Examining sustainability of government debt in India: post Covid prospects

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Abstract

In this paper, we examine the determination of the sustainable level of debt-GDP ratio for the combined debt of central and state governments relative to GDP using (a) an analytical approach which was followed by the Twelfth Finance Commission (FC 12) and (b) an econometric model using threshold estimation. These methods provide results which are quite close to the target debt-GDP ratio of 60% determined by the Fiscal Responsibility and Budget Management (FRBM) review committee of 2018. In order to understand the evolution of government debt in India, we have divided the period from 1991-92 to 2018-19 into two sub-groups (A) consisting of years where a primary deficit was incurred; and (B) years where a primary surplus was shown. In the case of India, all years are characterized by primary deficit. These years are further divided into three sub-categories based on the contribution to the debt-GDP ratio made by (i) primary balance and (ii) excess of nominal growth rate over interest rate. The approach used here provides a modified view of the dynamics of debt as explained by the contribution of cumulated primary deficit and that of the excess of nominal growth over interest rate which was used in Rangarajan and Srivastava (2004). We have shown that this dynamics is well captured by an ARDL estimation which estimates the individual contribution of each of the contributing factor to debt accumulation namely primary deficit to GDP ratio, lagged debt-GDP ratio, nominal GDP growth rate and interest rate. We find that government debt in India is likely to exceed the sustainable debt-GDP threshold by a large margin in the post Covid years and even after normalcy is restored, it would take a long period for sustainability to be restored. It would also require that adequate policy measures are taken to ensure that growth rate exceeds the interest rate over long contiguous periods.

Keywords: Covid-19, Government Debt, Growth, Inflation, debt
JEL Codes: E62, H63, H68, G01, H12

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1. Introduction

Government debt in India consisting of central and state government debt net of inter-governmental lending has experienced a sharp upsurge in 2020-21 due to the impact of Covid-19. However, even before this shock, government debt relative to GDP breached the sustainability threshold as specified by centre's FRBM act as revised in 2018 and as specified by the FC 12 and the subsequent FCs. Empirical testing using a number of econometric methods also substantiate this position. In Union Government's 2021-22 budget, the indicated central fiscal deficit and available information on states' fiscal deficit for 2020-21 and 2021-22 indicate that the general government debt in India would reach a level which is substantially higher than the estimated or prescribed sustainability threshold. This will call for a long period of adjustment so as to gradually bring down the general government debt-GDP ratio in India, requiring substantive fiscal discipline on the part of the central and state governments accompanied by robust growth performance.

In this paper, we estimate the sustainability threshold of general government debt in India using a 'Threshold Estimation' regression. We also conduct sustainability tests by suggested methods in the literature such as the stationarity of annual change in debt-GDP ratio and the existence of cointegration between government revenues and expenditures relative to GDP. We also estimate a relationship determining primary deficit relative to GDP as a function of lagged debt-GDP ratio, nominal GDP growth rate and effective interest rate using an 'Auto Regressive Distributed Lag (ARDL)' estimation procedure. This helps in substantiating the proposition of the non-sustainability of government finances in India as also in examining its future prospects. The sample period for this study is 1991-92 to 2018-19 for historical estimation. In India, the explicit fiscal deficit as published by the union and state budgets do not capture the off-budget borrowings by the central and state governments. However, these borrowings are captured in the debt data published as a part of the liabilities statement of the union and state budgets. Therefore, in order to arrive at the magnitude of true fiscal deficit, we make use of the combined debt as published in Indian Public Finance Statistics (IPFS - various issues), by the Department of Economic Affairs, Ministry of Finance, Government of India. Combined fiscal deficit is derived as the annual change in the combined debt of central and state governments between

two successive years. Further, to derive the primary deficit, we deduct the actual combined interest payments as given by the IPFS from the derived fiscal deficit.

2. Sustainability norms: FRBM and Finance Commissions

The FRBM review committee setup by government of India in 2016 had examined the earlier versions of centre's FRBM of 2003 as amended from time to time along with state level Fiscal Responsibility Legislations (FRLs) which were enacted from time to time. While these acts and FRLs had defined individual debt-GDP/ debt-GSDP targets, the FRBM review committee (2017) provided a consolidated target for general government debt at 60% of GDP. The responsibility for maintaining this target was with the central government. This committee also specified centre's debt target at 40% of GDP and by implication, that of state governments considered together at 20%. Our focus in this paper is with respect to the overall general government debt target and not its division between central and state governments. Preceding the analysis of the FRBM review committee, the FC 12 had provided a consolidated general government debt-GDP target of 56% consistent with sustainability norms. Subsequent FCs[5] did not specify such consolidated targets consistent with sustainability although they may have specified targets to be achieved by the end of their recommendation period, which may be well above sustainable thresholds. Thus, the FC 13 had specified a debt level of 68% of GDP to be achieved by 2014-15.

