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**PUBLIC DEBT AND EXTERNAL DEBT
SUSTAINABILITY AMONG BRICS COUNTRIES**

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among BRICS Countries*

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Public Debt and External Debt Sustainability among BRICS Countries

Magulsha George and K. R. Shanmugam

Abstract

This study analyses an important policy issue pertaining to the public debt and external debt of BRICS nations from 1993 to 2020 using the Bohn framework and a penalized spline estimation method. The results indicate that, as the primary surplus reacts positively and significantly to public debt in China and South Africa, the debt is sustainable in these nations. In Brazil, India and Russia, the debt is not sustainable. The external debt policy is sustainable only in China and not in other BRICS nations. These results suggest immediate policy interventions in Brazil, India and Russia to achieve sustainable levels of public debt and external debt. We hope that these results will be useful to policy makers and other stake holders to take appropriate strategies to improve the public debt and external debt position of BRICS nations and make them sustainable.

Keywords: *Sustainable Debt, BRICS, Bohn Model, Penalized Spline.*

JEL Codes: *H63, C23, D72, E62, H72.*

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INTRODUCTION

Fiscal discipline, particularly public debt sustainability, is important for any country or government. When its revenues fall short of its expenditure commitments, the government borrows to finance its excess expenditures. The public debt is the total liabilities of the Government. Deficit financing and public debt are common features of the public finance policy of any government. Many economists believe that debt is one way to raise money for development. Borrowings can enable countries to finance important development programs and projects (Hakura, 2020).

If the debt amounts can be used to finance the social and infrastructure development projects, these projects can lead to higher income in the future that may offset the cost of debt servicing. Therefore, the debt is not an issue for a government if it generates enough surplus resources in the future to service its debt. The public debt is considered sustainable if the government is able to meet all its current and future obligations without exceptional financial assistance or going into default. In lucid sense, it is basically about good housekeeping (Blanchard, 1991).

If the debt-GDP ratio exceeds certain prudent limits, it becomes unsustainable and this will lead to an excessive burden of debt servicing for the future. Excessive debt (i.e., debt overhang) is bad for growth and development and stability; it can negatively affect capital stock accumulation and economic growth via heightened long term interest rates, higher distortionary tax rates, inflation, and a general constraint on counter cyclical fiscal policies which may lead to increased volatility and lower growth rates (Rugy and Salmon, 2020). Sometimes, it can cause the government to default, which can cause borrowing country to lose market access and suffer from a higher cost of borrowing.

The Euro-Sovereign debt crisis gave alarm to most nations having a high level of debt. The Global Financial crisis and COVID-19 aggravated the problem further for many countries, including the BRICS (Brazil, Russia, India, China and South Africa are the constituents) nations. These nations, being fast growing developing nations, account for about 40 percent of the world population, 30 percent of global GDP, and 17 percent of global trade. They are not only growing faster, but also more integrated with the developed world in trade and investment. The key challenges faced by them will be to maintain robust and sustainable growth in order to reduce the gap in living standards to the mature market economies, employment generation, investment and maintain macroeconomic stability.

Further, for these economies, the major thrust of growth comes from within the economies, where governments assume the role of primary investors. However, the available evidence indicates that the average debt-GDP ratio of BRICS was 70.35 percent in 2020 (RBI, 2021), with the highest debt incurred by Brazil (99 percent), followed by India (89.6 percent), South Africa (69.5 percent), China (66.8 percent) and Russia (19.3 percent). Given the relative economic significance of the BRICS countries and the fact that any mismanagement of public debt in BRICS will have larger repercussions for the world economy, this study attempts to empirically analyse the debt sustainability conditions of BRICS nations from 1993 to 2020, using the penalized spline method.

The main contributions of this study are as follows. Firstly, while various alternative empirical approaches are available in the literature to analyse the debt sustainability issue, including the traditional Domar (1944) stability approach, indicator approach (e.g., Kaur , 2014), solvency approach, general accounting framework, unit root approach and co-integration approach, Bohn (1995) framework, which suggests that the debt is sustainable if primary surplus relative to GDP is a positive and at least linearly rising function of the debt to GDP ratio (see Pradhan, 2019 for more details of these approaches), is widely accepted and used

in many studies (e.g., Greiner , 2007; Greiner and Fincke, 2009; Greiner and Fincke, 2015; Renjith and Shanmugam, 2018). While few existing studies analyse the debt sustainability issue of some BRICS nations individually and with past data, a comprehensive study analysing this issue of all BRICS nations together using the Bohn framework is non-existent (Campos and Cysne, 2019; Lixin, 2019; Phiri, 2018; Redda, 2020; Tiwari, 2012). Secondly, although only one study, Joy and Panda (2020) analyses the debt sustainability of BRICS nations using the Bohn framework, it uses the regular panel data methodology and not penalized spline technique, which is useful to estimate the time-varying coefficients as in Greiner and Fincke (2009). Thirdly, it also empirically examines the external debt sustainability of BRICS nations because the larger accumulation of external debt will severely affect economic growth and be a constraint to poverty alleviation. Finally, while this study provides policy suggestions based on the BRICS experience, these may be relevant for other similar nations.

The rest of this study proceeds as follows. The next section briefly reviews the relevant literature. The subsequent sections explain the empirical model, the data and estimation techniques employed and present the empirical results. The final section provides the policy implications and concluding remarks of the study.

