Productive Public Expenditure and Debt Dynamics: An Error Correction Representation using Indian Data

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Productive Public Expenditure and Debt Dynamics: an Error Correction Representation using Indian data

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Abstract

The paper aims to explore the dynamics between components of public expenditure and public debt using an intertemporal optimization framework based on Turnovsky (2007). Public expenditure is classified as 'productive' and 'less-productive' based on the rationale that a proportion of the productive public expenditure (*phi*) corrects disequilibrium in the public debt in the long-run. The 'second-order' conditions resulting from the model demonstrate that as *phi* increases, the marginal social value of a unit of capital reduces. Thus, beyond its optimal level, an increase in *phi* could still affect public debt inversely; however, this will be at the cost of 'crowding out' of private investment. To test the theoretical representation and to analyse the relationship between public expenditure and debt, an empirical analysis using Indian Public Finance data (1980-2013) is carried out in this study. Time series methods are employed to test the hypothesis that capital expenditure of the government is productive public expenditure. The correlation, cointegration and ECM results show that real capital expenditure is cointegrated with real public debt of the Central and the General government. Additionally, in the long run, real capital expenditure adjusts to bring real public debt on a convergent path. The amount of disequilibrium corrected is 0.01 and 0.035 for the Central and the Consolidated General Government respectively. Key policy implications point towards a scope for increasing public capital expenditure in the Indian economy while complementing it with private investment stimulus to stabilize public debt in the long run.

JEL Classification: H63, E62, C61

Key words: Public Debt, Sustainability, Public Expenditure, Dynamic Optimization

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I. Introduction

Public debt sustainability is vital for both industrialized and emerging market countries alike. However, in emerging economies, the painful economic adjustments associated with a financial crisis that are aggravated by an unstable access to capital markets are an important incentive to keep public debt within sustainable grounds. One of the important methods to tackle this issue is to maintain fiscal balances in a way to offset the impact of transitory factors, thereby, preventing public debt from getting on to a divergent path. There is an abundance of literature on this issue, where tax based fiscal consolidation and its role in curtailing public debt is discussed. Furthermore, recent revival of interest in growth theory has led to deeper research on the link between public expenditure, growth and public debt (Alesina and Perotti 1999; Blanchard and Perotti, 1999; Giuliodori and Beetsma, 2004; Romer and Romer, 2007; Caldara and Kamps, 2008; Barrios, Langedijk and Pench 2010).

More specifically, on the issue of expenditure based fiscal consolidation, Devarajan, Swaroop, Zou (1996) made a seminal contribution through their paper which established a direct relationship between productive[1] components of public expenditure and growth. Based on a dynamic optimization framework, they demonstrated that until the level of 'optimal' productive expenditure is reached in the economy, it is worthwhile to increase the level of productive type expenditures in the economy. A number of other empirical studies that analysed the relationship between components of public expenditure and debt, as discussed in the forthcoming section, followed. However, as far as the author's knowledge goes, few attempts have been made to understand the direct link between components of public expenditure and debt so far.

This paper attempts to add to the existing body of literature by examining the relationship between components of public expenditure and public debt in an inter-temporal optimization framework. The aim of this theoretical exploration is to understand the dynamics of productive public expenditure with the level of public debt in light of the consumption and investment choices of the representative agent in the economy. To complement the theoretical analysis and to test the relationship between public debt and expenditure, an empirical exercise using Indian public finance data is performed. The key objective of the empirical analysis is to understand the dynamics between debt and public expenditure components using stationarity, cointegration and ECM modelling techniques in the context of a developing and emerging economy like India.

The remainder of the paper is organized as follows. Section 2 summarizes the extant theoretical and empirical literature on public expenditure, private investment, growth and debt. Section 3 presents the theoretical framework that has been formulated in the paper by discussing the

[1] Productive expenditures are those components of public expenditure which contribute to future growth of output, and do not only satisfy current needs (Devarajan, Swaroop, Zou 1999).

assumptions of the model, variables used, methodology, setting up of the framework, first and second order conditions followed by the implications. Section 4 deals with the empirical analysis of Indian Public Finance data. This part of the paper focuses on the reasons for choosing Indian data, the specific objectives of the empirical analysis, data sources, methodology, analysis and the key findings. Section 5 summarizes the key implications of the theoretical model and the key findings of the empirical analysis to discuss the issue at hand and to draw policy implications from the analysis.

II. Previous Research: Public Expenditure, Growth and Debt

To understand the relationship between public expenditure and debt, it is important to review both theoretical and empirical literature on the issue of public debt sustainability. In addition to the same, a review of the literature on public expenditure and growth related macroeconomic dynamics is also important as it provides insights on the components of public expenditures that could affect growth positively and debt inversely. A brief review of the literature that points to possible complementarities between public capital expenditure and private investment is also imperative given the key implications of the theoretical exercise presented in Section 3.

