Sustainable Debt Policies of Indian State Governments

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Abstract

This article empirically tests whether the public debt is sustainable in 20 major Indian States during 2005-06 to 2014-15, using the Bohn framework for panel data and penalized spline techniques. Results of the study indicate that the debt of Indian State governments as a whole is sustainable. However, at the disaggregated level, the public debt is sustainable in only 12 States and in the remaining 8 States, it is unsustainable and they need corrective actions. Incidentally, in these 8 States, the debt growth is lower than the economic growth and the poverty ratio has come down significantly, indicating that they have seemed to use their debt policy to enhance the welfare of their citizens. We hope these results are useful to policy makers, international agencies and other stakeholders to take appropriate steps to sustain the debt of Indian States

Acknowledgement

INTRODUCTION

After the seminal contribution of Hamilton and Flavin (1986), a large number of empirical studies have emerged in the economic literature on *"Sustainable Public Debt"*. Subsequently, three main empirical approaches have been evolved over time and dominated over the traditional indicator approach. They are: (i) *Unit Root approach* (Trehan and Walsh 1991; Caparole 1995; Uctum *et. al.* 2000), (ii) *Co-integration approach* (Hakkio and Rush 1991; Jha and Sharma 2004 and (iii) *Bohn's model-based approach* (Bohn 1998, 2005; Abiad and Ostry 2005; Greiner and Fincke 2009).

These approaches utilize different empirical conditions for debt sustainability. The required condition in the Unit Root approach is that the debt series needs to be a mean reverting process. In the Cointegration approach, the public revenue and the public expenditure series need to be cointegrated. The Bohn approach suggests that the primary surplus relative to GDP is a positive and at least linearly rising function of the public debt-GDP ratio. The economic intuition behind the Bohn approach is that if governments run into debt today, they have to take corrective actions in the future by increasing their primary surplus. Otherwise, the public debt will not be sustainable (Greiner and Fincke 2009). Thus, the Bohn's approach basically looks at whether the government undertakes corrective action in response to an increase in its public debt-GDP ratio or not.

Many studies have adopted the Bohn model and its extended versions to verify empirically whether public debt policies in different countries are sustainable or not (Abiad and Ostry, 2005; Haber and Neck

2006; Greiner and Kauermann 2008; Fincke and Greiner 2011; Mahdavi 2012; Kaur *et. al.* 2014).[1]

While the debt sustainability issue is relevant for national governments, it is equally essential for sub-national governments. In India, both the national and the sub-national governments (States) borrow in order to finance their deficit and so the debt sustainability is imperative for both type of governments. While the debt sustainability analysis received a critical importance in India in the late eighties due to the alarming growth of the combined (both Central and States) debt (almost 70 percent of GDP) and fiscal deficit (10 percent of GDP), the most of the earlier studies like Rangarajan *et. al.* (1989), Moorthy *et. al.* (2000), Patnaik *et. al.* (2003) etc. used the traditional indicators approach that basically uses the Domar condition.[2]

Studies like Buiter and Patel (1990), Pradhan (2014) etc. employed the Unit Root approach while Jha and Sharma (2004) and Tronzono (2013) used the Co-integration approach in the Indian context. However, a few studies such as Tiwari (2012), Kaur and Mukharjee (2012), Jose (2013) and Shastri and Sahrawat (2015) applied the Bohn framework.

A few studies have analyzed the debt sustainability issue at the state level too. However, the most of them have used the Domar framework (Dholakia *et. al.* 2004; Rajaraman *et. al.* 2005; Misra and Kundrakpam 2009 and Mourya 2015), except Kaur *et. al.* (2014) which has employed all three approaches including the Bohn framework (for panel data for 20 Indian States during 1980-81 to 2012-13). Kaur *et. al.* (2014) shows that on an average, the debt is sustainable at Indian States

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[1] Original Bohn model is of linear form and for time series data. The extended versions include non linear specifications, inclusion other determinants to take account of tax smoothing hypothesis (which states that primary deficit should be used to smooth out variations in expenditures and revenues), panel data context etc

[2] The debt or deficit won't be sustainable in the long run unless the growth rate of GDP exceeds the effective interest rate on public debt given zero primary deficit (Domar, 1944).

as a whole. But the question remains is: whether the debt is sustainable in each Indian State or not as the aggregate picture may hide the individual specific status? Therefore, this study is an attempt to utilize the Bohn framework and panel data methodology to test whether the public debt is sustainable in 20 major Indian States during 2004-05 to 2014-15.

It also uses the penalized spline estimation (p-spline) procedure to estimate the time varying coefficients or reaction coefficients which show how coefficients associated with the debt-GDP ratio evolve over time across States. This study also tests whether the public debt is sustainable in each of 20 major Indian States using debt ratio-state dummy interaction terms in the panel data Bohn framework. The State specific result of this exercise is useful to provide the State-specific policy suggestions on whether a given debt policy can go on or whether it needs to be changed.

Further, it analyzes descriptively the welfare effect of debt policy by relating the growth rates of the economy and the debt and the poverty reduction rates of the Indian States, as studies like Greiner and Fincke (2009) Ghosh (1998) etc. show that higher debt leads to higher welfare. That is, the debt is welfare enhancing. Greiner and Fincke (2009) using simulation technique show that a scenario where the public debt grows at the same rate as the output yields smaller growth and the welfare in the long run compared to the scenario where the debt grows but less than the output. That is scenario where the debt grows but less than the output leads to higher welfare than the balanced budget scenario.