BRIEF REVIEW OF THE LITERATURE

Theoretical Views: Conceptually, debt sustainability can be defined as a situation where the debt does not accumulate at a rate considerably exceeding the government's capacity to service it (IMF, 2011). There are three main theoretical views on debt/deficit financing in the literature: the Ricardian equivalence theorem, the Keynesian theorem and the neo-classical theorem. The Ricardian theorem argues that budget deficits today require higher taxes in the future when a government cuts taxes without changing the present or future public spending. Given that households are forward-looking, they will realize that they need to pay

higher taxes in the future so that their total tax burden remains unchanged. As a result, they will reduce their consumption and increase savings to meet their future tax burden. This theorem is based on the inter-temporal budget constraint of the government and on the permanent income hypothesis.¹

The Keynesian theorem envisages that deficit financing can boost aggregate demand and thereby stimulate growth. That is, an increase in government spending financed by borrowing would cause output to expand through a multiplier process and financing in this kind predominantly implies a re-allocation of resources from taxpayers to the bond-holders. Hence, this is beneficial for the economy. Further, public debt does not pose a problem if the government runs into debt in the home country (Greiner and Fincke, 2009).²

The Neo-classical view considers that the component of revenue deficit in the fiscal deficit implies a reduction in Government saving or an increase in Government dis-saving and thus, distorting the rate of growth. Thus, there is no consensus among economists on whether deficit financing is good or bad or neutral (Rangarajan and Srivastava, 2005). It needs to be resolved empirically.

On the empirical front also, there is no universal agreement on how public debt sustainability can be assessed (Akhmadev , 2018). Traditional studies employed the Domar (1944) stability condition: "As long as the real economic growth is greater than the real interest rate, the government can have a positive primary deficit such that its debt will

¹. The first principle states that public debt must be sustainable in the sense that outstanding debt today must be equal to the present value of government's future surpluses. The second principle states that the households do not base their consumption on current income but on permanent income so that they will not raise consumption as long as their income increases temporarily.

². Inter-generational re-distribution is the main justification for popular "Golden Rule" in public finance. This rule views that Governments should finance public investments that yield long-term benefits by public deficits in order to make future generations contributing to the financing. As future generations will enjoy the benefits from today's investment, their contribution to the financing is justified.

not rise and so the debt is sustainable". This approach was extended later to consider the inter-temporal budget constraint (IBC) of the Government and also with additional indicators (growth, liquidity, creditworthiness, fiscal burden, fiscal space, etc.) and renamed as "Indicator approach" (Blanchard, 1991; Pattnaik , 2003).³ However, this approach was criticized as it applied the condition on a year-to-year basis and didn't validate whether the IBC of the Government is satisfied or not.

Empirical Models: The modern empirical approach on debt sustainability utilizes statistical tests. The pioneer in this approach was the seminal work of Hamilton and Flavin (1986) which introduced the unit root test to check whether the public debt series in the US was stationary or not (i.e., whether the series of public debt contains a bubble term). Uctum , (2006) used the unit root test to test the debt sustainability in G7 countries, selected Latin American and Asian countries and found that the debt was sustainable only in G-7 countries. Trehan and Walsh (1991) employed another test to analyse whether a quasi-difference of public debt ($D_t - \nu D_{t-1}$) with $0 \leq \nu < 1 + r$, (where r is the interest rate) is stationary and whether public debt and primary surpluses (S_t) are cointegrated. If the public debt is quasi-difference stationary and public debt and primary surpluses are cointegrated, then the public debt is sustainable (Greiner and Fincke, 2009). Studies such as Hakkio and Rush (1991) and Jha and Sharma (2004) analysed the sustainability by verifying the cointegrating relationship between public revenue and expenditure. See Afonso (2005) and Neck and Sturm (2008) for a brief survey of studies employing these procedures.

³. The IBC is $d_t^* = \sum_{j=1}^{\infty} \frac{1}{(1+r)^j} E_t [s_{t+j}]$, where $d_t^* = (1 + r_t) \cdot d_{t-1}$ is the stock of the debt-output ratio in the beginning of period t , $E_t [.]$ denotes the expectation operator conditional on the information available at time t , and s_t is the primary surplus-GDP ratio. The IBC of the Government requires that the present value of public debt asymptotically converges to zero, and the interest rate r is resorted to in order to discount the stream of public debt, and this plays an important role.

However, the above time series approaches were criticized because: (i) the unit root test is very sensitive to structural breaks and the results could be misleading (Uctum , 2006); (ii) it is very difficult to reject a unit root in real debt or in the debt to GDP ratio and (iii) rejection of sustainability based on these two tests are invalid because the IBC may well be satisfied even if the components of the budget are not co-integrated and even if debts or deficits, revenues or spending are differencing stationary (Bohn, 2007).

Another model based test that has gained popularity is Bohn (1995). He constructed a general equilibrium stochastic model along with a stochastic version of IBC. This approach is basically to test whether the primary surplus-GDP ratio (s_t) is positive and, at least, a linearly rising function of the debt-GDP ratio (d_t):

$$s_t = \alpha + \psi d_t + \varepsilon_t \quad (1)$$

where ε is the random error and α and ψ are parameters to be estimated. If $\psi > 0$ and statistically significant, the debt is sustainable, which means that the initial stock of debt is equal to the sum of the present discounted values of the primary surpluses. The IBC is satisfied if the discounted sum of the end period debt converges to zero. The positive reaction coefficient ψ ensures this convergence.