In this paper, we examine whether such a sustainability threshold still holds, and the considerations taken into account by the FC 12 and the FRBM review committee for arriving at this threshold.

3. Examining sustainability: literature review

Three econometric tests have been suggested in order to examine the sustainability of fiscal policy or sustainability of debt in a country. For example, one necessary condition for fiscal sustainability is when the first difference of government debt relative to GDP is stationary, that is, it is integrated of order zero (Hamilton, 1986). Similarly, sometimes co-integration between government expenditures and government revenues is tested. If these two series are co-integrated, then government finances are supposed to be sustainable (Trehan and Walsh, 1998).

Bohn (2007) suggested an alternative approach where the existence of a co-integrating relationship between lagged level of debt and primary surplus was tested.

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[5] FC 13 and FC 14

In contrast, Canzoneri et. al. (2012) argued for estimating a relationship between primary surplus/deficit and lagged level of debt where if previous debt is able to drive a higher primary surplus in future years, it may be indicative of sustainability.

The concept of 'fiscal fatigue' introduced by Ghosh et. al. (2013) happens when public debt achieves some threshold and departs from this threshold value when the primary balance does not adjust to debt. In these contributions, it is important to test for the responsiveness of primary balance to lagged levels of debt relative to GDP. Most of this work has been undertaken with respect to advanced countries.

4. Understanding Evolution of government debt to GDP ratio in India: 1990-91 to 2018-19

In examining the evolution of government debt in India relative to GDP, it is useful to distinguish between the impact of main driver of growth in debt, that is, primary deficit as neutralized by the relative impact of excess of growth over interest rate. In this context, a decomposition was suggested by Rangarajan and Srivastava (2003) where the relative contribution of primary deficit relative to GDP and excess of growth over interest rate was estimated using the following relationship.

$$b_t = p_t + b_{t-1}[(1 + i_t)/(1 + g_t)] \qquad (1)$$

Where b_t is the debt-GDP ratio in period t

p_t is the ratio of primary deficit to GDP in period t

g_t is the nominal GDP growth rate in period t

i_t is the effective nominal interest rate in period t

Writing $z_t = b_t - b_{t-1}$, equation (1) can also be written as

$$z_t = p_t - b_{t-1}[(g_t - i_t)/(1 + g_t)] \qquad (2)$$

Summing equation (2) over all time periods, we get

$$\sum_{t=1}^{T} z_t = \sum_{t=1}^{T} p_t - \sum_{t=1}^{T} b_{t-1} \times \left[\frac{(g_t - i_t)}{(1 + g_t)}\right] \qquad (3)$$

In their paper, the relative contribution of different factors was studied over continuous periods of time such as decade wise contribution. However, in order to arrive at a more intuitive understanding of the drivers of debt, it is possible to utilize the same relationship by making a

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distinction between two sub-groups of years namely, (A) consisting of years where a primary deficit ($p_t > 0$) was incurred and (B) years where a primary surplus ($p_t < 0$) was shown. These may be further divided into three sub-categories each depending on the nature of contribution to change in debt-GDP ratio as arising from (i) difference between growth rate and interest rate and (ii) primary balance.

Category A1:

In category A1 years, which may be associated with large upsurges in the debt -GDP ratios, we have the condition that $p_t > 0$ and $g_t < i_t$. These would capture years where growth rates suddenly dip or contract due to slowdowns or recessions. In these years, debt accumulates both because of primary deficit and because of the g_t falling below i_t, implying $\sum_{t=1}^{T} z_t > 0$

Category A2:

In this category of years, forces of primary deficit ($p_t > 0$) and excess of growth over interest rate ($g_t > i_t$) partially offset each other. Debt increases if the contribution of excess of growth over interest rate is less than the contribution of primary balance. In this case also $\sum_{t=1}^{T} z_t > 0$.

Category A3:

In this case, even though $p_t > 0$ the contribution of the term ($g_t - i_t$) exceeds the contribution of p_t. This leads to a contraction in the debt-GDP ratio rather than an increase. Thus, in this case $\sum_{t=1}^{T} z_t < 0$.