Thus this study differs from past studies in the following aspects: (i) This is the first study using the Bohn framework to test the sustainability of debt in each of 20 major Indian States, and shows that in 12 out of 20 major Indian States, the debt is sustainable; (ii) this is the first study employs the penalized spline estimation procedure in the panel data modeling and for Indian States to show that the reaction coefficient

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has not stayed constant across States and years, but varying across States and time; and (iii) this study relates the growth rates of the economy and the debt and the poverty reduction to show that States that are not sustainable seem to use their debt policies to improve the welfare of their citizens.

Rest of this is study organized as follows: A brief note on public debt scenario in India, a brief review of literature relating to the research topic, discussion on data, model and estimation, results of data analysis, and, finally, conclusion and policy implications drawn from the empirical analysis.

INDIAN PUBLIC DEBT SCENARIO

Indian Constitution (1950) has provided for a two- tier system of governments- Centre and States. It has also provided for a separate tax powers and the expenditure functions to these two layers of governments. As all mobile and buoyant taxes are assigned to the Centre, the States generate their own revenues from restricted tax, nontax and non-debt capital receipts to meet their expenditure commitments. Recognizing this vertical imbalance, the Indian Constitution has already facilitated the transfer mechanisms which transfer resources from the Centre to the States in the form of tax devolution, grant-in aid and centrally sponsored schemes (Rao 2005).

In addition, both Centre and States are allowed to borrow if their revenues are not enough to meet their growing expenditure needs. The Centre in general borrows from internal as well as external sources[3] while the States debt indicates market loans and bonds, ways and means

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[3] Internal debt of the Central Government consists of fixed market borrowings, *viz.*, dated securities and Treasury Bills, 14-Day Intermediate T-Bills, securities against small savings, securities issued to international financial institutions, compensation and other bonds and special securities issued against Post Office Life Insurance Fund (POLIF). External debt is from multilateral agencies such as IDA, IBRD, ADB, *etc*. and small proportion of external debt originates from official bilateral agencies.

advances from RBI, loans from banks and other institutions, provident funds etc. The States can also borrow from external sources subject to ceiling and approval from the Centre. Thus the debt means the deficit budgeting of the government.

There are three broad deficit indicators used in India, namely, the revenue deficit (excess of revenue expenditures over revenue receipts), the fiscal deficit (primary deficit + interest payments = net borrowing) and the primary deficit (the excess of residual non-interest expenditures over total non-debt receipts). Since the State governments have constraints over borrowing sources, they face an inconsistency between the borrowing requirements and the debt servicing. On the other side, the annual borrowing requirements of the governments lie in the interest obligations on the accumulated debt. The extent of these commitments in every year is the reflection of the primary balance.

As a subset of the fiscal balance, the primary balance indicates the amount of government borrowings that are required to meet the expenses other than the interest payments (Primary deficit) or the pressure of the government on the interest commitments on previous borrowings to borrow (Primary surplus). Therefore, the primary balance is the root cause of all types of deficit and it improves or worsens as a result of the variations in the total debt requirements (Jose 2013).

There are two motivations for why governments use fiscal stimuli often financed by the excess borrowing, to expand their activities above the trend levels. The first is to play a countercyclical role to minimize the impact or the volatility of the cyclicality of growth while the second motive derives from the government's expansionary intervention for political motive. That is, the first is a response to the economic cycles and the second is a cause of political cycle driven by timing of elections (Srivastava 2012).

Trends in the primary deficit relative to GDP and the public debt relative to GDP since independence shown in many past studies indicate the cyclical nature of the former and the secular upward nature of the later (Rangarajan and Srivastava 2005; Srivastava 2012). Since the second half of 1990s, there has been a sharp deterioration of in the debt-deficit situation, both at the Centre and at the State level. With a view to bringing the debt in sustainable levels, the exogenous controls like fiscal responsibility legislation were brought in.[4] These efforts have some initial success. [5]

Due to the global economic slowdown (in 2007-08), the situation again worsened. These trends in the primary balance and the total liabilities of the States (aggregate), the Centre and the Combined (States and Centre together) relative to GDP since 2004-05 are shown in Table 1. Initially, there was a minimal combined primary deficit. Then, it became a surplus in 2006-07 and 2007-08 in both Centre and States mainly because of the effect of FRBM Act. The situation worsened after the global crisis. The combined primary deificit reached an alarming 4.53 percent level in 2009-10. Of these, the Cenre's primary deficit alone was 3.17 percent. In order to bring down the defict, the fiscal consolidation measures were adopted at all levels of governments. While the Centre's deficit started declinig but at a very slow pace, the States' deficit decilned to 0.36 percent in 2011-12, but again started increasing to 0.79 percent in 2015-16.

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[4] The Fiscal Responsibility and Budget Management (FRBM) Act was first enacted by Karnataka in 2002 followed by Kerala, Punjab, Tamil Nadu in 2003 and Utter Pradesh in 2004. In 2005, Andhra Pradesh, Assam, Chhattisgarh Gujarat, Haryana, Himachal Pradesh, Maharashtra, Madhya Pradesh, Odisha, Rajasthan and Uttarakhand adopted the FRBM rule. Bihar, Jammu and Kashmir and Jharkhand legislated the FRBM in 2006, 2006 & 2007 respectively and West Bengal in 2010.

[5] The implementation of the Golden Rule (UK) has still remained as a dream in the Indian context which envisages the generation of enough primary revenue to service their debt followed by no primary deficit and the fiscal deficit will be comprised to only public investment, i.e., zero primary deficit is the primary and necessary condition for achieving the golden rule.