Further, the Bohn model argues that the total deficit of the government must be stationary, which is a sufficient condition for sustainability of public debt. Bohn (1998) utilized the Barro's (1979) tax-smoothing hypothesis according to which public deficits should be used in order to keep tax rates constant, which in turn minimizes the excess burden of taxation. Hence, normal expenditure can be financed by regular revenues, and hence deficits will be incurred as a result of financing unexpected spending. Based on this, he derived the following fiscal rule or reaction function:

$$s_t = \alpha + \psi d_t + \phi_1 yvar_t + \phi_2 gvar_t + \varepsilon_t \quad (2)$$

where *yvar* and *gvar* are business cycle indicators, reflecting fluctuations in revenues and the deviation of real primary spending from its normal respectively. This model received great attention in the literature because of its intuitiveness (*i.e.*, if Governments run into debt today, they would have to take corrective actions in the future by increasing the primary surplus) and robust statistical properties (the positive response of primary surplus to public debt implies a mean reverting process)⁴. Accordingly, it was later extended by researchers by adding other determinants of primary balance, incorporating unobserved heterogeneity factors using panel data structures, and specifying non-linearity and time-varying coefficients in the model.

In the non-linear context, the Bohn model can be re-written as:

$$s_t = \alpha + \psi_t d_{t-1} + \phi_1 yvar_t + \phi_2 gvar_t + \varepsilon_t \quad (3)$$

where the reaction coefficient ψ_t is time-varying. Mathematically, any non-linear model can be approximated by a linear model with time-varying coefficients. This approximation is good under certain smoothness assumptions. Empirical estimations using these linear approximations employ the popular penalized spline method. To avoid endogeneity issues, Greiner and Fincke (2009) replaced d_t with d_{t-1} .

Empirical Studies: A handful of empirical studies used the above approach to verify whether the public debt is sustainable or not in various countries. For instance, Abiad and Ostry (2005) employed the extended version of the Bohn model to test the debt sustainability of 31 emerging market countries from 1990 to 2002. Haber and Neck (2006) investigated the sustainability of Austrian fiscal policy from a political economy

⁴. Because higher debt ratios lead to an increase in the primary surplus relative to GDP, making the debt ratio decline and return to its mean.

perspective by incorporating certain political variables. Greiner and Kauermann (2008) used the penalized spline method and found that debt is sustainable in Germany and not in Italy. Griener and Fincke (2009) used the Bohn framework and p-spline technique to analyse the debt sustainability issue of the USA and 6 Euro countries (Austria, France, Germany, Italy, The Netherlands, Portugal) and 6 developing countries (Botswana, Costa Rica, Mauritius, Panama, Rwanda, and Tunisia). Except in France, the debt was sustainable in the USA and 5 Euro countries. However, in France, the debt was sustainable. Debt was sustainable in only Botswana and Rwanda and all other 4 developing countries, it was unsustainable. Doi , (2011) used the Markov-switching model and found that the debt in Japan was unsustainable from 1980 to 2010.

Studies on Debt Sustainability of BRICS Nations: A few studies tested the public debt sustainability of BRICS nations. Campos and Cysne (2019) estimated the fiscal reaction function for Brazil with time varying coefficients (using the monthly data from January 2003 to June 2006) and found that the debt is unsustainable in Brazil. Tiwari (2012) used the Bohn framework and spline methodology and found that debt was unsustainable in India from 1970 to 2009. Renjith and Shanmugam (2018) used the Bohn model and spline methodology for panel data and showed that in 14 out of 20 Indian states the debt was sustainable from 2003-04 to 2014-15. Lixin (2019) employed a fiscal space framework, the threshold estimation, and the debt service-capacity measure to assess the sustainability of China's domestic and external debt and found that from 1985 to 2015, China's public and external debt were both sustainable. Redda (2020) analysed public debt sustainability and budget deficit in South Africa using Johansen co-integration, vector error correction model (VECM) and Granger causality test during 2000 to 2018 and found that both public debt and budget deficit are not sustainable. Joy and Panda (2020) used the Bohn framework with additional political economic variables and regular panel data methodology and found that public sustainability was weak for BRICS as a whole from 1980 to 2017. Phiri (2018) used nonlinear unit root testing procedure and found that among BRICS countries, the fiscal budgets of India and China are unsustainable and of Brazil, Russian and South Africa are sustainable.

Studies on External Debt Sustainability: Vinokurov, (2020) investigated the external debt sustainability of Kyrgyz Republic under the three different scenarios of global slowdown, financial vulnerability and economic crisis using the VAR Model during 2006 to 2019. They showed that the proneness to unsustainable debt is more under the global slow down compared to that of financial unsustainability. Hussain and Idrees (2019) investigated the impact of fiscal performance on the external debt sustainability of Pakistan during 1976 to 2013 using the co-integration technique along with VECM and parameter stability test and showed sustainability of external debt. Rais (2019) studied the external debt statistics for India during 1980-81 to 2017-18 and showed that the external debt was sustainable in India, on account of prudent debt management policy. Llorca (2017) examined a panel of 24 emerging and developing Asian economies, employing present value methodology to assess the long run external debt sustainability of these countries during 1993 to 2014. The results showed that external debt is sustainable for all the economies under consideration. Luporini (2000) used inter-temporal budget constraints and stationarity test to show that Brazil's domestic debt during 1981 to 1998 was sustainable.