Category B1:

In category B1 years, which may be associated with upsurges in the debt -GDP ratios, we have the condition that $p_t < 0$ and $g_t < i_t$. Despite a negative contribution of primary surplus, the relatively larger positive contribution of ($g_t - i_t$) leads to an increase in debt-GDP ratio. Therefore, we have $\sum_{t=1}^{T} z_t > 0$

Category B2:

In this category of years, forces of primary surplus and excess of growth over interest rate partially offset each other. Debt falls since the negative contribution of primary surplus more than neutralizes the positive contribution of ($g_t - i_t$). Therefore, we have $\sum_{t=1}^{T} z_t < 0$

Category B3:

In this case, both primary surplus and excess of growth over interest rate contributes to a fall in debt-GDP ratio. This leads to contraction in the debt-GDP ratio rather than an increase. Thus, the impact of the contribution of each factor to change in debt-GDP ratio and the categorization of years according to the scheme indicated above is summarized in table 1.

Table 1: contributions of key factors to change in debt-GDP ratio

Years under different Categories	Change in Government debt GDP ratio	Contribution of primary Deficit (+)/ Surplus (-)	Contribution of weighted excess of interest-rate over growth-rate
	$\sum_{t=1}^{T} z_t \quad =$	$p_t \quad +$	$\sum_{t=1}^{T} b_{t-1} \times \left[\dfrac{(i_t - g_t)}{(1 + g_t)} \right]$
Primary deficit years			
A1	+	+	+
A2	+	+	-
A3	-	+	-
Primary surplus years			
B1	+	-	+
B2	-	-	+
B2	-	-	-

Source (basic data): Authors's representation

Using this framework, we have analysed the evolution of general government debt in India over the period 1991-92 to 2018-19. The resultant categorization of the years is summarized in Table 2. It may be noted that in India's case, there are no years characterized by a primary surplus.

Table 2: Evolution of general government debt in India

Indicators	Σz_t	Σp_t	$b_{t-1} \times \left(\dfrac{i_t - g_t}{1 + g_t}\right)$	Σp_t	$b_{t-1} \times \left(\dfrac{i_t - g_t}{1 + g_t}\right)$	Number of years	Average annual change in debt-GDP ratio (points)
	points	points	points		% contribution to Σz_t		
Primary deficit years	**0.148**	**1.047**	**-0.899**	**7.061**	**-6.061**	**29**	**0.51%**
A1	0.225	0.198	0.027	0.880	0.120	3	7.50%
A2	0.200	0.458	-0.258	2.294	-1.294	11	1.82%
A3	-0.276	0.391	-0.667	-1.415	2.415	15	-1.84%
Primary Surplus years	**0**	**0**	**0**	**0**	**0**	**0**	**0**

B1	--	--	--	--	--	0	--
B2	--	--	--	--	--	0	--
B3	--	--	--	--	--	0	--
Total (all years)	**0.148**	**1.047**	**-0.899**	**7.061**	**-6.061**	**29**	**0.51%**
Memo	Debt GDP ratio (year-end)						
1991-92	0.609						
2019-20	0.757						

Memo		
Category	**Years**	**No. of years**
A1 years	2000-01, 2001-02, 2002-03	3
A2 years	1993-94, 1997-98, 1998-99, 1999-00, 2003-04, 2004-05, 2005-06, 2015-16, 2017-18, 2018-19, 2019-20	11
A3 years	1991-92, 1992-93, 1994-95, 1995-96, 1996-97, 2006-07, 2007-08, 2008-09, 2009-10, 2010-11, 2011-12, 2012-13, 2013-14, 2014-15, 2016-17	15

Source (basic data): IPFS – various issues, RBI, Union Budget – various issues, MoSPI

It is thus seen that from the viewpoint of accumulation of debt relative to GDP, a patch of three years namely 2000-01 to 2002-03 was the worst since in this short period, the debt-GDP ratio shot up by 22% points, that is, a per year increase of 7.3% points on average. This was the case when both components on the righthand side of the equation (3) contributed to debt accumulation. These were category A1 years. Category A2 years consisted of a total of 11 years in which while primary deficit accounted for increase in debt, it was partially neutralized by the excess of growth over interest rate. The net increase in debt-GDP ratio in these 11 years was 20% points, that is an increase of 1.8% points per year on average. There were 15 years in this history of 29 years when the debt-GDP ratio fell. A continuous patch of category A3 years was from 2006-07 to 2014-15. Overall, the category A3 years considered together accounted for a fall in the debt-GDP ratio of 28% points. This implies an average reduction in the debt-GDP ratio by a margin of 1.8% points per year. Noticeably, these years occurred after the enactment of centre's FRBM act of 2003 and the enactment of the state level FRLs in the next few years. When the debt-GDP ratio crosses the sustainability threshold, if it is followed by persistent fall or reduction in primary deficit, it would be one indication of absence of fiscal fatigue (Ghosh et. al., 2013). If on the other hand, primary deficit increases even as debt-GDP ratio remains above the sustainability threshold, it may accentuate non-sustainability.

