perspective and a more granular level, inflation played a quantitatively important role in liquidating the debt. Security level analysis shows that the large contribution of nominal returns poses a challenge to debt management.

Finally, what is the impact of inflation targeting on debt sustainability? We address this by performing the following counter-factual exercise. Suppose, projecting from 2018, the end of our sample, and over an arbitrarily chosen three year period, debt-GDP was to hypothetically rise by 10%, real GDP growth averages 6%, inflation is 4%, and the primary deficit is kept pegged to its 2018 value. What would the average nominal interest rate be across this three year period?

[28]The details of the weighted average interest rate calculations are provided in Appendix 8.6.

Our calibration yields 5.5%. If, on the other hand, we assume inflation averages 6% but we keep all other variables constant, then the calibrated interest rate turns out to be 6%. This jeopardizes meeting the $r < g$ condition. Our results suggest that FIT has helped with debt sustainability in India.

6.1 Effects of Debt Liquidation

The debt-decomposition exercise highlights two dominant channels of debt liquidation: economic growth and inflation. Debt liquidation via inflation can also be the outcome of fiscal dominance as in Reinhart and Sbrancia (2015). In this section we also check the volatility (measured by simple standard deviation, as shown in Table 9), for three variables-household savings-financial and physical assets as a percentage of GDP, REER, and an uncertainty index as in Baker et al. (2016). We find that volatility is more in the pre-FIT period (2003–2014) compared to post-FIT period (2014–2018).[29] In addition we also look at the co-movements of these variables with inflation and growth components over 2003–2018.

Table 9: Volatility of Variables pre and post Adoption of IT

	Standard Deviation	
Variables	Period: 2002–2014	Period: 2014–2018
Growth component (%)	1.78	1.00
Inflation component (%)	1.52	0.88
Household saving-GDP	1.47	0.84
REER	4.01	2.48
Uncertainty Index	46.02	7.86

Figure 11 plots each of the above variables in the pre-FIT regime (2003-2014) with the post-FIT regime (2014-2018) against the form of debt liquidation (inflation or growth). We find that the volatility of all the variables (including the components) was higher when compared to the

[29]We obtain the data on the real effective exchange rate from FRED (2020b). The data for household savings has been obtained from MOSPI (2012) and MOSPI (2020). Our analysis is from 2003–2018 because of the availability of the uncertainty index data from 2003 onwards. The inflation and growth components are obtained from Figure 6. A high value for each component implies higher debt liquidation.

post-FIT years. The drop in volatility is considerably higher in the inflation component and the uncertainty index when comparing the pre-and post-FIT years. When looking at the co-movement in the whole time period (2003–2018), we find that the relation between the inflation component and the uncertainty index is positive. The overall co-movement between the growth component and the uncertainty index is negative, even though in some periods (2008–2014), the co-movement is positive with a correlation of about 0.65. Despite the positive correlation between uncertainty index and growth component during 2008–2014, for the overall period (2003–2018) correlation is negative (-0.22) and that in the post-FIT years (2014–2018) it is -0.89. We also find that there is a positive co-movement between the REER and the growth component, but negative between the inflation component and the REER. This suggests that inflation induced pressure on the Indian Rupee to depreciate. Finally, while the co-movement between the inflation and growth components with household savings is less clear, in the post-FIT period, the growth component co-moves positively with household savings.

7 Conclusion

We assemble a novel data-set on Indian public debt that contains consistently defined aggregate annual components from 1951–2018, and Centre-State security level data from 2000–2018. Our debt decomposition on the aggregate data between 1959–2018 shows that inflation is the dominant component in reducing India's public debt. We also examine India's debt dynamics across three major reforms: the dismantling of administered interest rates by 1998, the passing of the FRBM by 2003, and the the de-facto adoption of FIT in 2014. By quantifying the impact of inflation on India's debt dynamics, our paper helps feed the debate on the adoption of FIT in India.

Next, we undertake a debt-decomposition following Hall and Sargent (1997, 2011) using outstanding Centre and State security level data between 2005–2018. We find higher contribution from inflation and growth towards reduction in debt-GDP during the high inflationary and growth years. Also, post-FIT the contribution of inflation drops. We show that nominal returns on the marketable and non-marketable portions of the Centre's debt account for the highest contribution