Table 1: Centre, States and Combined Primary Balance and Publc Debt Ratios in India

Year	Primary Balance-GDP Ratio			Public Debt-GDP Ratio		
	Centre	States	Combined	Centre	States	Combined
2004-05	0.04	-0.52	-1.25	61.5	26.30	87.90
2005-06	-0.37	0.03	-0.83	61.2	26.80	88.00
2006-07	0.18	0.36	0.29	59.11	25.49	84.60
2007-08	0.88	0.39	1.00	56.90	23.73	80.62
2008-09	-2.57	-0.53	-3.24	56.11	23.56	79.67
2009-10	-3.17	-1.22	-4.53	54.49	23.24	77.73
2010-11	-1.79	-0.39	-2.29	50.6	21.64	72.24
2011-12	-2.78	-0.36	-3.26	51.71	21.18	72.89
2012-13	-1.78	-0.45	-2.27	50.95	20.76	71.71
2013-14	-1.14	-0.71	-1.92	50.30	20.63	70.93
2014-15*	-0.80	-1.34	-2.21	49.62	20.77	70.39
2015-16#	-0.71	-0.79	-1.43	48.73	20.78	69.51

Source (Basic data): Indian Public Finance Statistics (various years); * and # are revised and budget estimates respectively; (-) represents primary deficit and (+) represents primary surplus' Up to 2010-11, GDP at market prices (2004-05 series) and then GDP at market prices (2011-12 series) are used.

The combined debt ratio of the Centre and the States contiuously declined as a result of consolidation measures from about 88 percent in 2004-05 to about 70 percent in 2015-16. The Centre's debt ratio was 48.73 percent and States' ratio was 20.78 percent in 2015-16. Thus, still the debt figures seem unfavourable to the fiscal health of both layers of governments.

Figure 1 shows the trends in primary balance and the debt ratios for major Indian States during 2004-05 to 2014-15. In 2004-05, Madhya Pradesh (-2.51 percent), Maharashtra (-2.32 percent) and Jammu and Kashmir (-2.06 percent) had a huge primary defict-GSDP ratio, while Uttarakhand (5.5 percent), Bihar (2.87 percent) and Odisha (2.53 percent) had a primary surplus. In 2014-15, the situation deteriorated in 14 out of 20 major Indian States. While the debt-GSDP figures also declined in all major States in 2014-15, it was more than 25 percent in

seven states. In Jammu and Kashmir (54.94 percent), Himachal Pradesh (41.93 percent) and West Bangal (34.66 percent) it was too high. If this trend continues in future, many States will undergo some adverse effects. The proposed Seventh Pay Commission recommendations and rolling out of GST from mid of 2017 will add fuel to the debt positions of State governments, which will in turn raise the question on the debt sustainability at the Indian States.

Figure 1: Debt-deficit Profile of Major State Governments in India (2004-05 to 2014-15)

Source : Author's construction

BRIEF REVIEW OF LITERATURE

There is no consensus among economist either in analytical grounds or on the basis of empirical results that financing by incurring the fiscal deficit is good or bad or neutral (Rangarajan and Srivastava 2005). Among the three mainstream analytical/theoretical perspectives, the neo-classical view considers that the fiscal deficit is detrimental to the investment and the economic growth while the Keynesian view considers a growth stimulated effect. In addition the Keynesian view states that the public debt does not pose a problem if the governments run into debt in the home country. This holds because no resources are lost and the public deficits just imply a reallocation of resources from the tax payers to the bond holders (Greiner and Fincke 2009).

The Ricardian equivalence theorem asserts that the fiscal deficit does not really matter except for smoothing the adjustment to the expenditure or the revenue shocks. According to this theorem, the budget deficits today require higher taxes in the future when a government cut 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 in order to meet their future tax burden. This theorem is based on the intertemporal budget constraint of the government and on the permanent income hypothesis. The first principle states that the public debt must be sustainable in the sense that the outstanding debt today must be equal to the present value of the future government 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.

Empirical studies also differ in supporting these different views. Since the Keynesian view was dominating in 1970s, the public debt rose

considerably over the period in many countries. Further the rising public debt often was even larger than the GDP growth in many countries so that the ratio of public debt to GDP increased, too. This evolution raised the question of whether the time path of public debt is sustainable.[6] A large number of studies emerged to address this question starting with the seminal paper by Hamilton and Flavin (1986).

Prior to this, earlier studies mostly employed the Domar (1944) condition. According to Domar, three conditions emerge from the basic debt accumulation equation:

$$d_t = p_t + d_{t-1}[(1 + i_t)/(1 + g_t)] \tag{1}$$

where, d_t is the debt-GDP ratio in period t; g is the nominal economic growth rate; i is the nominal interest rate; and p_t is the primary deficit relative to GDP in period t and the conditions are $g_t = i_t$, $g_t < i_t$ and $g_t > i_t$. The fiscal policy is unsustainable when are $g_t = i_t$ or $g_t < i_t$, because d_t grows linearly when $g_t = i_t$ and explosively when $g_t < i_t$. The debt is sustainable when $g_t > i_t$. The last one is considered as the necessary condition for sustainability based on the instinct that faster the income grows the lighter will be the burden of debt.

This approach has been extended by adding various indicators (which reflect growth, liquidity, credit worthiness, fiscal burden, fiscal space etc) and renamed as the "Indicator approach" (Blanchard *et. al.* 1990; Patnaik *et. al.* 2003; Dholakya *et. al.* 2004; Rajaraman *et. al.* 2005; Mishra and Kundrakpam 2009; Kaur and Mukharjee 2012; Kaur *et. al.* 2014; Mourya 2015). As this approach considers the conditions year by year and does not sufficient enough to validate whether the inter-temporal budget of the government is satisfied or not, many economists

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[6] The debt sustainability is given as long as debt is not accumulate at a rate considerably exceeding the government's capacity to service it in the absence of policy adjustment, negotiating or defaulting (IMF,2011) and if not it can lead to major disruptions in economic activity and reorientation of priorities in an economy.

started thinking about the econometric or the statistical validation to substantiate the sustainability conditions.