Theoretical Underpinnings

Arrow and Kurz (1970) in their seminal paper developed a model where consumers derive utility from private consumption as well as public capital stock. The literature on endogenous growth theories has further generated models linking public spending with the economy's long-term growth rate. Barro (1990, 1991) introduce government expenditure and classify public spending as consumption and investment expenditure. The empirical findings suggest that all non-productive expenditures can have a negative effect on the growth rate of real GDP per capita in the long term. This would lead to higher level of debt as the growth rate will be reduced. However, in Barro's models public spending only affects the economy's transitional growth rate, while the steady-state growth rate remains unaltered. Devarajan, Swaroop, Zou (1996) relax the assumption of exogenous public spending. They build an optimization problem with two types of expenditure, productive and unproductive. They find that there is an optimal level of productive expenditure in an economy, beyond which such expenditures can have a negative impact on growth, due to over investment in capital and diminishing returns to scale. Agenor and Neanidis (2006) explored a similar framework years later. They analysed the possible optimal allocation of public spending among health, education and infrastructure, taking into account the dynamics between the sectors.

The theoretical work of Chatterjee and Turnovsky (2005, 2007) was also an important contribution as they use an open economy model to analyse the effect of financing public investment through foreign aid. Their results show that an important determinant of the impact on growth is linked to whether the foreign aid is used for investment purposes or not. In their recent work, Christie, Rioja

(2012) are able to demonstrate that fiscal conditions of the economy are a key determinant of the optimal strategy to finance public investment. Thus, lending support to the fact that public investment must be increased only until its 'optimal' point which can be reached at different points of times by different countries, depending on the level of economic advancement and other fiscal conditions of the economy.

Overall, the theoretical literature and key policy perspectives on government expenditure and its effect on growth are governed by the neoclassical view, Ricardian Equivalence perspective and Keynesian view of fiscal deficits. According to Rangarajan and Srivastava (2005), the neoclassical view is apprehensive of fiscal deficits as they have a negative effect on investment and growth, whereas in the Keynesian paradigm, fiscal deficits dominate the policy perspective. Ricardian equivalence, on the other hand, asserts that fiscal deficits do not really matter except for aiding the process of adjustment to expenditure or revenue shocks. Hence, the neoclassical and Ricardian schools focus on the long-run while the Keynesian view emphasizes on the short-run effects. In light of the above, the discussion on public expenditure, growth and debt is not complete without understanding the linkages of the same with major macro-economic variables of the economy.

Deficits, Public debt and Macro-economic linkages

For contrarian believers of Ricardian equivalence, high debt to GDP ratio contributes to an inflationary spiral. In addition to this dynamic interaction with inflation, the link with interest rates, prices, trade balance and output growth is also imperative.

In the short-run, an increase in the interest rate burden contributes to a rise in the stock of public debt. This, in turn, leads to the 'crowding out' of private savings and increases the pressure on interest rates (Kannan et.al 2007). Additional borrowing adds to the pressure on the absorptive capacity of market. This pressure intensifies when commercial banks are holding excess government securities as risk-return considerations may not work efficiently. As the long-term yields show a downward slope, investors prefer to invest in short-term bonds which satisfy the objective of relatively reducing the funding cost to government.

In summary, macroeconomic variables that are linked with fiscal deficit can be classified into endogenous (interest rates on government bonds, interest rate on government debt, interest payments, taxes on income, excise duties, customs revenues) and exogenous (primary revenue expenditure, capital expenditure, non-tax revenues, non-debt capital receipts, import volume). These factors, in turn, bear linkages with other macroeconomic variables and affect the magnitude of fiscal deficit and ensuing public debt indirectly. For instance, as described in Kannan et.al 2007, the level of broad money (M3) in the economy, determines the commercial bank lending rates which in turn influences the interest rate on government bonds (endogenous variable) and the fiscal deficit. The

commercial bank lending rate also affects private capital formation which affects the public capital formation and capital expenditure (exogenous variable).

Specifically, in the case of India, Rangarajan and Srivastava (2005) show that the overall growth rate is dependent on the overall savings rate and investment rate. Thus, in the past, when government saving fell, the private savings rate increased by virtue of the fact that wealth held in the private sector as government bonds increased. On the investment side, the public investment demand as a ratio of debt-GDP also fell while the ratio of interest payments to revenue receipts rose. Empirical analysis on Indian data indicated that government capital expenditures responded inversely to interest payments and bore a direct relationship with revenue receipts. In the 1990s and beyond, government capital expenditures relative to GDP fell not only because interest payments relative to GDP increased but also because the ratio of revenue receipts to GDP fell.

Extant Empirical Literature

Carranza, Daude, Melguizo (2014) look at the relationship between fiscal consolidation and public investment in six of the main Latin American economies namely Argentina, Brazil, Chile, Colombia, Mexico, and Peru. They find that simple austerity measures that focus on cuts in current expenditures may not be appropriate for fiscal consolidation. They point to the case of Peru where fiscal imbalances were reduced by means of measures that favoured public infrastructure investment and placed ceilings solely on current expenditures. Gupta, Kangur *et al.* (2014) look at the effect of public investment on capital accumulation and growth. Based on an empirical analysis performed on a panel of low-income economies, they find that the quality of public investment is statistically significant in explaining variations in economic growth. Panizza and Presbitero (2014) use a panel of OECD countries to look at the links between economic growth and public debt along with examining a causal relationship between them. Their results are consistent with other studies where a negative correlation between the two variables is found. However, studies such as Herndon, Ash and Pollin (2014) do not find such a causal relationship while analysing the data for the same set of countries for a similar time period even if the negative correlation exists. Thus, recent empirical literature has clearly shown that public capital expenditure could boost economic growth and hence affect public debt inversely, in the long run.