EMPIRICAL MODEL, DATA AND ESTIMATION

To test the public debt and external debt sustainability of BRICS nations, this study uses the following Bohn's model based fiscal reaction function for each country:

$$s_t = \alpha + \psi_t d_{t-1}(\text{or } ed_{t-1}) + \phi_1 yvar_t + \phi_2 gvar_t + \varepsilon_t \quad (4)$$

where s_t is the primary surplus to GDP ratio in year t ; d_{t-1} is the debt to GDP ratio in $t-1$ year; ed_{t-1} is the external debt-GDP ratio. The lagged debt ratio/external debt ratio is used to avoid the endogeneity issue. ε_t is an error term, which is assumed to be i.i.d.N(0, σ^2). $yvar$ and $gvar$ are business cycle indicators. $yvar$ accounts for fluctuations in revenues and reflects the deviation of real GDP from its trend, computed using the

Hodrick-Prescott (HP) filter. Positive values for *yvar* indicate booms and negative values indicate recessions. The *gvar* reflects the deviation of real primary spending from its normal value with positive values indicating expenditures above the normal level and vice versa (Greiner and Fincke, 2009).

In (4), the reaction coefficient ψ_t is time-varying. To estimate the time-varying coefficients, this study uses the p-spline method. ψ is the average (response) coefficient and the actual coefficient is the sum of ψ and the deviation, which is given by the smooth function, $sm(t)$. If ψ is positive, there is an indication of debt sustainability, and the time-varying values indicate a change in the response coefficient over the years. For more details about p-spline method, see Fincke and Greiner (2011); Hastie and Tibshirani (1999) and Ruppert , (2003).

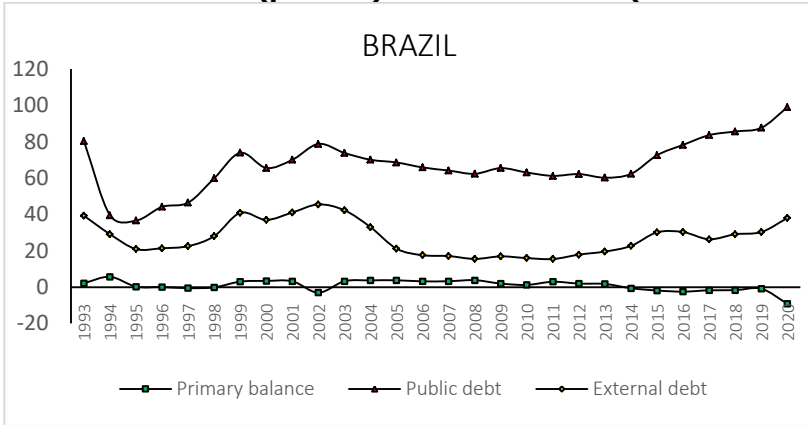
This study uses the secondary (annual) data from 1992 to 2018 drawn from various published sources: Public Finances in Modern History database (IMF), The World Economic Outlook (WEO) Database (IMF) and World Development Indicators (World Bank). The choice of the time period is due to the availability of data for this period. Because of the use of lag of debt/external debt variables in (4), the total observations included in the final analysis are 28 (1993 to 2020). The descriptive statistics of the study variables are shown in Table 1.

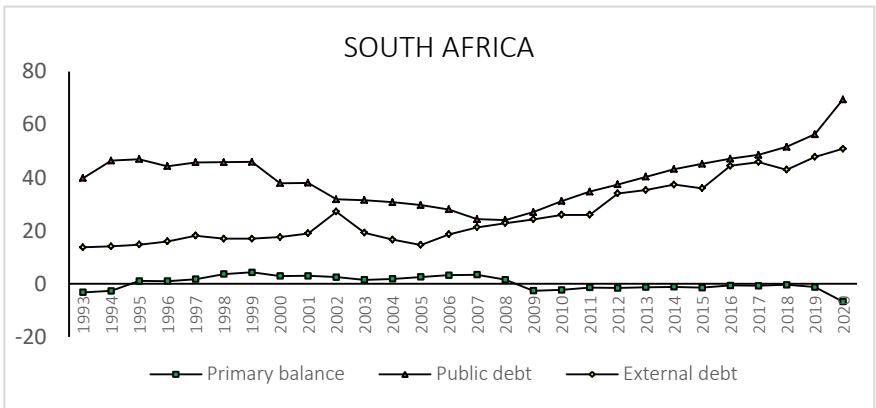
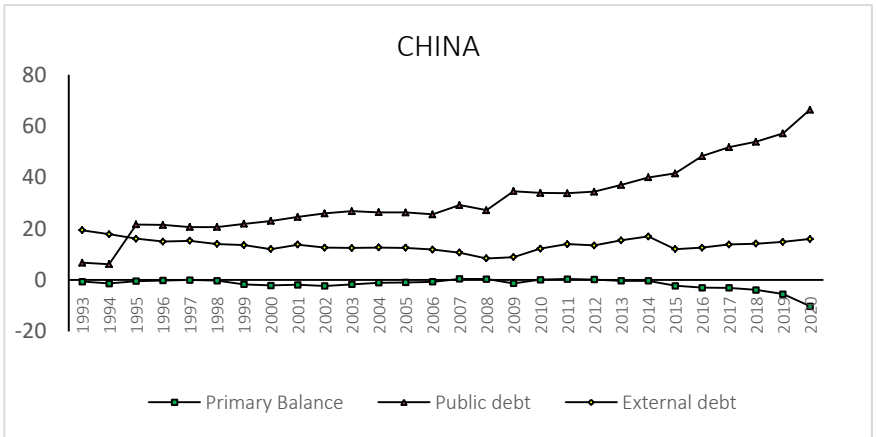
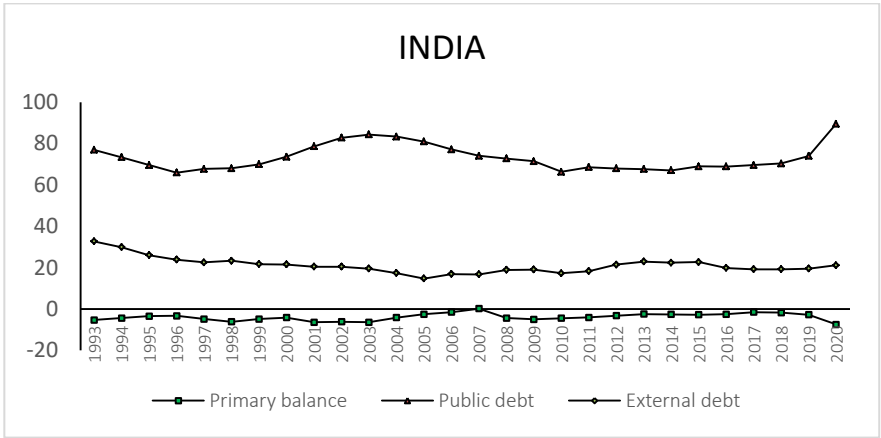
Chart 1 shows the trend in primary balance-GDP ratio, public debt-GDP and external debt-GDP ratio of BRICS nations from 1993 to 2020. The debt-GDP ratio of Brazil was 83.9 percent in 1992 and declined to 36.5 percent in 1995. Then it started increasing to reach 78.8 percent in 2002. After that, it continuously declined till 2013, except 2009. From 2013, it increased continuously and reached 98.8 percent in 2020. Its external debt-GDP ratio was 33.47 percent in 1992. It came down to 15.44 percent in 2011 and then started increasing and reached 38.02 percent in 2020. Brazil had a primary surplus till 2014 except for a few years (1996-1998 and 2002). Since 2014, it had a primary deficit.