Hamilton and Flavin (1986) was the first study using the unit root test to check whether the public debt series (D_t) in USA is stationary or not, followed by Trehan and Walsh (1991). They use the Augmented Dickey Fuller (ADF) statistics to test the hypothesis that the given series is non stationary (H_0) against the alternative hypothesis that it is stationary(H_a) by estimating the following equation:

$$\Delta D_t = \alpha + \beta t + \pi D_{t-1} + \sum \gamma_j \Delta D_{t-j} + \epsilon_t \qquad (2)$$

Another test used by Trehan and Walsh (1991) is to analyse whether a quassi-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 the public debt and the primary surpluses (S_t) are cointegrated. If the government debt is quasi-difference stationary and the public debt and the primary surpluses are cointegrated, then the public debt is sustainable (Greiner and Fincke 2009). See Afonso (2005) for a brief survey of studies employing these procedures[7].

Many studies have raised doubts on these two approaches and highlighted their limitation as: (i) the unit root test is very sensitive to the structural breaks and the results could be misleading (Uctum *et. al.* 2006), (ii) it is very difficult to reject a unit root in real debt or in debt to GDP ratio (iii) the rejection of sustainability based on these two test are invalid because the Inter-temporal Budget Condition (IBC) may well be satisfied even if the components of the budget are not co-integrated and

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[7] One can also assess the sustainability by seeing co-integratiing relationship between public revenues (R_t) and expenditure (Exp_t) in the following equation; $R_t = \alpha + \beta\, Exp_t + \nu_t$ (Hakkio and Rush 1991; Jha and Sharma 2004 ; Afonso *et. al.* 2005 and Payne *et. al.* 2008), where R and Exp are I(1) while v is I(0).

even if debts or deficit, revenues or spending are difference stationary (Bohn 2007).

The IBC is $d_t^* = \sum_{j=1}^{\infty} \frac{1}{(1+r)^j} E_t \left[s_{t+j} \right]$, i. e, Where $d_t^* = (1+ r_t). \, d_{t-1}$ is the stock of the debt-output ratio in the beginning of period t, $E_t \left[. \right]$ 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 the public debt asymptotically converges to zero, and the interest rate r that is, resorted to in order to discount the stream of public debt, and plays an important role. Thus, both the unit root and the cointegration tests are independent of the interest rate.

Bohn (1998) proposed another test. His model based approach uses the debt sustainability equation (3) to test whether the primary surplus to GDP (s_t) is a positive and at least a linearly rising function of the debt to GDP ratio (d_t):

$$s_t = \alpha_0 + \alpha_1 \, d_t + \varepsilon_t \tag{3}$$

If this property holds, the debt is sustainable. That is, if $\alpha_1 > 0$ and statistically significant, the debt is sustainable. Bohn (1998) utilizes Barro (1979)'s tax smoothening hypothesis according to which the public deficits should be used in order to keep the tax rates constant which minimizes the excess burden of taxation. Hence, normal expenditures should be financed by regular revenues and the deficits should be incurred to finance the unexpected spending. He derives the following fiscal rule or reaction function:

$$s_t = \alpha_0 + \alpha_1 \, d_t + \phi_1 yvar_t + \phi_2 gvar_t + \varepsilon_t \tag{4}$$

where $yvar$ and $gvar$ are business cycle indicators. $yvar$ accounts for fluctuations in revenues and it gives 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. $gvar$ gives

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).

As the relationship may not be linear and in order to bring this, the above Bohn model is modified as:

$$s_t = \alpha_0 + \alpha_{1t}\, d_t + \phi_1 yvar_t + \phi_2 gvar_t + \varepsilon_t \tag{5}$$

where the reaction coefficient α_1 is time-varying. It is noticed that any non-linear model can be approximated by a linear model with time-varying coefficients. The approximation is good if it changes smoothly. So the empirical estimation resorts to the splines (a type of smoothing technique that allows to analyze the data in a more flexible way).[8] The functional form or smoothness is shaped by the deviation on individual points (i.e., changing points which are termed as knots). The penalized spline estimation technique is used to estimate the equation (5). To avoid the endogeneity issue, d_t is replaced with d_{t-1}. α_1 is average coefficient and the actual coefficient is the sum of α_1 and the deviation which is given by the smooth function, sm(t). If α_1 is positive, there is an indication of debt sustainability and the time varying values indicate change in the response coefficient over the years.

Bohn (1998) is pioneering one capturing the significance of reaction by analyzing the behavior of US public debt and deficit (using the OLS procedure). Among the other studies Abiad and Ostry (2005) extended the basic Bohn framework by adding the extra determinants of primary balance ratio and the panel data of 31 emerging market countries during 1990 to 2002. They used the panel random effects procedure including the spline for debt at a threshold of 50 percent of GDP. Haber and Neck (2006) investigated the sustainability of Austrian fiscal policy from a political economy perspective by incorporating certain

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[8] See Rupert *et. al.* (2003) and Greiner and Fincke (2009) for more details on spline estimation procedure.

political variables. Greiner and Kauermann (2008) incorporated the time varying parameters in the regression (i.e., spline technique) for the European context. Later many studies have used this procedure to analyze the debt sustainability issues of various countries, See Fincke and Greiner (2011) for a review of these studies.