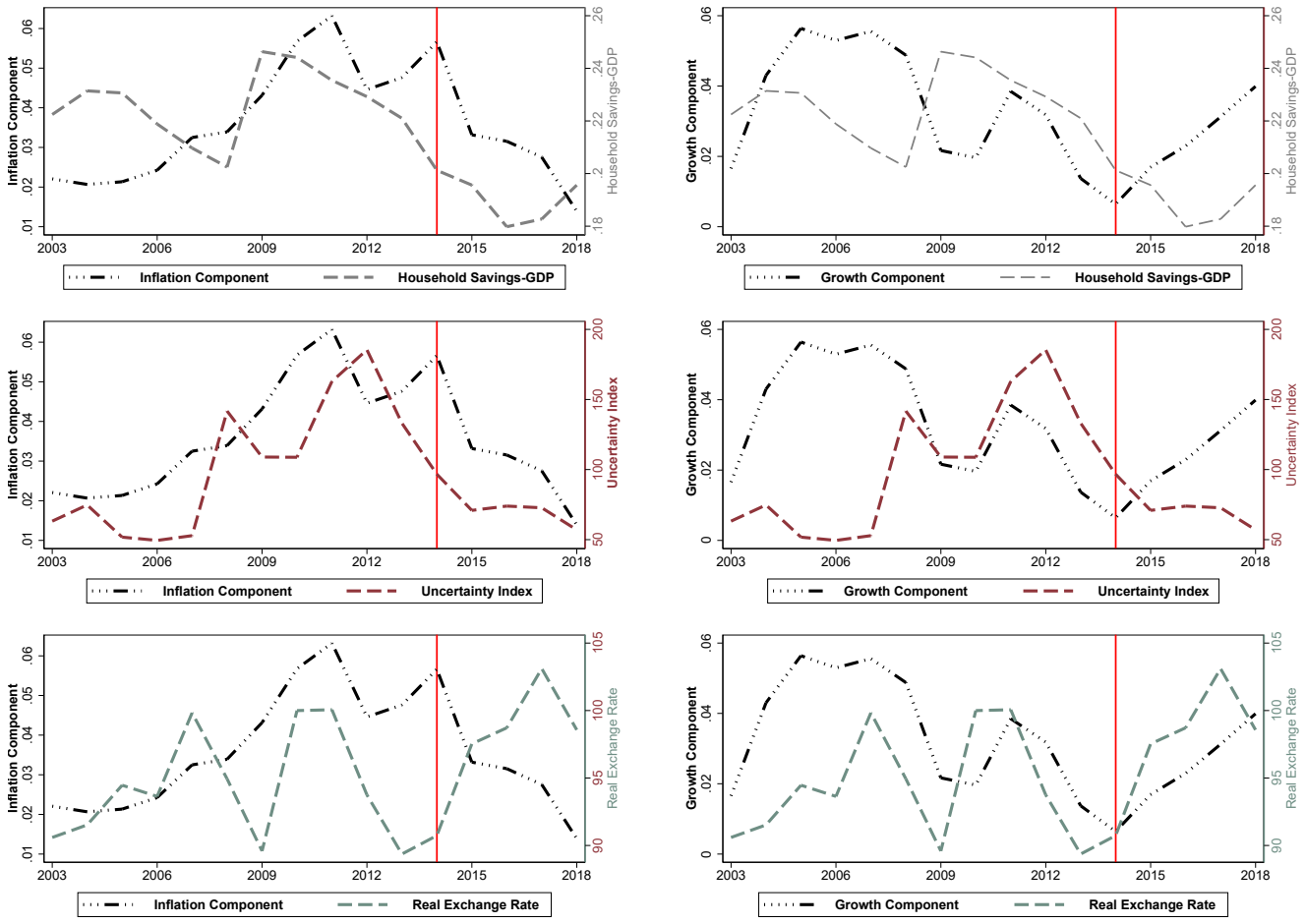

Figure 11: Co-movements of Variables vis-a-vis Inflation & Growth Rate

in explaining the change in public debt. This suggests that the nominal interest rate is the predominant component driving the change in the debt-GDP ratio during this period. The large contribution of nominal returns, at least in the accounting sense of Hall and Sargent, therefore poses a challenge to debt sustainability and debt management in India.

Inflation's growing contribution since 1951 to lowering public debt lends support to the hypothesis that the sustainability of Indian public debt has been helped by debt liquidation in an environment of fiscal dominance. While we find that $r < g$ in both the aggregate data and the security level data, our analysis highlights a potential risk that the nominal interest component of public debt poses for debt-GDP dynamics. We also find that in the pre-FIT period volatility in the

variables associated with fiscal dominance was higher. This suggests a possible link between debt liquidation via inflation and its impact on volatility and uncertainty in the economy, an aspect of fiscal dominance that we hope to develop in future work.

While we think our analysis is valuable for the fiscal-monetary interactions literature in the context of India and other EMEs, we feel that our results can be taken in several directions. First, our analysis tells us that a more accurate way to look at debt-sustainability in other EMEs (which may have similar data problems as India) is to use granular security level data rather than aggregate data. This is because the residuals from the debt decomposition exercise are much smaller. Second, while the costs and benefits of adopting flexible inflation targeting are actively debated in India and other EMEs, our paper shows that at least in the Indian case, flexible inflation targeting reduced the extent of debt-financing via inflation, and has helped with debt sustainability. Both the aggregate and security level decompositions are general enough to permit a range of counter-factual experiments that back out the required inflation rate, interest rate, primary deficit, and growth rate to meet a particular debt-target with a particular maturity structure. This would quantify the trade-offs confronting policy makers, that ex-ante, may not be obvious.

REFERENCES

Abbas, S. M. A., Belhocine, N., El-Ganainy, A., and Horton, M. (2011). Historical Patterns and Dynamics of Public Debt—Evidence From a New Database. *IMF Economic Review*, 59(4):717–742.

Acharya, V. (2020). *Quest for Restoring Financial Stability in India*. Sage Publications: India.

Acharyya, R. (2012). India's Trade and Exchange Rate Policies: Undertaking the BOP Crisis and the Reforms Thereafter. In Ghate, C., editor, *The Oxford Handbook of the Indian Economy*, chapter 24, pages 704–731. Oxford University Press: New York, New York.

Ahmed, F. and Ghate, C. (2020). Modernizing Monetary Policy Frameworks in South Asia. Mimeo, Indian Statistical Institute.

Aizenman, J. and Ito, H. (2020). Post COVID-19 Exit Strategies and Emerging Markets Economic Challenges. Working Paper 27966, National Bureau of Economic Research.

Baker, S. R., Bloom, N., and Davis, S. J. (2016). Measuring Economic Policy Uncertainty. *The Quarterly Journal of Economics*, 131(4):1593–1636.

Blanchard, O. (2019). Public Debt and Low Interest Rates. *American Economic Review*, 109(4):1197–1229.

Buiter, W. and Patel, U. (2012). Fiscal Rules in India: Are they Effective? In Ghate, C., editor, *The Oxford Handbook of the Indian Economy*, chapter 21, pages 621–655. Oxford University Press: New York, New York.

Buiter, W., Persson, T., and Minford, P. (1985). A Guide to Public Sector Debt and Deficits. *Economic Policy*, 1(1):14–79.

Buiter, W. H. and Patel, U. R. (1992). Debt, Deficits, and Inflation: An Application to the Public Finances of India. *Journal of Public Economics*, 47(2):171–205.

Buiter, W. H. and Patel, U. R. (2006). India's Public Finances: Excessive Budget Deficits, a Government-Abused Financial System, and Fiscal Rules. *CEPR Discussion Paper*, (5502).

Claeys, P., Moreno, R., and Suriñach, J. (2012). Debt, Interest rates, and Integration of Financial Markets. *Economic Modelling*, 29(1):48–59. Frontiers in Spatial Econometrics Modelling.

Combes, J.-L., Minea, A., and Sow, M. (2017). Is Fiscal Policy Always Counter- (Pro-) Cyclical? The Role of Public Debt and Fiscal Rules. *Economic Modelling*, 65:138–146.

Das, P. (2021). Fiscal Financing Components in a Simple Model of Policy Interaction. *Economic Modelling*, 96:257–276.

Eichengreen, B., El-Ganainy, A., Esteves, R., and Mitchener, K. J. (2019). Public Debt Through the Ages. Working Paper 25494, National Bureau of Economic Research.

Eichengreen, B., Gupta, P., and Choudhary, R. (2020). Inflation Targeting in India: An Interim Assessment. Policy Research Working Paper Washington, DC. ©World Bank 9422, World Bank.

FRBM Review Committee (2017). FRBM Review Committee Report: Responsible Growth A Debt And Fiscal Framework For 21st Century India. Review committee report, Government of India Ministry of Finance Department of Economic Affairs.

FRED (2020a). Baker, Scott R., Bloom, Nick and Davis, Stephen J., Economic Policy Uncertainty Index for India [INDEPUINDXM]. Technical report. retrived from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/INDEPUINDXM.

FRED (2020b). Bank for International Settlements, Real Broad Effective Exchange Rate for India [RBINBIS]. Technical report. retrieved from FRED, Federal Reserve Bank of St. Louis;https://fred.stlouisfed.org/series/RBINBIS.

Fukunaga, I., Komatsuzaki, T., and Matsuoka, H. (2019). Inflation and Public Debt Reversals in Advanced Economies. *IMF Working Paper*, (297).

Furman, J. and Summers, L. (2020). A Reconsideration of Fiscal Policy in the Era of Low Interest rates. *Unpublished manuscript, Harvard University and Peterson Institute for International Economics*.