Table 1: Descriptive Statistics of the Study Variables

Variables	Countries	Notation	Mean	Std. Deviation
Primary balance-GDP ratio (percent)	Brazil	s_t	0.924	3.029
	Russia	s_t	0.384	4.666
	India	s_t	-3.825	1.780
	China	s_t	-1.556	2.210
	South Africa	s_t	0.258	2.607
Lagged Debt- GDP ratio (percent)	Brazil	d_{t-1}	66.648	13.300
	Russia	d_{t-1}	36.594	35.278
	India	d_{t-1}	72.829	5.479
	China	d_{t-1}	29.464	13.243
	South Africa	d_{t-1}	38.880	8.672
Lagged External Debt- GDP ratio (percent)	Brazil	ed_{t-1}	27.361	9.435
	Russia	ed_{t-1}	35.938	14.632
	India	ed_{t-1}	21.437	4.210
	China	ed_{t-1}	13.696	2.458
	South Africa	ed_{t-1}	24.736	11.385
Real GDP gap (Billions, national currency)	Brazil	yvar	0.000001	49.985
	Russia	yvar	-0.00019	5157.452
	India	yvar	-0.00026	5715.030
	China	yvar	-0.00001	3525.956
	South Africa	yvar	-0.000002	128.545
Real Primary Expenditure Gap (Billions, national currency)	Brazil	gvar	0.0000008	23.025
	Russia	gvar	-0.00003	2696.739
	India	gvar	-0.00001	1203.200
	China	Gvar	0.00003	1893.191
	South Africa	Gvar	-0.000003	66.386

Chart 1: Trends in Debt, External Debt and Primary Balance relative to GDP (percent) in BRICS Nations (1993 to 2020)





Till 2000, Russia's debt-GDP ratio was above 50 percent. After that it started decreasing and reached 19.3 percent in 2020. Its external debt relative to GDP reached 91.90 percent in 1999 and came down to 25.24 percent in 2008. Then it started to increase and reached 41.45 percent in 2016. It reached 32.05 percent in 2020. Except for 10 years during the 2000s, Russia had a primary deficit-GDP ratio from 1992 to 2017 except from 2011 to 2012. In 2018, it had a primary surplus relative to GDP of 3.45 percent. At present, Russia has a deficit of 3.77 percent. Between 1992 and 2018, India's debt-GDP ratio ranged between 65.98 percent and 84.4 percent. In 2020, it rose to 89.6 percent. Its external debt-GDP ratio was 32.7 percent in 1993 and it came down to 14.77 percent in 2005. After that, it increased and in 2020 it was 21.2 percent. Until 2011, India's primary deficit-GDP ratio was close to (or above) 4 percent except, in a few years. After that, it continuously started decrease and in 2017, it was 1.5 percent, but reached 7.41 percent in 2020.

Till 2008, debt-GDP ratio of China was kept below 30 percent. After that, it started increasing and in 2020, it was 66.8 percent. The external debt-GDP ratio of China was 16.9 percent in 1992 and it declined to 8.4 percent in 2008. Then it increased to 15.95 percent in 2020. China has a primary deficit-GDP ratio of 0.62 percent in 1992 and it increased to 10.22 percent in 2020 with minor fluctuations in different years. Between 1992 and 2017, the debt-GDP ratio of South Africa was below 50 percent. After that, it exceeded 50 percent and in 2020, it was 69.45 percent. Its external-debt ratio was 4.82 percent in 1992. It increased continuously to 47.78 percent in 2020 with few fluctuations in some years. During 1995 to 2008, South Africa had a primary surplus-GDP ratio. Then it had a primary deficit-GDP ratio and in 2020, it reached 6.71 percent.