5. Empirical tests and estimation of sustainability threshold

5.1 Determining sustainability threshold using balance of investible resources and investment demand

There can be two approaches to determining a sustainable level of debt-GDP ratio in a country. One approach is based on an analytical examination of saving and investment trends in the

economy and competitive claimants on the supply of investible resources in order to ascertain an appropriate level of borrowing that can be undertaken by the government which would not drive the interest rate up and thereby crowd out private investment. In such an approach, government borrowing should be in consonance with supply of investible resources and demand for it from non-government sectors that is, non-government public sector and private sector, so as to ensure that the economy keeps close to its potential growth rate. An analytical perspective of this kind was provided in India's context by the FC 12 in their report published in 2004. In this analysis, a sustainable debt-GDP ratio was linked to a corresponding fiscal deficit-GDP ratio such that if the fiscal deficit-GDP ratio is maintained at the given level, it would ensure that the debt-GDP ratio remains stable. This combination of stable fiscal deficit-GDP ratio and debt-GDP ratio was given by the following relationship.

$$f^* = b^* \cdot \frac{g}{1 + g} \qquad (4)$$

Where f^* is the debt stabilizing fiscal deficit-GDP ratio, b^* is stabilized debt-GDP ratio and g is the nominal GDP growth

In this equation, once f^* that is, the debt-stabilizing level of fiscal deficit relative to GDP is determined, the corresponding level of b^* at which debt is stabilized can also be determined. As indicated in equation (4), this relationship depends on the level of GDP growth. In order to determine f^*, considerations of supply and demand for investible resources are brought in. The Commission argued at that time that in India's case, it is the household sector's financial savings which provided the investible surplus in the system on which claims are made by three deficit sectors whose own savings fell short of their own investment demand namely, government, non-government public sector and the private sector. Estimated total investible resources consisted of household sector's financial savings (10-11% of GDP), and sustainable net inflow of foreign capital (1.5-2% of GDP). On this, government demand based on their fiscal deficit of 6% of GDP would leave the balance of 6% of GDP to be shared between the non-government public sector and the private sector of say 2.5% and 3.5% of GDP respectively. If government fiscal deficit of 6% of GDP is combined with a nominal growth rate of 12%, it provides an estimate of the sustainable level of debt, i.e. b^* at 56%. Since then, the household financial savings have come down and private investment demand of these investible resources has also come down. The FRBM Review Committee (2018) had marginally uplifted the FC 12 norm from 56% to 60% based on similar reasoning. The alternative to this approach is to utilize an econometric method for determining the

sustainability threshold. As discussed in the next section, the results of the econometric approach are not much different from the analytical approach discussed in this section.

5.2 Econometric estimation of sustainability and sustainability threshold

In this section, we carry out certain preliminary tests to ascertain sustainability of government finances in India. In the debt sustainability literature, a necessary condition for fiscal sustainability is when the first difference of government debt relative to GDP is stationary, that is, it is integrated of order zero. The empirical estimations in this paper have been carried out using E-Views 11 software.

Table 3: Stationarity test (ADF test): results for z_t

Test statistic		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.207	0.208
Test critical values:	*1% level*	*-3.689*	
	5% level	*-2.972*	
	10% level	*-2.625*	

*MacKinnon (1996) one-sided p-values

Source (basic data): Authors' estimates
Notes: ZT = change in government debt to GDP ratio

Clearly, the first difference in the debt-GDP ratio in India's case has a unit-root, that is it is not stationary. The related estimation results of the ADF test equation are given in

Another test suggested in the literature is to examine whether the government revenue and expenditure series tend to move together in a manner such that the resultant of their relationship produces a stationary series (Hamilton, 1986 and RBI, 2020). This requires testing of the existence of cointegration between government revenues and expenditures. Here we have considered both series relative to GDP.