In the Indian context, Kaur and Mukharjee (2012) estimated the fiscal policy response function[9] (as in equation 4) using the OLS procedure and found the evidence of the positive response of the primary surplus ratio to increasing debt ratio for combined (Centre and State together) data during 1980-81 to 2012-13. By employing the Central government's primary balance and the public debt data for the period 1983-2010 and OLS procedure, Jose (2013) generated a similar result. Shasthri and Sherawat (2015) used the unit root approach, the cointegration approach and the Bohn's model based approach (estimated by ARDL method) and found that the Central government's revenue and expenditure are not co-integrated and reported the absence of long run relationship between the primary surplus and the debt ratios. Tiwari (2012) is the only study employing the Bohn framework with spline methodology for the national level (combined) data during 1970 to 2009, but unable to find a clear cut evidence on the sustainability of public debt.

A few studies have analyzed the debt sustainability at the sub-national level. For instances, Finke and Greiner (2011) used the Bohn framework and the spline technique to test the debt sustainability of each State in Germany. Employing a panel version (fixed effects model) of Bohn framework, Mahadavi (2012) analyzed the debt sustainability position of 48 American States from 1961 to 2008 and found that the debt is sustainable. Kaur et al (2014) used all three empirical models viz, the stationarity (panel unit root), the co-integration (panel co-integration) and the Bohn model (Random effects model) for the panel of 20 major

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[9] Bohn's approach is often referred as fiscal reaction function/ fiscal policy response function approach since it captures the reaction coefficient.

Indian states during 1980-81 to 2012-13 and find the evidence of sustainability of aggregate debt position in the long run. Table 2 provides the summary results of a few but selective studies on the topic. It is noticed that none of the existing studies so far in the Indian context use the Bohn model to test the sustainability at individual Sstate level. This is the gap in the literature and the present study is an attempt to fill this gap.

Table 2: Summary Results of Important (Selective) Studies on Debt Sustainability

Study	Country	Data Period	Variables/ methodology	Debt is Sustainable or not?
(i)Unit root approach				
Hamilton and Flavin (1986)	USA	Annual; 1992-84	Public Debt, Deficit	Sustainable
Trehan and Walsh (1991)	USA	Annual; 1890-1983	Deficit, Public Debt	Sustainable
Caparole (1995)	EU countries	Semi-annual and Annual; 1960-91	Deficit, Public Debt	Not
(ii) Co-integration approach				
Hukkio and Rush (1991)	US	Quarterly; 1950:II to1988:IV	Revenue and expenditure	Not
Payne *et. al.* (2008)	Turkey	Annual; 1990-08	Revenue and expenditure	Not
Tronzono (2013)	India	Annual; 1950-2010	Revenue and expenditure	Weakly sustainable
Kaur *et. al.* (2014)	20 Indian States	Annual; 1980-13	Revenue, Expenditure and Debt (Panel test)	Sustainable
(iii) Bohn model				
Bohn (1998)	US	Annual; 1916-95	OLS	Sustainable

Study	Country	Data Period	Variables/ methodology	Debt is Sustainable or not?
Haber and Neck (2006)	Austria	Annual; 1962-0	OLS	Sustainable
Doi et al (2011)	Japan	Quarterly (1980:I to 2010:I)	Markov-Switching model	Not
Shastri and Sahrawat (2015)	India	Annual; 1980-13	OLS	Not
Greiner and Kauerman (2008)	Germany and Italy	1960-03 and 1975-03	p-spline	Sustainable (Only Germany)
Fincke and Greiner (2011)	Euro Countries	Annual; 1971-09	p-spline	Sustainable (Except Greece and Italy)
Tiwari (2012)	India	Annual; 1970-09	p-spline	Not
Abiad and Ostry (2005)	31Emerging countries	Annual; 1990-02	Panel GLS, Arellano Bond	Sustainable
Adams et al (2010)	33 Asian Countries	Annual; 1990-08	Panel GLS	Sustainable
Mahdavi (2014)	48 US States	Annual; 1961-08	Panel FE	Sustainable
Kaur *et. al.* (2014)	20 Indian States	Annual; 1980-13	Panel FE	Sustainable

Source : Author's construction

MODEL, DATA AND ESTIMATION

In order to test the sustainability of public debt in the Indian States, this study employs the following extended version of Bohn framework for panel data:

$$s_{it} = \phi_0 + \psi\, d_{it-1} + \phi_1 yvar_{it} + \phi_2 gvar_{it} + \lambda_i + \mu_t + \epsilon_{it} \qquad (6)$$

where s_{it} primary surplus- GSDP ratio for i^{th} State in t^{th} time period, d_{it-1} is the debt- GSDP ratio for i^{th} State in t-1th period, $yvar_{it}$ and $gvar_{it}$ are business cycle variables to account for fluctuations in the GSDP and the primary spending respectively. They are calculated by subtracting the long term trend of GSDP (real) from its realized values and the long term trend of primary government spending (real) from its realized values. The long term trends of respective variables are computed using the Hodrick-Prescott (HP) filter to the real GSDP and the real primary expenditure series. λ_i and μ_t are individual (States) effects and time effects (year) respectively. It is noticed that the lagged debt ratio is used to take into account the endogeinity issue. If $\psi > 0$ and statistically significant, then the debt is sustainable.