It is noticed that the BRICS nations have not had a very stable government over the years. Since 1980, India has had either a minority or coalition government till 2014. The first presidential election happened in 1981 in South Africa. Brazil's military government gave way to

democracy only in 1985 with its first presidential election (Joy and Panda, 2020). While the left-ideological government has been stable since 1996, central and right-ideological governments were formed in Brazil. Russia and China were single-party communist countries even in the 1990s and they have been slightly moving towards a democratic system and voting (since 1991 in Russia and since 2012 in China). These could be the reasons for why these nations have a high debt-GDP ratio.

EMPIRICAL RESULTS

Public Debt Sustainability Analysis Results

Table 2 presents the penalized spline estimation results of the policy response function of equation (4) for BRICS countries. As expected, the coefficient of business cycle variable $yvar$ is positive and that for $gvar$ is negative and statistically significant at 1 percent level for all five BRICS countries. These results imply that GDP growth above its normal value in these countries has increased the primary surplus value while primary spending above its normal value has reduced the primary surplus value.

Table 2: P-spline Estimation Results of Public Debt Sustainability Equations for BRICS Countries (1993 to 2020)

Variables	Notation	Brazil	Russia	India	China	South Africa
(Intercept)	$\hat{\alpha}$	-3.6511 (-1.803)	1.585 (1.452)	-6.2390 (-1.064)	-2.607 (-4.226)	-4.5480 (-2.172)
Lagged Debt-GDP ratio (percent)	d_{t-1}	0.0950 (1.656)	-0.4057 (-3.286)	0.0053 (0.091)	0.0818 (2.978)	0.0875 (2.041)
Real GDP gap	$yvar$	0.0472 (4.196)	0.0007 (8.678)	0.0003 (4.4290)	0.0008 (8.352)	0.0139 (6.5910)
Real Primary Expenditure Gap	$gvar$	-0.0744 (-5.591)	-0.0016 (-11.138)	-0.0016 (-4.42)	-0.0011 (-6.921)	-0.0206 (-4.177)
edf		7.628	8.823	5.669	4.035	7.594
F [p-value]		15.12 [0]	16 [0]	4.806 [0]	18.43 [0]	25.2 [0]
R-sq.(adj)		0.891	0.967	0.795	0.970	0.960
GCV		1.6562	1.293	0.9640	0.1996	0.4463
N		28	28	28	28	28

Note: Figures in parentheses are t values.

The main variable of interest is the lagged debt-GDP ratio, d_{it-1} . As expected, the parameter associated with this variable is positive and statistically significant at 1 percent level in China and at 10 percent level in South Africa. Therefore, China's public debt is sustainable while South Africa's is weakly sustainable. For Brazil and India, although the coefficient of previous year's debt on primary balance is positive, it is not statistically significant even at 10 percent level. In the case of Russia, this coefficient is negative. These results imply that the public debt is unsustainable in Brazil, India and Russia.

The estimated degrees of freedom, edf , of $sm(t)$ provide information on possible time dependence. As this term is statistically significant at 1 percent level in all BRICS countries, the reaction coefficients of these countries have not stayed constant over time. Chart 2 shows the time path of the smooth terms of respective BRICS countries, where the two dashed lines show the 95percent confidence interval and a solid line shows the point estimate of smoothed terms over time. The curve is drawn such that the values larger (smaller) than zero indicate that the coefficient is above (below) its average value shown in Table 2 for corresponding countries. The actual reaction coefficient of any given year is the sum of the average coefficient and the value of the curve for that year.

Chart 2: Deviation $sm(t)$ from its Average Coefficient of Public Debt (d_{t-1}) for BRICS Countries