Table 4: Cointegration Rank Test: results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.337	11.706	15.495	0.172
At most 1	0.022	0.605	3.841	0.437

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source (basic data): Authors' estimates
Notes: RT = government revenues relative to GDP, ET = government total expenditure to GDP ratio

These results indicate that there is no cointegration between the revenue and expenditure series relative to GDP at 5% level of significance. The results of the unrestricted cointegrated rank test are given in Appendix Table 2.

Next, we consider the determination of primary deficit relative to GDP as a function of lagged debt-GDP ratio, real GDP growth rate and interest rate in an ARDL framework. With respect to lagged debt-GDP ratio, four lags are considered relevant. Two of these have a positive coefficient and two of these have a negative coefficient. The net effect is negative indicating that higher levels of previous debt relative to GDP lead to reduction in primary deficit relative to GDP. The impact of nominal growth rate both contemporaneous and the lagged term is negative on primary deficit as expected. The interest rate has a strong positive impact. A 1%-point increase in interest rate results in 4.05% points increase in the primary deficit relative to GDP. This equation can be used to project forward the future path of primary deficit by an iterative process. It requires future values of growth and interest rate variables.

Table 5: ARDL model

Dependent variable is PT				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
PT(-1)	2.637	0.804	3.280	0.007
PT(-2)	-0.712	0.651	-1.094	0.297
PT(-3)	3.338	0.480	6.957	0.000
PT(-4)	0.431	0.198	2.183	0.052
DT(-1)	**-1.957**	**0.752**	**-2.604**	**0.025**
DT(-2)	3.167	0.823	3.848	0.003
DT(-3)	-4.917	0.773	-6.359	0.000
DT(-4)	3.620	0.433	8.359	0.000
GT	**-0.243**	**0.060**	**-4.048**	**0.002**
GT(-1)	-1.280	0.451	-2.841	0.016
GT(-2)	0.734	0.345	2.125	0.057
GT(-3)	-2.693	0.319	-8.431	0.000
IT	**4.053**	**0.498**	**8.145**	**0.000**
C	0.043	0.123	0.353	0.731
R-squared	0.969	Mean dependent var	0.037	
Adjusted R-squared	0.932	S.D. dependent var	0.017	
S.E. of regression	0.005	Akaike info criterion	-7.658	
Sum squared resid	0.000	Schwarz criterion	-6.975	
Log likelihood	109.722	Hannan-Quinn criter.	-7.468	
F-statistic	26.489	Durbin-Watson stat	1.647	
Prob(F-statistic)	0.000			

*Note: p-values and any subsequent tests do not account for model selection

Source (basic data): Authors' estimates
Notes: PT = government primary deficit to GDP ratio, DT = government debt-GDP ratio, GT = real GDP growth, IT= effective interest rate.

Estimating sustainability threshold

In this sub section, we estimate the sustainability threshold for government debt-GDP ratio using a discrete threshold regression[6] where primary deficit relative to GDP is considered as a function of lagged debt-GDP ratio, and contemporaneous growth and interest rate variables. The sustainable level of debt-GDP ratio is estimated at 59.3% which is very close to the FRBM norm as also the norm specified by the FC 12. This is also close to the sustainability threshold of 61% estimated by Kaur and Mukherjee (2012) for India, although using a different methodology. We consider a single threshold dividing the sample period into two regimes as relevant. We consider that the behaviour of primary deficit relative to GDP may change if the debt-GDP ratio crosses a certain threshold. It may trigger suitable responses by policymakers to reduce primary deficit relative to GDP if the debt-GDP ratio is assessed to have crossed a certain prudent norm.

Table 5 shows that up to the end of the sample period there is no indication that this threshold has changed. This is possibly because, in India the interest rate has not fallen significantly over time as was the experience of many advanced countries.

Table 6: Threshold regression results

Dependent Variable: primary deficit to GDP ratio (PT) Selection: Trimming 0.15, Sig. level 0.05 Threshold variable: DT(-2)				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.***
DT(-2) < 0.593 -- 5 obs				
C	-0.589	0.127	-4.640	0.000
DT(-1)	0.921	0.210	4.379	0.000
0.593 <= DT(-2) -- 23 obs				
C	-0.137	0.039	-3.567	0.002
DT(-1)	0.149	0.029	5.232	0.000
Non-Threshold Variables				
IT	1.144	0.274	4.183	0.000
GT	-0.203	0.061	-3.331	0.003
R-squared	0.741	Mean dependent var	0.037	
Adjusted R-squared	0.682	S.D. dependent var	0.017	
S.E. of regression	0.010	Akaike info criterion	-6.260	
Sum squared resid	0.002	Schwarz criterion	-5.975	
Log likelihood	93.640	Hannan-Quinn criter.	-6.173	
F-statistic	12.585	Durbin-Watson stat	1.970	
Prob(F-statistic)	0.000			