Hall, G. J. and Sargent, T. J. (1997). Accounting for the Federal Government's Cost of Funds. *Economic Perspectives*, 21(4):18–28.

Hall, G. J. and Sargent, T. J. (2011). Interest Rate Risk and Other Determinants of Post-WWII US Government Debt/GDP Dynamics. *American Economic Journal: Macroeconomics*, 3(3):192–214.

Kaur, B., Mukherjee, A., and Ekka, A. P. (2018). Debt Sustainability of States in India: An Assessment. *Indian Economic Review*, 53(1):93–129.

Law, S. H., Ng, C. H., Kutan, A. M., and Law, Z. K. (2021). Public Debt and Economic Growth in Developing Countries: Nonlinearity and Threshold Analysis. *Economic Modelling*, 98:26–40.

Leeper, E. M. (1991). Equilibria Under 'Active' and 'Passive' Monetary and Fiscal Policies. *Journal of Monetary Economics*, 27(1):129–147.

Ministry of Finance (2012). Government Debt Status Paper. Annual report, Ministry of Finance Department of Economic Affairs. Also available from https://dea.gov.in/public-debt-management.

Ministry of Finance (2014). Government Debt Status Paper. Annual report, Ministry of Finance Department of Economic Affairs Budget Division Middle Office. Also available from https://dea.gov.in/public-debt-management.

Ministry of Finance (2018). Status Paper on Government Debt for 2017–2018. Annual report, Ministry of Finance Department of Economic Affairs Budget Division Middle Office. Also available from https://dea.gov.in/public-debt-management.

Ministry of Finance (2019). Status Paper on Government Debt For 2018–2019. Annual report, Ministry of Finance Department of Economic Affairs Budget Division. Also available from https://dea.gov.in/public-debt-management.

Ministry Of Finance Department Of Economic Affairs (2010). Government Debt, Status and Road Ahead. Annual report, Ministry Of Finance Department Of Economic Affairs. Also available from https://dea.gov.in/public-debt-management.

Mohan, R. (2007). State of the economy. In Kapila, R. and Kapila, U., editors, *Economic Developments in India*, volume 110, chapter 4: State of the Economy, pages 71–108. Academic Foundation, New Delhi, India.

Mohanty, R. K. and Panda, S. (2019). How Does Public Debt affect the Indian Macroeconomy? A Structural VAR Approach. Working Papers 19/250, National Institute of Public Finance and Policy.

Moharir, A. (2020). Fiscal Rules and Debt Dynamics in India. *Macroeconomics and Finance in Emerging Market Economies*, pages 1–24.

MOSPI (2012). Back Series Of National Accounts (Base 2011-12). Technical report, Government of India, Ministry of Statistics and Programme Implementation. Statement 23 Saving by type of Institutions (Current Prices) is available from http://www.mospi.gov.in/publication/back-series-national-accounts-base-2011-12.

MOSPI (2020). National Accounts Statistics 2020. Technical report, Government of India, Ministry of Statistics and Programme Implementation. Statement 5.3 Financial assets and liabilities

of the household sector is available from http://www.mospi.gov.in/publication/national-accounts-statistics-2020.

Rangarajan, C. and Srivastava, D. (2003). Dynamics of Debt Accumulation in India. *Economic and Political Weekly*, 38(46).

Reinhart, C. M. and Sbrancia, M. B. (2015). The Liquidation of Government Debt. *Economic Policy*, 30(82):291–333.

Reis, R. (2021). The Constraint on Public Debt when r<g but g<m. *Working Paper London School of Economics*.

Reserve Bank of India (2004). State Finances: A Study of Budgets. Various years (2004–2017). Annual report, Reserve Bank of India. Also available from State Finances: A Study Of Budgets.

Reserve Bank of India (2009). Report of the Working Group on Benchmark Prime Lending Rate. Working group report, Reserve Bank of India.

Reserve Bank of India (2021). Report On Currency and Finance 2020-21: Reviewing Monetary Policy Framework. Technical report, Reserve Bank of India.

Robert, D., Semeraro, G., de Matos, J. C., Catz, J., Quirós, G., and Lima, F. (2017). Deficit and Debt of General Government and Public Sector. In *Understanding Financial Accounts*, chapter 6. OECD. Also available from https://www.oecd-ilibrary.org/content/publication/9789264281288-en.

Sokolova, A. (2015). Fiscal Limits and Monetary Policy: Default vs. Inflation. *Economic Modelling*, 48:189–198. Special Issue on Current Challenges on Macroeconomic Analysis and International Finance Modelling.

8 Technical Appendix (For Online Publication)

8.1 Data Description

In this section, we add to the discussion in the paper on data description. In India both Centre and States can raise debt by issuing government securities (or G-sec in short). A G-sec is a tradeable instrument that can be both short-term (like treasury bills) or long-term (dated securities) in nature. Treasury bills are securities of maturity one year or less and dated securities are those with maturity more than a year. In India the Central government issues both treasury bills and dated securities and the States issue only dated securities, mostly consisting of State Development Loans (SDL). In this paper we consider aggregate and security level debt data for both Centre and States. The aggregate debt data for both Centre and States is collected from 1951–2018 and that for security level data it is from 1999–2018.

8.1.1 Aggregate Debt: Centre and States

Public debt for the Centre includes debt contracted under the Consolidated Fund of India and as liabilities under Public Account. The aggregate Centre debt classification is shown in Figure 12. Other than public debt government also receives funds as liabilities under Public Account whose classification is shown in Figure 13.

A similar classification of debt and liabilities exist for the States with some exceptions. Unlike the Centre, the States cannot raise debt in the international market and thus external debt is absent for the States. Also, States cannot issue treasury bills and thus issuance of debt for the States is restricted to long-term instruments i.e., those with maturity more than a year. Figures 14 and 15 shows the details of States' debt and liabilities.