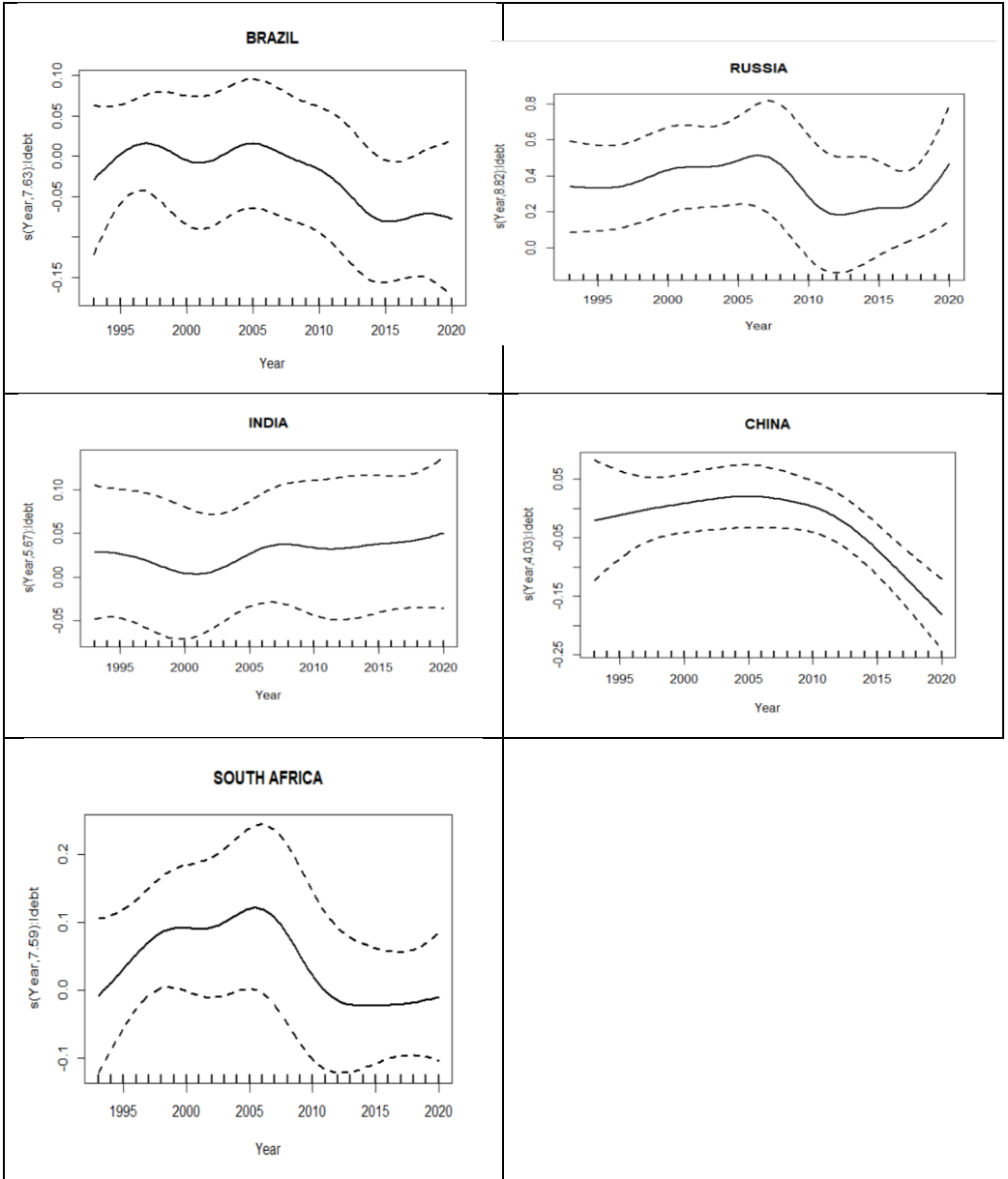


Chart 2 shows that the reaction of the primary surplus to public debt continuously declined in Brazil from 2005 till 2015 and then it showed a slightly increasing trend. In the case of Russia, it increased till 2007 and started declining. But it started rising again in 2015. In India, it slightly increased with some fluctuations in some years. For China, it continuously declined after 2005. For South Africa also, it continuously declined after 2005 but showed an upward trend after 2015.

External Debt Sustainability Analysis Results

Table 3 reports the estimation results of the external debt sustainability analysis for BRICS countries. As expected, the coefficient of business cycle variable $yvar$ is positive and the coefficient of the primary expenditure variable $gvar$ is negative in all 5 BRICS nations. Both coefficients are statistically significant at a 1 percent level in all cases, indicating that GDP growth above its normal value has increased the primary surplus value and that primary spending above its normal value has reduced the primary surplus value in these nations.

Table 3: P-spline Estimation Results of External Debt Sustainability Equations for BRICS Countries (1993 to 2020)

Variables	Notation	Brazil	Russia	India	China	South Africa
(Intercept)	$\hat{\alpha}$	0.4180 (0.239)	-0.6031 (0.515)	-0.9783 (-0.378)	-1.4906 (-1.893)	0.3282 (0.377)
Lagged External Debt-GDP ratio (percent)	ed_{t-1}	-0.0229 (-0.232)	-0.0032 (-0.050)	-0.1181 (-1.364)	0.2902 (4.124)	0.0416 (0.349)
Real GDP gap	$yvar$	0.0402 (3.513)	0.0006 (8.796)	0.0002 (3.945)	0.0008 (6.165)	0.0119 (4.509)
Real Primary Expenditure Gap	$gvar$	-0.0836 (-5.972)	-0.0016 (-11.510)	-0.0018 (-5.075)	-0.0009 (-4.155)	-0.0347 (-5.844)
edf		6.093	5.542	5.545	5.592	8.348
F [p-value]		7.68 (0)	16.16 (0)	3.38 (0)	34.26 (0)	5.82 (0)
R-sq.(adj)		0.850	0.955	0.778	0.967	0.945
GCV		2.0940	1.4532	1.0366	0.2354	0.6478
N		28	28	28	28	28

Note: Figures in parentheses are t values.