Source (basic data): Authors' estimates

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[6] For a review of threshold models see Hansen (1999) and Tong. H, (2010, 2015)

The threshold value indicates that the impact of lagged debt-GDP ratio on primary deficit to GDP ratio at 0.149 is noticeably lower than that when the debt-GDP ratio is below the threshold. This marginal response coefficient is 0.921. In both cases, the sign is positive.

In the context of the European countries for example, a recent paper by Ramos-Herrera and Prats (2020) has estimated 93.01% as the sustainability threshold for the debt-GDP ratio which is well above the Maastricht Treaty norm of 60%. In their case, both growth rate and interest rate have fallen over time. This empirical experience does not apply to India.

6. Covid shock and post-Covid prospects

Covid-19 has led to an upsurge in the government debt-GDP ratio of almost all countries across the world. It is likely that in the post-Covid period, large increases in the government debt-GDP ratio of most countries would call for significant changes in their fiscal policy framework. In an earlier paper, Srivastava et. al. (2020) found that major economic crises have led to one-time upsurges in the debt-GDP ratios of G-20 countries. These ratios tend to remain at high levels well after the crises are over, showing downward rigidity. It was estimated that Covid-19 induced increase in government debt-GDP ratio for the G-20 countries, would amount to 14.9% points on average which is more than 141% higher than the increase of 6.2% points resulting from the 2008 crisis.

Srivastava et. al. (2020) developed a methodology to project government debt-GDP ratio as a function of incremental borrowing relative to GDP, real GDP growth and GDP deflator-based inflation. This methodology along with results for India are briefly discussed in this section.

The change in the government debt-GDP ratio in a country can be decomposed into three factors namely, (1) increased borrowing, (2) real growth rate and (3) inflation rate. Change in government debt amounts to a country's fiscal deficit which is one of the main instruments through which a stimulus is injected in order to overcome an economic crisis.

Change in the government debt-GDP ratio in any year t may be defined as:

$$b_t - b_{t-1} = f_t - b_{t-1}\left[\frac{g_t^n}{(1 + g_t^n)}\right] \qquad (5)$$

Here, b_t and b_{t-1} denote the debt-GDP ratio in the year t and t-1 respectively. f_t is the fiscal deficit to GDP ratio in year t which is defined as change in the level of debt relative to the level of nominal GDP, that is, $f_t = \frac{B_t - B_{t-1}}{Y_t}$

g_t^n refers to the nominal growth rate which can be expanded as the sum of real growth rate and the inflation rate, that is, $g_t^n = g_t + \pi_t + g_t \pi_t$

Equations (5) can be written as follows after ignoring the interaction term ($g_t \pi_t$):

$$b_t = f_t + b_{t-1}.[1 - g_t - \pi_t + g_t^2 + \pi_t^2 + 2.g_t.\pi_t] \tag{6}$$

Equation (6) was used to project the government debt-GDP levels for 2020 and 2021 using independent projections of fiscal deficit to GDP ratio, real GDP growth and inflation rate. Projected government debt-GDP ratio for India in 2020 (Fiscal year 2020-21) and 2021 (Fiscal year 2021-22) are given in Table 6. An increase of 16.6% points in India's government debt-GDP ratio is likely in 2020 over 2019, reflecting the adverse impact of the pandemic.

Table 7: Projected government debt relative to GDP: 2020 and 2021

Country	Percent of GDP				Change (percentage points)	
	2018-19	2019-20	2020-21	2021-22	2020 minus 2019	2021 minus 2020
IND	69.6	72.3	88.9	89.8	16.6	0.9

Source: Srivastava, et al. (2020).

This increase in government debt-GDP ratio has been decomposed into contributions from three factors namely, fiscal deficit, growth and inflation. Equation (6) can be re-written as

$$b_t = f_t + b_{t-1}.[1 - (g_t - g_t^2) - (\pi_t - \pi_t^2)] \tag{7}$$

Equation (7) indicates that in order to derive the current level of debt-GDP ratio, only a proportion of previous year's debt to GDP ratio should be added to the current fiscal deficit relative to GDP. This fraction applied to previous year's debt to GDP ratio depends on current real growth and inflation levels. Higher the levels of current growth and inflation, the lower would be the increase in the current level of debt to GDP ratio.