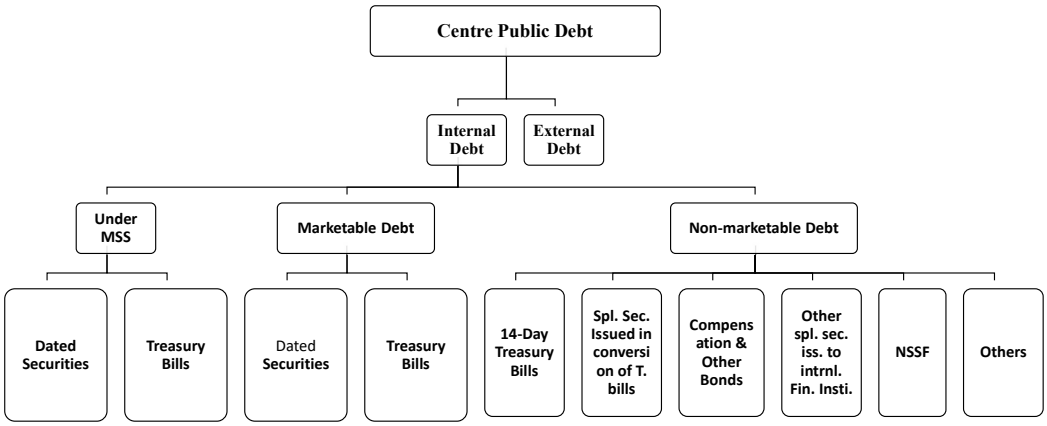

Figure 12: Centre Debt Classification

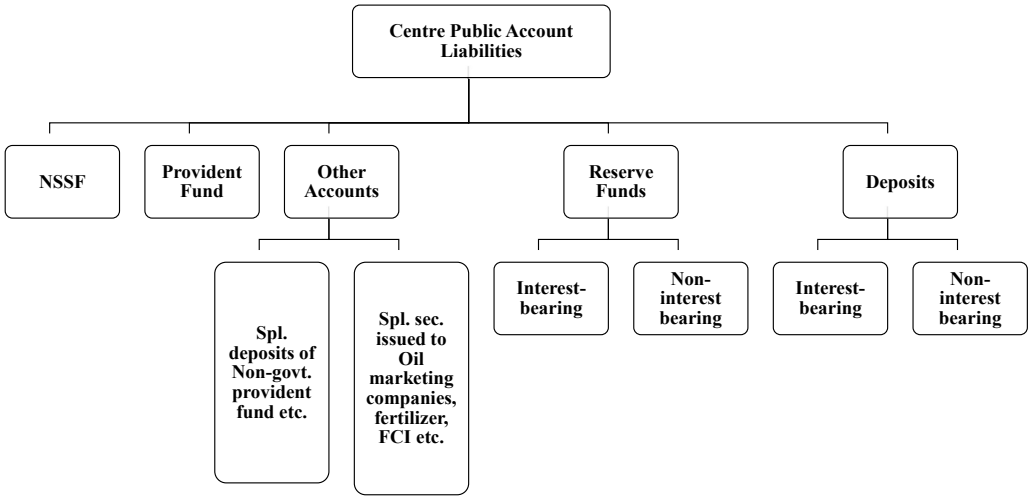

Figure 13: Centre Liabilities Classification

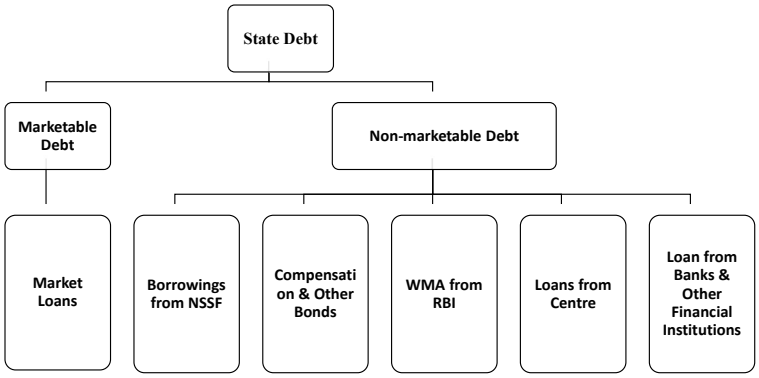

Figure 14: State Debt Classification

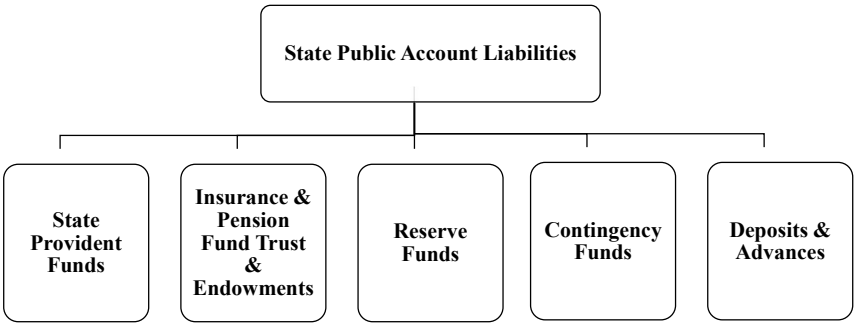

Figure 15: State Liabilities Classification

8.1.2 General Debt and Liabilities

For the analysis we use general public debt that includes both Centre and States' public debt. Accordingly, we make adjustments that account for common items and is calculated as follows:

$$\begin{aligned} \text{General debt} &= \text{Centre debt} + \text{States debt} \\ &\quad - \text{States investment in Treasury bills of Centre} \\ &\quad - \text{Loans from Centre to States} \end{aligned} \tag{8.7}$$

where,

$$\begin{aligned} \text{Centre debt} &= \text{Internal debt} + \text{External debt} \\ &= \text{Marketable} + \text{Non-Marketable} + \text{External debt} \\ &= \text{Dated securities} + \text{Treasury bills (91-day + 364-day + 182-day)} \\ &\quad + \text{14-day treasury bills} \\ &\quad + \text{Special securities issued in conversion of treasury bills} \\ &\quad + \text{Compensation and other bonds} \\ &\quad + \text{Other special securities issued to international financial institutions/Special floating bonds} \\ &\quad + \text{NSSF Securities} + \text{Others} + \text{External debt} \end{aligned} \tag{8.8}$$

External debt is considered at historical exchange rate instead of current exchange rate as the former is available from 1950 onwards and the latter is available from 1974 onwards. External debt data at historical exchange rate from 1974–1980 is taken from NIPFP and the relevant data post 1980 is taken from RBI.

$$\begin{aligned}\text{State debt} &= \text{Marketable debt} + \text{Non-Marketable debt} \\ &= \text{Market loans} \\ &+ \text{Borrowings from NSSF} \\ &+ \text{Compensation and Other Bonds} \\ &+ \text{WMA from RBI} \\ &+ \text{Loans from Centre} \\ &+ \text{Loans from banks and other financial institutions}\end{aligned} \tag{8.9}$$

It is important to note here that in our analysis we do not include liabilities for both Centre and States. Liabilities are not used by the government to fund the deficit and debt is directly related to funding of deficits. Since our analysis involves decomposition of debt we therefore consciously exclude the liabilities. In our decomposition exercise we look at primary deficit and not fiscal deficit. Fiscal deficit includes interest payments, whereas, primary deficit does not. In our debt decomposition exercise we use primary deficit because we account for the role of nominal interest rates as a separate component. Therefore, we only include those government funds that has a direct bearing on the primary deficit. The items under public debt for both Centre and State are directly related to the primary deficit whereas those under liabilities are not associated with funding the deficit (Ministry of Finance, 2012).

When considering the general debt-GDP we do find that around that around 2000 there is a substantial increase in the ratio that i attributable to the 5th Pay Commission. Figure 17 suggests that the rise in the debt-GDP around 2000 is both a Centre and State phenomenon.