The equation (6) can be estimated using the standard panel data methodologies: Fixed effects (FE) and Random Effects (RE). The former posits that the unobserved heterogeneity factors, λ_i and the time effects, μ_t are correlated with other X variables in the equation while the latter assumes that they are not. The choice of the relevant model depends on the Hausman statistics. If it support for FEs model, then the OLS is used to estimate equation (5) by incorporating λ_i and μ_t with State and year dummies. If the time dummies are jointly zero, then the model is one way FE model. If the Hausman supports for the RE model, then the GLS procedure is used to estimate the equation.

In order to estimate the time varying (and State-specific) estimates, this study also uses the penalized spline (P-spline) estimation. This allows to estimate the reaction coefficient ψ as a function of time showing how that coefficients evolve over time and across States. The study uses the following "within-estimation" specification to employ the p-spline estimation:

$$s_{it} - \overline{s_i} = \psi(it)\,(d_{it} - \bar{d_i}) + \emptyset_1\,(yvar_{it} - \overline{yvar_i}) + \emptyset_2\,(gvar_{it} - \overline{gvar_i}) + \in_{it} \quad (7)$$

where $s_{it} - \overline{s_i}$ is the difference of primary surplus - GSDP ratio of each State i in year t from its mean value for State i. Mean differences of d_{it-1}, $yvar$ and $gvar$ of each State also constructed using similar procedure. It is noticed that the within estimation wipes out the individual (and time) effects. Both these procedures would reveal whether the debt is sustainable or not for the Indian States as a whole. However, the within model which is estimating using the p-spline method would reveal in addition how the debt ratio coefficients evolve over time and across States. That is, ψ (it) is both state-specific and time-specific. If this reaction function is positive and significant, the debt is sustainable at the Indian States as a whole.

To check whether the debt is sustainable in each sample State, we allow d_{it-1} to interact with each of the State dummies (K_i) in Equation (6) to get:

$$s_{it} = \phi_0 + \sum_i \psi_i K_i * d_{it-1} + \phi_1 yvar_{it} + \phi_2 gvar_{it} + \lambda_i + \mu_t + \epsilon_{it} \qquad (8)$$

In Equation (8), the coefficients associated these interaction terms (ψs) would directly reveal whether the debt is sustainable in each Indian State.

To estimate the above equations, the study uses the data compiled from various secondary sources for 20 major Indian States: Andhra Pradesh, Assam, Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal. The State-wise GSDP (real and nominal) are compiled from the Central Statistical Organization, Ministry of Statistics and Programme Implementation (MOSPI), Government of India website (http://www.mospi.gov.in/data) and all other fiscal

variables from Comptroller and Auditor General (CAG) of India Audit reports and finance Accounts of the various State governments for the period 2004-05 to 2014-15. Since the lagged debt ratio is included, the total observations included in the final analyses are: 200 (20 States x 10 years). Table 3 presents the descriptive statistics of the study variables.

Table 3: Descriptive Statistics of the Study Variables (2005-06 to 2014-15)

Definition	Variables	Mean	Standard Deviation
Primary Balance (Rs. Crores)	S_{it}	-1816.935	3655.00
Primary Balance to GSDP Ratio (%)	s_{it}	-0.368	1.499
Public Debt (Rs. Crores)	D_{it}	86994.310	69678.10
Debt to GSDP Ratio (%)	d_{it}	30.516	10.95
Nominal GSDP (Rs. Crores)	$ngsdp_{it}$	318935.200	282519.60
Real GSDP(Rs. Crores)	$rgsdp_{it}$	211169.60	171379.60
Real GSDP Gap (Rs. Crores)	$yvar_{it}$	0.0005	4105.348
Primary Expenditure (Rs. Crores)	pe_{it}	46951.610	37050.41
Real Primary Expenditure (Rs. Crores)	rpe_{it}	30841.670	21258.50
Real Primary Expenditure Gap (Rs. Crores)	$gvar_{it}$	0.00002	1626.539

Source (Basic Data): CSO and CAG Reports (Computed by authors).

Table 4 shows the panel unit root tests using Levin, Lin and Chu (LLC) hypothesis and Im, Perresan and Shin (IPS) results. Both tests results confirm that all the variables used in the study are stationary i.e., they are I(0).

Table 4: Results of Panel Unit Root Tests

Variables	LLC t statistics	IPS w statistics
s_{it}	-14.966*	-2.353 *
d_{it}	-5.364*	-3.374*
$yvar_{it}$	-7.934*	-2.549*
$gvar_{it}$	-7.392*	-3.099*

Note: * and ** indicate the rejection of the null hypothesis of panels contain unit roots (non-stationarity) at 1 per cent and 5 per cent levels of significance, respectively; LLC -Levin, Lin and Chu test ;IPS- Im, Peseran and Shin test.

EMPIRICAL RESULTS

Bohn's Sustainability Analysis Results

Table 5 presents the estimation results of equation 6 (Model1). The Chow test and the Hausman statistics support the one way fixed effects (FE). The business cycle variable $yvar$ is positive as expected but not statistically significant even at 10 percent level. The primary expenditure gap variable $gvar$ has a negative coefficient and it is statistically significant at 1 percent level, implying that the primary spending above its normal value has reduced the primary surplus ratio. The variable of interest is d_{it-1}. Its coefficient is positive and statistically significant at 1 percent level, indicating the sustainability of public debt in Indian States as a whole.