Equation (7) can be further modified and written as:

$$1 = \frac{f_t}{\Delta b_t} + \frac{(-1)*b_{t-1}*[(g_t - g_t^2) + (\pi_t - \pi_t^2)]}{\Delta b_t} \tag{8}$$

The contribution of the second term in equation (8) can be divided into two terms with associated signs as indicated below:

$$\frac{(-1)*[b_{t-1}.(-|g_t|-|g_t|^2)]}{\Delta b_t} \text{ [that is } \frac{b_{t-1}.(g_t+g_t^2)}{\Delta b_t}] \text{ and } \frac{(-1)*b_{t-1}.(\pi_t-\pi_t^2)}{\Delta b_t}$$

Thus, a negative growth rate will contribute positively to the increase in the debt-GDP ratio while a positive inflation will contribute negatively to the increase in debt-GDP ratio. If a country experiences a price deflation in a crisis year, even the third term would contribute

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positively to the increase in the debt-GDP ratio. Table 7 shows the estimated contribution to increase in government debt-GDP ratio for India with respect to the two crisis years namely, 2009 and 2020.

Table 8: contributions to change in debt-GDP ratio

Period	Contribution (percentage points)					Real GDP growth (percent)
	Fiscal deficit	Growth	Inflation	Residual	Total	
2009 over 2008	7.9	-5.6	-4.1	0.3	-1.7	8.5
2020 over 2019	12.1	8.2	-3.1	-0.7	16.6	-10.3

Source: Srivastava, et al. (2020).

With respect to the 2008 crisis, India could show a contraction in its debt-GDP ratio of (-)1.7% points as the contribution of the growth factor to the increase in government debt-GDP ratio was negative. The dynamics reversed in the 2020 crisis with real GDP growth contracting sharply. Consequently, there was a positive contribution of the growth factor to the increment in government debt-GDP ratio. Further, the fiscal deficit-GDP ratio also increased sharply due to large stimulus package announced by the government.

7. Concluding observations

In the pre-Covid era, the sustainable level of government debt in India, comprising both central and state government debt, was specified at 56% of GDP by the FC 12 using an analytical approach which involved balancing available investible resources consisting of household sector's financial savings and net capital inflows from abroad against demand for these resources from the three deficit sectors namely, government, non-government public sector and the private sector. Using a similar approach, the FRBM Review Committee (2017) uplifted this sustainability threshold to 60% of GDP. Empirical tests indicate that the debt-GDP ratio in India in the pre-Covid years had already exceeded this threshold by a large margin. Srivastava, et al. (2020) estimated the combined government debt-GDP ratio at 72.3% at the end of 2019-20. With significantly high fiscal deficit in 2020-21 for providing fiscal stimulus, the estimated debt-GDP ratio at the end of 2020-21 and 2021-22 would be close to 90%. Since there is no significant increase in investible resources in the near future, high levels of primary deficit may soon have to be reversed in order to guide the economy back towards sustainable debt levels. The impact of lagged debt relative to GDP on primary deficit relative to GDP in the debt dynamics relationship indicates that high levels of previous debt would reduce future primary deficits thereby leading to reduction in the debt-GDP ratio. Given the large departure of actual debt-GDP ratio from its sustainable threshold, it may however take a considerable time before

sustainability is restored. If we go by the average per year reduction of 1.8% points of the category A3 years in the sample period, where growth rate exceeds the interest rate, it would take about 17 years for India's debt-GDP ratio to reach back to sustainable levels provided any major growth slowdowns do not occur in the intervening years.

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9. Appendix

Appendix Table 1: ADF Test: results

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
ZT(-1)	-0.323	0.146	-2.207	0.036
C	0.003	0.005	0.605	0.551
R-squared	0.158	Mean dependent var	0.002	
Adjusted R-squared	0.125	S.D. dependent var	0.027	
S.E. of regression	0.025	Akaike info criterion	-4.469	
Sum squared resid	0.016	Schwarz criterion	-4.374	
Log likelihood	64.563	Hannan-Quinn criter.	-4.440	
F-statistic	4.869	Durbin-Watson stat	2.000	
Prob(F-statistic)	0.036			