8.1.3 Debt Components-NSSF, Non-marketable debt

An important feature of India's public debt is the role played by the National Small Savings Fund (NSSF). When considering the Centre's total liabilities i.e., public debt and other liabilities, the

NSSF enters both (Ministry of Finance, 2019). Specifically, out of the total NSSF corpus, special securities were first issued by the Centre in 1999–2000 and thus featured as an item listed as 'NSSF securities' under the non-marketable portion of the debt. As can be seen from Figure 16, since 2000, NSSF securities have been the main driver of the non-marketable debt of the Centre contributing on an average about 46% to non-marketable debt from 2000–2018 with the highest share being that for 2004 at about 72%.[30] However, the share of the NSSF in the total debt of Centre for the same period averaged 12%, recording a maximum value of 24% in the year 2000. A similar result is observed for the States so that 'NSSF borrowings' (an item listed under non-marketable debt for the States) was also the main driver, and averaged about 59% of the non-marketable debt of States during the same period with the share reaching 68.5% in 2011. In terms of the share of NSSF borrowing in total State debt the average was about 29% and the highest was recorded in 2007 when it was about 47%. [31]

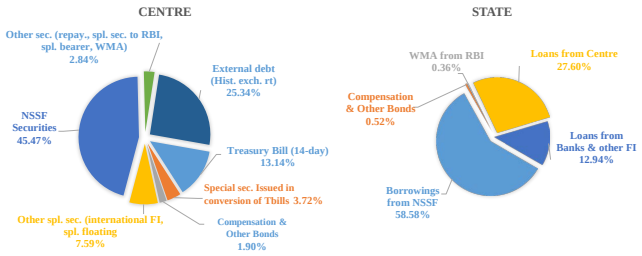

Figure 16: Share of Components in Non-Marketable debt of Centre and States (2000–2018)[32]

[30]Prior to 2000 the data reports zero issuance of NSSF securities. This is because a change in the system of accounting for loans to States and UTs were brought about in the budget of 1999–2000. As per the new accounting system small savings collections were to be credited to the "National Small Savings Fund" (NSSF) and all withdrawals by the depositors would be made out of the accumulation of the fund. The balance amount in the fund would then be invested in the Centre and State government securities. Thus, all investments in the Central securities would be reckoned as part of the internal debt of the Centre from 1999–2000 onwards and the total small savings collection would not appear as part of the Centre's fiscal deficit.

[31]Public finances, between 1996–2005, witnessed a deterioration reflecting a variety of factors such as the decline in tax revenue because of the cyclical downturn in economic activity, and the effects of the 5th Pay Commission. Central revenue expenditure increased from 11.8% of GDP in 1996 to 13.2% in 2001. The combined (Centre plus State) fiscal deficit in 2001–02 (about 10% of GDP) was higher than that in 1990–1991 (about 9% of GDP). See Mohan (2007).

[32]Note: Percentages are calculated from average of the variables from 2000–2018.

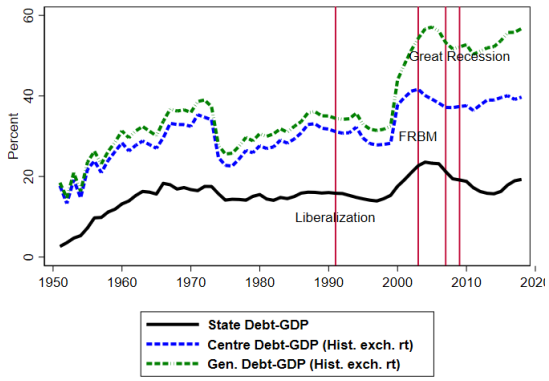

Figure 17: Debt-GDP:General, Centre & State

8.1.4 Security level data: Centre And States

For the security level debt decomposition we also consider general debt, i.e., debt for the Centre and States. We begin by looking at the securities issued by the Centre and States. For both Centre and States we look at securities issued and not matured as of end March every year. For Centre securities our data begins from 1999 and for State securities data starts from 2004.

The Centre securities' data is collected from Status Papers published by the Ministry of Finance.[33] We consider all outstanding Centre securities since 1999. We track each of these securities until maturity and collect the face value outstanding as of end March each year for each security. We then retained only those securities for which the amount outstanding was equal to the aggregate debt value for a particular year.[34] From the selected securities by keeping track of the month and year of maturity of each security we constructed the principal and coupon matrices used in our analysis. So that across each year we have principal and coupon entries under maturities of one year, two years, three years etc. until 30 years. This is obtained by summing over the principal and coupons coming from all securities. For the price series we used the yield to maturity data from RBI.

[33] Status Papers are published every year since 2010.

[34] This criterion of matching the outstanding debt in each year led to many securities being dropped out and eventually led to the start year of the analysis to be 2000. An alternative data source could have been the data from RBI that started from 1996. However, one limitation of using that dataset was that the relevant table reported only securities issued in a particular year. This meant we would miss out on the securities that were issued prior to 1996 and had not matured as of 1996.

For State securities the procedure and criteria used to select the securities was similar to that of the Centre's. Our main data sources were the *Statements on State Government Market Loans* from the 'State Finances: A Study of Budgets' (Reserve Bank of India, 2004) for various years, Public Debt Statistics from RBI, and RBI Press Releases.[35] We collected the security level data for each State and taking into account the fact that there were cases when the States have been bifurcated. This was the case for Bihar, Madhya Pradesh, and Uttar Pradesh. In such cases the loans pertaining to the public debt were bifurcated in the population ratio of: 74.71% and 25.29% for Bihar and Jharkhand, respectively. For Madhya Pradesh and Chattisgarh the division was 73.4% and 26.6%, respectively. Finally, it was about 95% and 5% for Uttar Pradesh and Uttaranchal, respectively. The face values for such securities had been populated accordingly. Also, in order to calculate the principal and coupon matrices we required data on the issue date, specifically, the issue month was important as it would then help guide as to when the coupons were due. In order to trace when certain securities were issued, we fetched data for the issuance of SDLs from RBI. Three sources were used for this: Auction data (2006–2018), SGL data (1996–2002) and various press releases (Tap Sales).

8.2 Comparison with Buiter-Patel Public Debt series

As mentioned in the Introduction, Buiter-Patel (henceforth, BP) uses the following definitions for their public debt series:

> CDD: Internal debt of the central government less net credit outstanding from the Reserve Bank of India; plus liabilities on account of small savings fund and other accounts.
>
> SDD: Rupee denominated market and other loans of state governments (excluding loans and advances from the central government) less net credit outstanding from the Reserve Bank of India; plus provident funds etc.
>
> PEDD: Long-term Rupee denominated debt of public enterprises not held by government.

[35] See State Government Market Loans. This statement is not available for 2005 and hence the list of securities outstanding in 2005 have been populated using 2004 and 2006 data.

NTDD: CDD+SDD+PEDD (excluding Rupee short-term public enterprise domestic debt, or STPEDD, reported above, for which data is unavailable prior to 1990–91).