Table 5: Panel Model Estimation Results of Bohn Framework for Indian States
(Dependent Variable: Primary Surplus to GSDP Ratio)

Variables	Model 1	Model 2
$yvar_{it}$	0.00002 (0.880)	0.00002 (0.830)
$gvar_{it}$	-0.0002 (-4.670)	-0.0002 (-4.690)
d_{it-1}	0.1195 (8.050)	-
$d_{it-1}\times$ Dummy for Andhra Pradesh (K_1)		0.0320 (0.360)

Variables	Model 1	Model 2
$d_{it-1}\times$ Dummy for Assam (K_2)		0.3698 (4.420)
$d_{it-1}\times$ Dummy for Bihar (K_3)		0.0577 (1.970)
$d_{it-1}\times$ Dummy for Chhattisgarh (K_4)		0.2213 (3.310)
$d_{it-1}\times$ Dummy for Gujarat (K_5)		0.0877 (0.940)
$d_{it-1}\times$ Dummy for Haryana (K_6)		0.5428 (4.660)
$d_{it-1}\times$ Dummy for Himachal Pradesh (K_7)		0.1648 (4.740)
$d_{it-1}\times$ Dummy for Jammu Kashmir (K_8)		0.2192 (1.790)
$d_{it-1}\times$ Dummy for Jharkhand (K_9)		0.2575 (2.100)
$d_{it-1}\times$ Dummy for Karnataka (K_{10})		-0.1634 (-0.960)
$d_{it-1}\times$ Dummy for Kerala (K_{11})		0.4052 (2.430)
$d_{it-1}\times$ Dummy for Madhya Pradesh (K_{12})		0.1111 (1.400)
$d_{it-1}\times$ Dummy for Maharashtra (K_{13})		-0.0239 (-0.350)
$d_{it-1}\times$ Dummy for Odisha (K_{14})		0.2516 (4.340)
$d_{it-1}\times$ Dummy for Punjab (K_{15})		0.1587 (2.890)
$d_{it-1}\times$ Dummy for Rajasthan (K_{16})		0.0634 (1.590)
$d_{it-1}\times$ Dummy for Tamil Nadu (K_{17})		0.3133 (1.880)
$d_{it-1}\times$ Dummy for Uttar Pradesh (K_{18})		0.0232 (0.470)
$d_{it-1}\times$ Dummy for Uttarakhand (K_{19})		0.1366 (2.540)
$d_{it-1}\times$ Dummy for West Bengal (K_{20})		0.0532 (0.740)
State Effects	Included	Included
Adjusted R^2	0.427	0.530
F Statistics	7.740	6.470
Hausman Statistics	52.600	47.040

Note: Estimated by authors; Total of observations (N):200; Figures in parenthesis are t values.

Penalized Spline Estimation Results

The panel within estimation results is given in Column (1) of Table 6 for a comparative purpose. These results are exactly the same as in FE model results shown in Model 1of table 6. The p-spline estimation results are shown in Column 2 of Table 6. The estimated parameter of interest

associated with debt ratio is $\psi(it)$ and it represents the mean of this coefficient and the smooth term sm(it) shows the deviation from that mean over the individual and the time varying coefficients. The results indicate that for the Indian States, the reaction coefficient has been positive on average and statistically significant at 1 percent level so that sustainability of public debt is achieved. The business cycle variable $yvar$ is not statistically significant even at 10 percent level as in Table 5. The coefficient for $gvar$ is negative and statistically significant at 1 percent level, implying that the public (primary) spending (real) above its normal value reduces the primary surplus ratio.
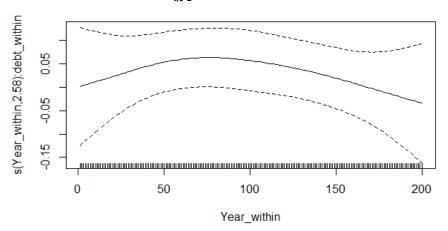
The estimated degrees of freedom, edf, of sm(it) provides information on possible time and State dependencies. As the estimated value of edf=2.52 and the smooth term sm(it) is significant at the 1 percent level, we may conclude that the reaction coefficient has not stayed constant across States and over time. Figure 2 shows the path of the smooth term, where the two stashed lines show the 95 percent confidence interval and the solid line shows the point estimates of the smooth term. The curve is drawn such that values larger (smaller) than zero indicate that the coefficient was above (below) its average value shown in Column 2 of Table 6. In the estimation the data are arranged such that the data for Andhra Pradesh come first, followed by Assam Bihar, Chhattisgarh, Gujarat, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Karnataka, Kerala, Madhya Pradesh, Maharashtra, Odisha, Punjab, Rajasthan, Tamil Nadu, Uttar Pradesh, Uttarakhand and West Bengal. It is noticed that in Figure 2, there are 200 points. The first 10 points are for Andhra Pradesh for the year 2005-06 to 2014-15. The points to 11-20 belong to Assam, points 21-30 to Bihar and so on. The actual reaction coefficient in State i in year t is the average coefficient (0.0927) plus the value of curve for that year for that State.

Table 6: Penalized Spline Estimation Results of Bohn Model for Indian States

Variables	Panel Within Estimation	Spline Estimation
	(1)	(2)
$d_{it-1} - \bar{d}_i$	0.1195 (8.050)	0.0927 (2.811)
$yvar_{it} - \overline{yvar}_i$	0.00002 (0.880)	0.00002 (0.948)
$gvar_{it} - \overline{gvar}_i$	-0.0002 (-4.670)	-0.0002 (-4.922)
sm(it)	-	edf: 2.577
ρ-value		0.0451
F Statistics	29.11	2.901
Adj-R^2	0.3304	0.333

Note: t value is given in the parentheses.