Source: Authors' estimates

Notes: D(ZT) = first difference of change in debt

Appendix table 2: Cointegration Rank Test Results

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.337	11.101	14.265	0.149
At most 1	0.022	0.605	3.841	0.437
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	**Eigenvalue**	**Max-Eigen Statistic**	**0.05 Critical Value**	**Prob.**
None	0.337	11.101	14.265	0.149
At most 1	0.022	0.605	3.841	0.437
Max-eigenvalue test indicates no cointegration at the 0.05 level * denotes rejection of the hypothesis at the 0.05 level **MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):				
RT		**ET**		
-66.916		109.362		
60.456		26.250		
Unrestricted Adjustment Coefficients (alpha):				
D(RT)		0.003	-0.001	
D(ET)		-0.004	-0.001	
1 Cointegrating Equation(s):		Log likelihood	191.127	
Normalized cointegrating coefficients (standard error in parentheses)				
RT		**ET**		
1.000		-1.634 (0.405)		
Adjustment coefficients (standard error in parentheses)				
D(RT)		-0.230 (0.100)		
D(ET)		0.243 (0.096)		

Source: Authors' estimates

Notes: D(RT) = first difference of government revenues to GDP ratio, D(ET) = first difference of government expenditure to GDP ratio

Appendix table 3: Evolution of parameters used in estimations: 1990-91 to 2018-19

Year	Debt-GDP ratio (b_t)	Change in debt-GDP ratio (z_t)	Primary deficit-GDP ratio (p_t)	Nominal GDP growth (g_t)	Real GDP growth (g_t^r)	Effective interest rate (i_t)	Revenues-GDP ratio (r_t)	Expenditures-GDP ratio (e_t)
1990-91	0.609	--	--	0.168	0.055	--	0.172	0.266
1991-92	0.597	-0.011	0.021	0.150	0.011	0.088	0.184	0.260
1992-93	0.593	-0.004	0.026	0.149	0.055	0.091	0.178	0.258
1993-94	0.612	0.019	0.048	0.151	0.048	0.094	0.168	0.255
1994-95	0.590	-0.022	0.018	0.173	0.067	0.097	0.173	0.248
1995-96	0.570	-0.020	0.018	0.173	0.076	0.097	0.172	0.239
1996-97	0.552	-0.018	0.010	0.157	0.075	0.102	0.168	0.230
1997-98	0.574	0.022	0.025	0.108	0.040	0.102	0.167	0.239
1998-99	0.581	0.007	0.029	0.147	0.062	0.104	0.155	0.251
1999-00	0.616	0.035	0.043	0.122	0.088	0.107	0.165	0.259
2000-01	0.712	0.096	0.082	0.076	0.038	0.100	0.164	0.255
2001-02	0.781	0.069	0.062	0.082	0.048	0.092	0.164	0.262
2002-03	0.841	0.060	0.054	0.077	0.038	0.085	0.170	0.264
2003-04	0.876	0.035	0.062	0.120	0.079	0.084	0.178	0.268
2004-05	0.894	0.018	0.066	0.141	0.079	0.079	0.184	0.259
2005-06	0.895	0.001	0.054	0.140	0.079	0.072	0.192	0.258
2006-07	0.854	-0.041	0.035	0.171	0.081	0.072	0.205	0.257
2007-08	0.821	-0.033	0.028	0.151	0.077	0.069	0.206	0.254
2008-09	0.813	-0.007	0.034	0.126	0.031	0.069	0.191	0.274
2009-10	0.791	-0.023	0.037	0.155	0.079	0.071	0.185	0.285
2010-11	0.737	-0.054	0.031	0.199	0.085	0.070	0.203	0.276
2011-12	0.729	-0.008	0.039	0.144	0.052	0.072	0.189	0.270
2012-13	0.718	-0.011	0.031	0.138	0.055	0.072	0.194	0.266
2013-14	0.712	-0.006	0.029	0.130	0.064	0.075	0.193	0.263
2014-15	0.706	-0.006	0.018	0.110	0.074	0.073	0.185	0.255
2015-16	0.721	0.015	0.035	0.105	0.080	0.074	0.198	0.274
2016-17	0.709	-0.012	0.017	0.118	0.083	0.073	0.199	0.267
2017-18	0.724	0.015	0.037	0.110	0.068	0.075	0.198	0.260
2018-19	0.725	0.002	0.023	0.105	0.065	0.072	0.196	0.262
2019-20	0.757	0.032	0.037	0.078	0.040	0.070	--	--

Source (basic data): IPFS statistics – various issues, Union Budget documents - various issues and MoSPI,