NTDD: Net total domestic debt.

TFD: Foreign currency public and publicly guaranteed long-term debt plus use of IMF credit plus imputed short-term public debt.

GTD: Gross total debt (NTDD + TFD).

R: Official foreign exchange reserves including gold and special drawing rights.

NTFD: Net total foreign debt (TFD – R).

NTD: Net total debt (NTDD + NTFD).

BP's debt series consists of liabilities and is therefore not purely debt. Our debt series (henceforth, Das-Ghate or DG-series) consists of purely those that are classified as Debt and excludes Liabilities. We follow the definition of debt as laid out in the Status Papers. In particular, our reason for not including liabilities in our analysis stems from the fact that we use the government budget constraint (GBC). Among other variables included in the GBC primary deficit plays an important role in affecting debt. Since liabilities are not related to deficit we use debt in our analysis without including liabilities.

One difference between the two datasets comes from the inclusion of debt issued by the Public Sector Enterprises-BP includes it whereas DG does not. The relevant variable in the Buiter-Patel(2006) paper is PEDD (equals the ratio of Public Sector Enterprises as a share of GDP). Between 1971–2004 on an average as a share of GDP it was about 3% (2.91%) reaching a maximum of about 6% (5.8%) in 1999 and was 0.2% in 1979. Although we agree that inclusion of PEDD is warranted in an analysis of public debt but given the magnitude of PEDD it will not make any substantial difference to the results.

Secondly, BP's data series spans 1971–2004 whereas DG series (specifically, the aggregate debt data series spans 1951–2018). Our aggregate debt decomposition analysis though starts roughly

from 1960 given the availability of reliable data for all variables required for the decomposition. Specifically, our inflation data starts from 1958 and therefore we had to start our debt decomposition analysis from 1959.

Another major difference between BP and our series comes from the treatment of the external debt data. External debt data for BP is valued at current prices whereas we consider the same valued at historical prices. The reason being that external debt data at historical prices could be extended back until 1951 and the external debt data at current prices were available from 1975 onwards. Also, we follow the Status Paper (published by the Ministry of Finance since 2010) in defining external debt to be the sum of multilateral and bilateral debt. On an average from BP, on the other hand, consider the external debt to be the sum of long-term and short term external debt. Long term external debt consists of multilateral debt, bilateral debt, IMF credit, trade credit, commercial borrowings, NRI and FC deposits and rupee debt. Figure 18 shows the external debt series from BP as it compares with our external debt data series. Since BP uses external debt at current prices we also show the external debt at current prices from our dataset.

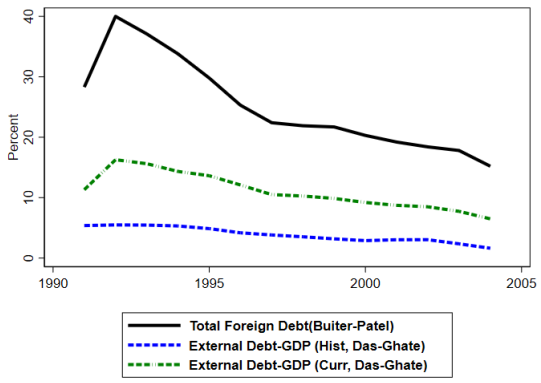

Figure 18: Comparison of External Debt BP-DG

Below is a comparison plot of BP and the DG debt-GDP series.

Therefore, given the differences in approaches/definitions used by BP and ours, the series from BP that best compares with our series is the "Gross Total Debt". In figure 19 we compare "Gross Total Debt" (the comparable Debt-GDP series from Buiter-Patel) with the debt-GDP series used by Das-Ghate, "General Debt-GDP" (this is the debt-GDP series with external debt calculated at

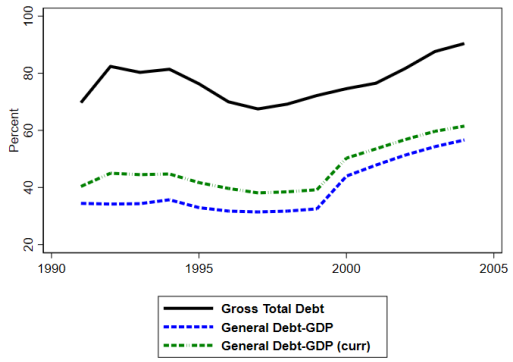

Figure 19: Comparison of BP-DG

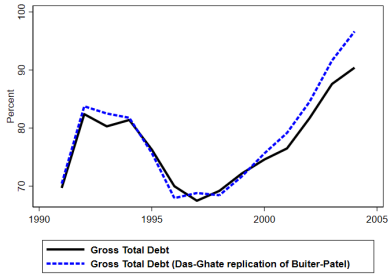

Figure 20: Comparison of BP-DG (replication)

historical prices). Since Buiter-Patel use external debt at current prices we also added the "General debt-GDP" series at current prices from Das-Ghate dataset.

Our debt definitions are as follows:

Centre debt: Marketable debt + Non-marketable debt + External debt (historical prices)

States debt: Market loans+ Non-marketable debt

General debt: Centre debt + States debt - States investment in Treasury Bills of Centre - Loans from Centre to States.

8.3 Debt Decomposition: derivation of equation (2)

In this section we derive the debt decomposition equation (2) for aggregate debt as in Section 3.1. Consider the following GBC:

$$B_t = (1 + r_{t-1})B_{t-1} + G_t - T_t \tag{8.10}$$

where B_t is the debt in rupees at the end of period t and B_{t-1} is the debt with which government enters period t. The nominal interest rate on the debt is denoted by r_{t-1}, with G_t and T_t denoting the government spending and tax revenue during period t, respectively. If Def_t denotes the primary

deficit (i.e., $\text{Def}_t = G_t - T_t$) then equation (8.10) can be re-written as:

$$B_t = (1 + r_{t-1})B_{t-1} + \text{Def}_t \tag{8.11}$$

Let P_t and Y_t denotes the price-level and the output (RGDP) in time t. Then the above equation can be further written as:

$$\frac{B_t}{P_t Y_t} = (1 + r_{t-1})\frac{B_{t-1}}{P_{t-1}Y_{t-1}}\frac{P_{t-1}}{P_t}\frac{Y_{t-1}}{Y_t} + \frac{\text{Def}_t}{P_t Y_t} \tag{8.12}$$

Letting b_t denote the real debt-GDP ratio at time period t, π_t the gross inflation rate, g_t the real growth rate of output, and def_t the real primary deficit, then

$$b_t = \frac{(1 + r_{t-1})}{(1 + \pi_t)(1 + g_t)}b_{t-1} + \text{def}_t \tag{8.13}$$