Figure 2: Deviation sm(it) from the Average Coefficient (Spline) for d$_{i,t-1}$ for Indian States

Debt Sustainability Results for Individual States

In order to check whether public debt is sustainable in each of the Indian States, we estimate the equation 8 by allowing d_{it-1} variable to interact with each of the State dummies. The Chow test and the Hausman

statistics support the one way fixed effects model. The estimated results are shown in Table 5 (Model2). As in Model1, $yvar$ is not statistically significant. $gvar$ has a negative and significant coefficient. The coefficient of the lagged debt to GSDP ratio and the state dummy interaction term is positive and statistically significant in the cases of Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Jharkhand, Kerala, Odisha, Punjab, and Uttarakhand. For these 10 States, the public debt is sustainable. In the cases of Jammu and Kashmir and Tamil Nadu the coefficient of debt-interaction term is positive but statistically significant only at 10 percent level implying that the debt is sustainable in these two States too. However, they are closer to the danger zone. For Andhra Pradesh, Gujarat, Madhya Pradesh, Rajasthan, Uttar Pradesh and West Bengal, the debt interaction coefficient is positive but not statistically significant even at 10 percent level. For Karnataka and Maharashtra the coefficient is negative but not significant. Therefore, the debt is not sustainable in these eight States and so they need to take corrective actions to make their debt sustainable.

Debt Sustainability and Welfare
In order to check whether higher debt in the above eight States led to higher welfare, we relate the growth rates of economy (nominal GSDP), the public debt (nominal) and the poverty reduction rates of these States (Table 7). The poverty reduction rate for each State is computed by subtracting the poverty ratio in 2011-12 from the poverty ratio in 2004 05 (available in Planning Commission's Expert Committee Report using Tendulkar methodology). The annual growth of debt/GSDP is computed using the compounding growth formula.

In all the eight States where the debt is unsustainable, we can observe that the growth rate of debt was less than the GSDP growth rate and the poverty reduction rate was higher. For instances, Andhra Pradesh, Rajasthan and Maharashtra have larger economic growth rate than their debt rate. At the same time, they have higher poverty ratio reduction rates too. As in Greiner and Finke (2009), higher debt can be welfare enhancing in these States.

Table 7: Growth Rates of Debt and GSDP and Poverty Reduction Rates of Indian States

States	Poverty Ratio (%)			Public Debt (Rs. Crore)			Nominal GSDP Growth
	2004-05	2011-12	Poverty Reduction Rate	2004-05	2014-15	Annual Growth	
Andhra Pradesh	29.9	9.2	20.7	74288	206243	0.11	0.16
Assam	34.4	32	2.4	17855	38,512	0.08	0.13
Bihar	54.4	33.7	20.7	42483	99055.8	0.09	0.18
Chhattisgarh	49.4	39.9	9.5	12,240	31181	0.10	0.16
Gujarat	31.8	16.6	15.2	71083	202313	0.11	0.15
Haryana	24.1	11.2	12.9	24,255	88,446	0.14	0.16
Himachal Pradesh	22.9	8.1	14.8	16,533	38,192	0.09	0.14
Jammu & Kashmir	13.2	10.3	2.9	14,199	48,304	0.13	0.12
Jharkhand	45.3	37	8.3	13,512	43569	0.12	0.13
Karnataka	33.4	20.9	12.5	46,940	164,279	0.13	0.15
Kerala	19.7	7.1	12.6	43,697	141,947	0.13	0.14
Madhya Pradesh	48.6	31.6	17	37525	108688	0.11	0.16
Maharashtra	38.1	17.4	20.7	121026	319746	0.10	0.15
Odisha	57.2	32.6	24.6	36093	50493	0.03	0.15
Punjab	20.9	8.3	12.6	47403	112366	0.09	0.14
Rajasthan	34.4	14.7	19.7	60134	147609	0.09	0.16
Tamil Nadu	28.9	11.3	17.6	55144	196589	0.14	0.16
Uttar Pradesh	40.9	29.4	11.5	131401	307,859	0.09	0.14
Uttarakhand	32.7	11.3	21.4	9910	33481	0.13	0.19
West Bengal	34.3	20	14.3	104334	277579	0.10	0.14

25

SUMMARY AND CONCLUSION

This study has analyzed empirically the debt sustainability issue of twenty major Indian States during 2005-06 to 2014-15 using extended Bohn sustainability framework for panel data. It has employed three estimation methods, namely (i) the panel FE model to test whether the debt is sustainable at the Indian States as a whole; (ii) the Panel FE including the debt-State dummy interaction term to test whether the debt is sustainable in each sample State; and (iii) the penalized spline method to obtain the State-specific and the time specific response effects of debt-ratio.

The results of the study indicate that the primary balance of the State governments in India reacts (responses) to high public debt as predicted in the Bohn framework. This means that the State policies during 2005-06 to 2014-15 were in general somewhat seem to be successful in sustaining the debt situation at the Indian States as a whole. However the situations differ in different (individual) States. Only in 12 out of 20 States namely Assam, Bihar, Chhattisgarh, Haryana, Himachal Pradesh, Jammu and Kashmir, Jharkhand, Kerala, Odisha, Punjab, Tamil Nadu and Uttarakhand, the public debt is sustainable. Remaining 8 States need to take corrective actions as their debt is unsustainable.

Interestingly, this study also shows that although the debt is not sustainable in eight States, they meet the condition that the rate of growth of debt is lower than the GSDP growth rate. As a result, they are successful in bringing down their poverty ratios. Thus, this study shows the evidence that States where the debt is unsustainable use their debt policy to enhance the welfare of their citizens. We hope these results are useful to policymakers, academicians and other interested agencies to take appropriate actions to improve the debt situation of Indian States where the debt is unsustainable.

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