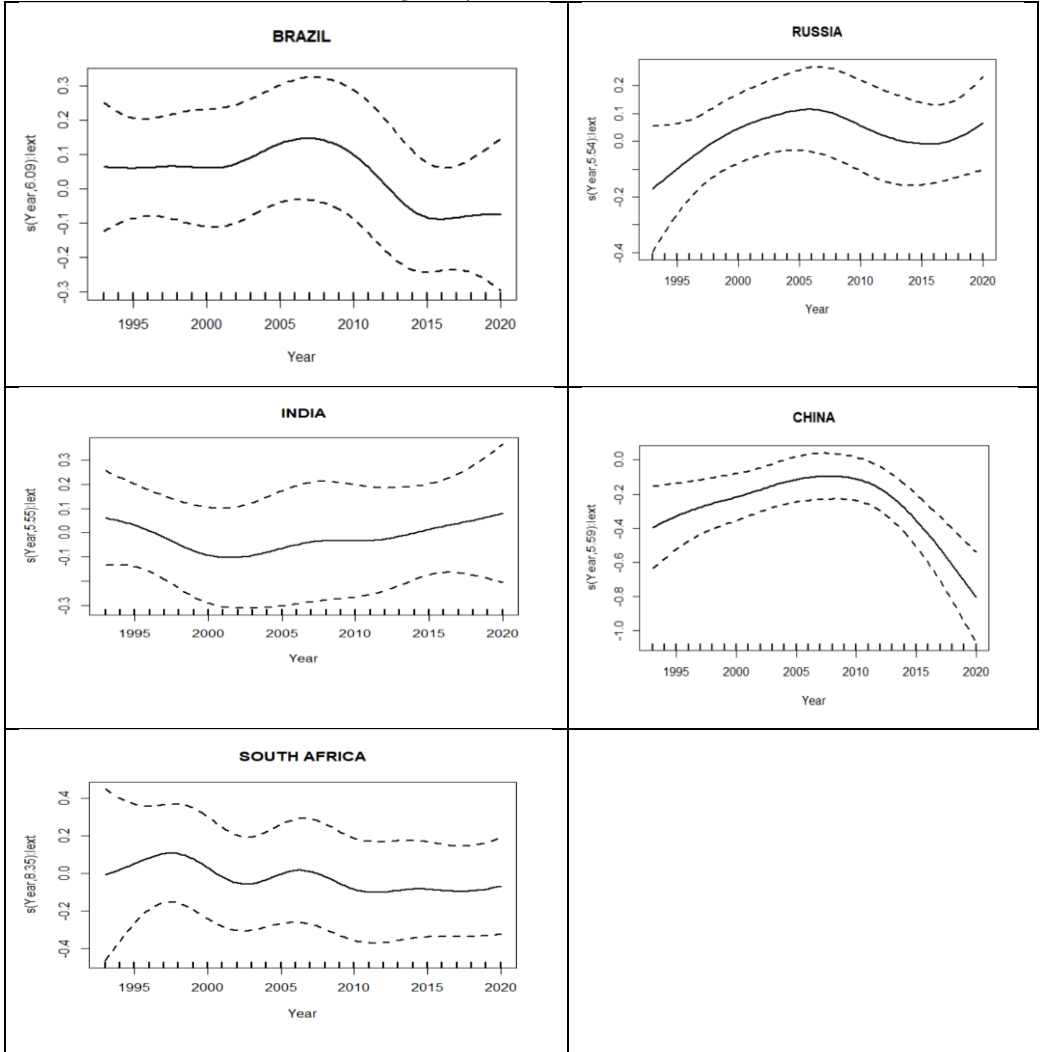
The variable of interest is the lagged external debt-GDP ratio, ed_{it-1} . The parameter associated with this variable is positive and statistically significant at 1 percent level only in China. Interestingly, the magnitude of this coefficient is larger in China, indicating that China's external debt is sustainable. In all other countries, the coefficient is either negative or not statistically significant, and therefore the paths of external debt policies of Brazil, Russia, South Africa and India are unsustainable.

Interestingly, the estimated degrees of freedom, edf , of $sm(t)$ term is statistically significant at 1 percent level in all BRICS nations, meaning that the reaction coefficients of all these BRICS countries have not stayed constant over time. Chart 3 presents the time path of the smooth terms of the respective BRICS countries. It can be observed that the reaction of the primary surplus to external debt had continuously increased till 2007 and started declining but again rose in 2016 in both Brazil and Russia. In the case of India, it decreased till the 2000s and then started to increase except for the period 2010 to 2015. For China, it continuously increased till 2010. After that, it continuously declined. For South Africa, it declined continuously with some minor fluctuations.

SUMMARY AND CONCLUSION

This study has analysed the public debt (and external debt) policies of BRICS nations using the latest data from 1993 to 2020 and the p-spline estimation technique. The results indicate that the government improved the primary balance in the current year as a response to the increased debt to GDP ratio of last year in China and South Africa. Therefore, the public debt path is sustainable for these two BRICS nations. However, in Brazil, Russia and India, the public debt is unsustainable. The debt overhang in these nations could hinder fiscal adjustment, exacerbate fiscal risks, and raise risk-premia, thereby perpetuating a vicious cycle of increasing rates, further deteriorating growth outlook (RBI, 2021). Therefore, these three nations-India, Russia and Brazil need to improve their debt positions such that their public debt becomes sustainable. They should use the borrowed amounts primarily for investment purposes and attempt to show a primary surplus in their budget. If they follow this policy strategy, it will certainly be a major step towards the consolidation of government finances of these nations.

Chart 3: Deviation $sm(t)$ from its Average Coefficient of External Debt (ed_{t-1}) for BRICS Countries



The results imply that the external debt policy of China is sustainable. However, the paths of external debt policies of Brazil, Russia, India and South Africa are not sustainable. In both debt and external debt analyses, the reaction coefficients of all the BRICS

countries have not stayed constant over time. That is, the reaction function in non-linear and reaction coefficient is time-varying in all BRICS nations.

A comparison of our results with past results of studies reveals that Brazil's unsustainable debt result is consistent with Campos and Cysne (2019)'s results for the period 2003 to 2006. India's unsustainable debt results also consistent with Tiwari (2012)'s results from 1970 to 2009. Our findings that China's debt and external debt policies are sustainable are consistent with Lixin (2019). While our study shows that the debt policy of South Africa is sustainable, Redda (2020) showed that from 2000 to 2018 the public debt was not sustainable in South Africa. But Redda study uses a different methodology.

To our knowledge, this is the first empirical study to analyse the public debt and external debt sustainability aspects of all five BRICS nations using the Bohn model framework and p-spline estimation method. Nevertheless, the study is not free from limitations. Firstly, the study is faced with data constraints and hence it has not dealt with interactions of some of the important institutional and political factors. Secondly, the solvency condition (no-Ponzi condition) was not analysed in the study. Despite these limitations, we hope that the results of the study are useful to policymakers, academicians and other stakeholders in taking appropriate measures to improve the debt situation of BRICS nations.

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