Using standard approximations, we can write the above equation as

$$b_t = (1 + r_{t-1} - \pi_t - g_t)b_{t-1} + \text{def}_t \tag{8.14}$$

Equation (8.14) can be used to express the difference between debt-GDP between periods t and $t - 1$. This is given in equation (8.15) and suggests that the change in the debt-GDP ratio between two consecutive periods is positively affected by the nominal interest rate and the primary deficit, and negatively by inflation and the real growth rate, i.e.,

$$b_t - b_{t-1} = (r_{t-1} - \pi_t - g_t)b_{t-1} + \text{def}_t \tag{8.15}$$

If we iterate backward on equation (8.15) to account for the change in debt-GDP ratio between any two arbitrary time periods (say t and τ) we obtain,

$$b_t - b_{t-\tau} = \sum_{i=0}^{\tau-1}\left[(r_{t-1-i} - \pi_{t-i} - g_{t-i})b_{t-1-i} + \text{def}_{t-i}\right]$$

which can be written as

$$b_t - b_{t-\tau} = \sum_{i=0}^{\tau-1} \Big[\underbrace{(r_{t-1-i} b_{t-1-i})}_{\text{Nominal return}} - \underbrace{(\pi_{t-i} b_{t-1-i})}_{\text{Inflation}} - \underbrace{(g_{t-i} b_{t-1-i})}_{\text{Growth rate}} + \underbrace{\text{def}_{t-i}}_{\text{Primary deficit/surplus}} \Big] \tag{8.16}$$

which is equation (2) in Section 3.1

8.4 Centre-State Borrowing

We provide more details on the nature of Centre-State borrowing as described in Section 3.3.4. Below is a table showing the result from the debt-decomposition for States. In the Indian context the Loans from the Centre was a sizeable component in total State debt (between 1960–2000, on an average the share of loan from Centre was about 78.5%). See figure below. Post 2004 Loans from the Centre fell and the Market loans for the States picked up as in the Figure. Following this fact we undertook the debt-decomposition for the States between 1990–2018 with 2004 as the break year to see how the components line up as reported in Table 2.

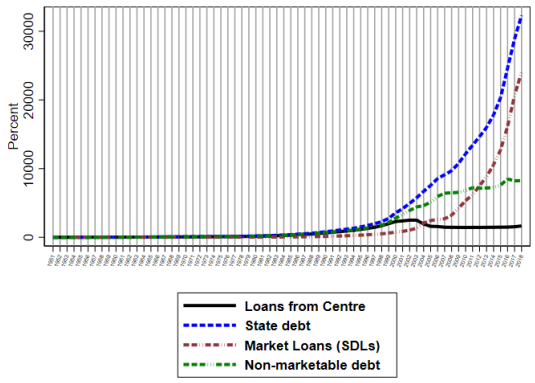

Figure 21: Centre Loan, Marketable and Non-marketable debt of State

8.5 Residuals Across Centre & States

We find from the aggregate debt decomposition analysis with general debt residuals that are comparatively higher than in the case of decomposition with security level debt data. To check if the residuals change under different specifications of debt we undertook the decompositions with Cen-

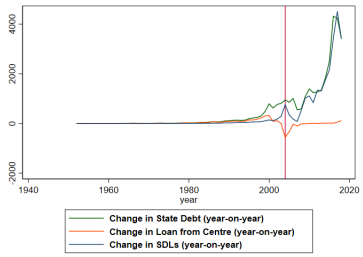

Figure 22: Change in Centre Loan and Market Loans for States

tre debt only and State debt only alongside the general debt. This is reported in Table 10 below.

Table 10: Residual Comparison Across different Specifications of Debt

Period		Debt-GDP (LHS)			Components (RHS)					RHS
Start	End	Start	End	Change	Nominal interest	Inflation	Growth	Deficit	Residual	Total
General Debt										
1959	1963	28.5	32.4	3.9	0.8	-3.5	-5.0	3.6	7.9	3.9
1963	1972	32.4	39.0	6.6	2.2	-20.4	-12.5	7.1	30.1	6.6
1972	1981	39.0	30.0	-9.0	3.2	-24.6	-11.3	12.3	11.4	-9.0
1981	1990	30.0	35.0	5.1	7.5	-26.5	-15.1	27.3	11.8	5.1
1990	1999	35.0	32.5	-2.5	15.4	-30.5	-14.5	18.4	8.7	-2.5
1999	2008	32.5	51.7	19.2	16.2	-20.6	-33.2	7.9	48.9	19.2
2008	2018	51.7	56.7	5.1	12.2	-41.8	-24.3	9.4	49.6	5.1
Centre Debt										
1959	1963	26.2	28.8	2.6	0.7	-3.2	-4.5	4.2	5.3	2.6
1963	1972	28.8	34.7	5.9	2.0	-18.3	-11.2	4.9	28.5	5.9
1972	1981	34.7	26.9	-7.8	2.8	-22.1	-10.0	9.0	12.5	-7.8
1981	1990	26.9	31.8	4.8	6.8	-24.1	-13.7	19.7	16.1	4.8
1990	1999	31.8	28.2	-3.5	13.8	-27.3	-13.0	10.7	12.3	-3.5
1999	2008	28.2	37.1	8.9	12.4	-15.4	-24.5	1.2	35.2	8.9
2008	2018	37.1	39.7	2.6	8.9	-30.4	-17.5	5.8	35.9	2.6
State Debt										
1959	1963	11.9	16.3	4.4	0.4	-1.6	-2.2	0.3	7.5	4.4
1963	1972	16.3	17.5	1.3	1.1	-10.2	-6.0	0.6	15.8	1.3
1972	1981	17.5	14.4	-3.1	1.6	-12.6	-5.7	1.3	12.2	-3.1
1981	1990	14.4	16.0	1.6	3.4	-12.2	-6.9	4.8	12.5	1.6
1990	1999	16.0	15.3	-0.7	6.9	-13.6	-6.4	4.1	8.4	-0.7
1999	2008	15.3	19.4	4.1	6.7	-8.5	-13.7	3.1	16.5	4.1
2008	2018	19.4	19.3	-0.2	4.1	-14.0	-8.2	3.0	15.0	-0.2

8.6 Debt Sustainability Equation

The weighted average interest rate in Section 4 is calculated as follows. The Centre securities' weighted average interest rate is given by:

$$r_t^{\text{cen}} = r_{1,t}^{\text{cen}} \frac{\tilde{B}_{1,t}^{\text{cen,m}}}{(\tilde{B}_t^{\text{cen},m} + \tilde{B}_t^{\text{cen},nm})} + \sum_{j=2}^{10} r_{j,t}^{\text{cen}} \frac{\tilde{B}_{j,t}^{\text{cen,m}}}{(\tilde{B}_t^{\text{cen,m}} + \tilde{B}_t^{\text{cen,nm}})} + \sum_{j=11}^{30} r_{j,t}^{\text{cen}} \frac{\tilde{B}_{j,t}^{\text{cen,m}}}{(\tilde{B}_t^{\text{cen,m}} + \tilde{B}_t^{\text{cen,nm}})} + r_t^{\text{cen,nm}} \frac{\tilde{B}_{1,t}^{\text{cen,nm}}}{(\tilde{B}_t^{\text{cen},m} + \tilde{B}_t^{\text{cen},nm})} \tag{8.17}$$

where, $r_{j,t}^{\text{cen}}$ and $\tilde{B}_{j,t}^{\text{cen,m}}$ is the interest rate and the corresponding marketable debt for j-year maturity tranche of Centre securities at time t for $j = 1, 2-10, 10+$ years. And $r_t^{\text{cen,nm}}$ and $\tilde{B}_t^{\text{cen,nm}}$ is the interest rate and the corresponding non-marketable debt at time t for Centre.

The States' securities' weighted average interest rate is given by:

$$r_t^{\text{sta}} = r_{1,t}^{\text{sta}} \frac{\tilde{B}_{1,t}^{\text{sta,m}}}{(\tilde{B}_t^{\text{sta},m} + \tilde{B}_t^{\text{sta},nm})} + \sum_{j=2}^{10} r_{j,t}^{\text{sta}} \frac{\tilde{B}_{j,t}^{\text{sta,m}}}{(\tilde{B}_t^{\text{sta,m}} + \tilde{B}_t^{\text{sta,nm}})} + \sum_{j=11}^{30} r_{j,t}^{\text{sta}} \frac{\tilde{B}_{j,t}^{\text{sta,m}}}{(\tilde{B}_t^{\text{sta,m}} + \tilde{B}_t^{\text{sta,nm}})} + r_t^{\text{sta,nm}} \frac{\tilde{B}_{1,t}^{\text{sta,nm}}}{(\tilde{B}_t^{\text{sta},m} + \tilde{B}_t^{\text{sta},nm})} \tag{8.18}$$

where, $r_{j,t}^{\text{sta}}$ and $\tilde{B}_{j,t}^{\text{sta,m}}$ is the interest rate and the corresponding marketable debt for j-year maturity tranche of States' securities at time t for $j = 1, 2-10, 10+$ years. And $r_t^{\text{sta,nm}}$ and $\tilde{B}_t^{\text{sta,nm}}$ is the interest rate and the corresponding non-marketable debt at time t for the States.

The Centre and States' securities' weighted average interest rate is therefore given by:

$$r_t^{\text{gen}} = \frac{(r_{1,t}^{\text{cen}} \tilde{B}_{1,t}^{\text{cen,m}} + r_{1,t}^{\text{sta}} \tilde{B}_{1,t}^{\text{sta,m}})}{(\tilde{B}_t^{\text{cen,m}} + \tilde{B}_t^{\text{cen,nm}} + \tilde{B}_t^{\text{sta},m} + \tilde{B}_t^{\text{sta},nm})} + \sum_{j=2}^{10} \frac{(r_{j,t}^{\text{cen}} \tilde{B}_{j,t}^{\text{cen,m}} + r_{j,t}^{\text{sta}} \tilde{B}_{j,t}^{\text{sta,m}})}{(\tilde{B}_t^{\text{cen,m}} + \tilde{B}_t^{\text{cen,nm}} + \tilde{B}_t^{\text{sta,m}} + \tilde{B}_t^{\text{sta,nm}})}$$
$$+ \sum_{j=11}^{30} \frac{(r_{j,t}^{\text{cen}} \tilde{B}_{j,t}^{\text{cen,m}} + r_{j,t}^{\text{sta}} \tilde{B}_{j,t}^{\text{sta,m}})}{(\tilde{B}_t^{\text{cen,m}} + \tilde{B}_t^{\text{cen,nm}} + \tilde{B}_t^{\text{sta,m}} + \tilde{B}_t^{\text{sta,nm}})} + \frac{(r_t^{\text{cen,nm}} \tilde{B}_t^{\text{cen,nm}} + r_t^{\text{sta,nm}} \tilde{B}_t^{\text{sta,nm}})}{(\tilde{B}_t^{\text{cen,m}} + \tilde{B}_t^{\text{cen,nm}} + \tilde{B}_t^{\text{sta,m}} + \tilde{B}_t^{\text{sta,nm}})} \tag{8.19}$$

where, $r_{j,t}^{\text{gen}}$ and $\tilde{B}_{j,t}^{\text{gen,m}}$ is the interest rate and the corresponding marketable debt for j-year maturity tranche of Centre and States' securities at time t for $j = 1, 2-10, 10+$ years. And $r_t^{\text{cen,nm}}$, $r_t^{\text{sta,nm}}$, and $\tilde{B}_t^{\text{cen,nm}}$, $\tilde{B}_t^{\text{sta,nm}}$ are the interest rates and the corresponding non-marketable debt at time t for Centre and States, respectively.

8.7 Data Sources

Table 11: Data Sources

Variable		Source	Time period	Remarks
Aggregate debt	Centre	Outstanding debt as of end March each year from Long Term Fiscal Trends published by NIPFP.	1950–1980	
		Outstanding debt as of end March each year from Status Papers published by Ministry of Finance.	1981–2018	The Ministry of Finance started publishing Status Paper on Government Debt from 2010.
	States	Outstanding debt as of end March each year from Long Term Fiscal Trends published by NIPFP.	1951–1980	Long Term Fiscal Trends had State debt data going back till 1951, though two components of State debt data (Provident Funds etc. and Loans from other banks and institutions) are missing from 1951-1959. We merged the data from NIPFP with that of Ministry of Finance to have the data from 1951 onwards.
		Outstanding debt as of end March each year from State Finances from RBI.	1981–2018	
Security level debt	Centre	Status Paper Appendix Table: HB2: Outstanding Central Government Securities.	2000–2018	This dataset dataset is from 2000-2017. The 2018 data is appended from Status Paper 2017-2018.
	States	State Finances Statement 25: State Government Market Loans.	2005–2018	This statement is not available for 2005 and hence the list of securities outstanding in 2005 have been populated using 2004 and 2006 data.
GDP		DBIE from RBI.	1951–2018	
Inflation		CPI data from OECD/RBI (Base year 2001).	1958–2018	CPI Industrial Workers (CPI-IW).
Interest rate		Combined Interest payments on all liabilities from Long Term Fiscal Trends published by NIPFP.	1951–1980	We use "Effective" interest rate for our debt decomposition exercise. The details of the calculation are provided in the paper.
		Combined Interest payments on all liabilities from RBI.	1981–2018	
Primary Deficit		Combined Gross Primary Deficit from Long Term Fiscal Trends published by NIPFP.	1951–1980	The numbers coming from Long Term Fiscal Trends are revenue expenditure and capital expenditure (net of loan recovery).
		Combined Gross Primary Deficit from RBI.	1981–2018	The numbers coming from RBI are calculated as: Total expenditure (Table 96, RBI) minus Loan Recovery (Table 95, RBI).

Notes:

1. NIPFP is National Institute of Public Finance and Policy.

2. RBI is Reserve Bank of India.

3. DBIE is Database of the Indian Economy