The empirical literature on economic growth and debt also has diverse results depending on the kind of economies analysed (developing vs. advanced). Ortiz, Cummins (2013) analyse the IMF government spending projections for 181 countries by comparing the four distinct periods of 2005-07 (pre-crisis), 2008-09 (crisis phase I: fiscal expansion), 2010-12 (crisis phase II: onset of fiscal contraction) and 2013-15 (crisis phase III: intensification of fiscal contraction) in light of the main adjustment measures used by these countries According to them, a disaggregated analysis of the different types of infrastructure is able to play a significant role in understanding the trade-offs

between public deficits to close infrastructure gaps. Seccareccia (2012) discuss the modern "financial balances" view of fiscal policy while supporting a return to a view of long-term fiscal policy, which Keynes promoted and emphasize on the role of public investment as a tool in promoting long term growth. They replicate the technique used by Reinhart and Rogoff (2010A and 2010B) to analyse the effect of high public debt/GDP on the growth of an economy. Using a dataset of advanced economies they find that high public debt/GDP ratios do not necessarily reduce a country's GDP growth. Thus, the relationship between economic growth and debt could be stronger for developing countries in comparison to that of their advanced counterparts.

Bose, Haque, Osborne (2003) examined the growth effects of government expenditure for a panel of 30 developing economies with a focus on sectoral expenditures during the 1970s and 80s. Their main empirical result is that the ratio of government capital expenditure to GDP is positively and significantly correlated with economic growth, while the growth effect of current expenditure is not significant for a large group of countries. Gupta, Clements, Baldacci, Granados (2005) test the effects of fiscal consolidation and expenditure composition on economic growth in a sample of 39 low-income countries during the 1990s. The results show a strong link between public expenditure and growth , as fiscal consolidations achieved through current expenditures cuts are, in general, more conducive to growth. Higher current expenditures and domestic financing of deficit are associated with less favourable economic performance. Empirical literature with similar results includes Landau (1983) and Summers, Kravis, Heston (1984). Hence for the empirical analysis in this paper, based on the findings in the above literature, the hypothesis of productive public expenditure being capital expenditure is tested for Indian data. In fact, the cointegration exercise presented in section 4 on empirical results, reconfirms the hypothesis, for India, where capital expenditures emerge to be of productive type.

Finally, since the theoretical model points towards an inverse link between *phi* and marginal social value of capital, the latest debates on this issue would also be relevant for this paper. Cavallo, Daude (2011) using a panel of 116 developing countries show that the effect of public investment on its private counterpart would depend on the quality of private institutions in the country. In countries where openness to trade and financial flows is high and public institutions are good, a complementarity exists between public and private investment. Khan and Kumar (1997), states that some components of public expenditure may be complementary with private investment. For instance, public investment in infrastructure and human capital formation could increase the productivity of private capital. Earlier literature such as Pradhan, Ratha, Sarma (1990) through their theoretical exploration find that public investment does crowds out private investment. However, the effect that public investment has on total investment, growth and distribution of income, offsets this crowding out effect. The theoretical exercise in this paper demonstrates a similar policy implication, as outlined in the next section of this paper.

III. Theoretical Model

The representative agent model has become a dominant macroeconomic framework over the past decade or so for economists analysing the optimal level of macroeconomic variables from a planner's perspective. The basic structure dates back to the Ramsey's (1928) study of the optimal savings and economic growth rate; although recent economic literature is more focused on all issues of macroeconomic policy. The theoretical model presented in this paper draws from the representative agent model and characterizes the general macro-dynamic adjustments in the economy following changes in the composition of government expenditure; namely productive and less productive. Additionally, the consequences of government expenditure change in the composition of public debt and effect on the private sector is also explored.

Framework

Tinbergen (1952) and Theil (1958) were the pioneers of the theory of economic policy that models and recognizes the point that one of roles of the government is to carry out policy to attain certain objectives. Their work evaluated the effects of policy as loss functions that measured the deviations of an economy from its specified objectives. This framework was discussed in the context of dynamic and stochastic systems by Turnovsky (1977, 2000) which has been used as the framework for the model that has been developed in this paper.

Turnovsky (2000) uses a representative agent framework wherein the welfare of the representative agent is at the centre of the derivation of macroeconomic equilibrium. The government is benevolent and evaluates its policy in terms of its impact on the intertemporal welfare of the representative agent. The choice of optimal government policy is then analysed in a purely static setting such that the issue can be analysed using traditional public methods of Ramsey Taxation (Atkinson and Stiglitz, 1980). The framework that has been adopted for the model in this paper is a model of optimal taxation of capital wherein the characterization of the time path of optimal taxes in an intertemporal macroeconomic framework was used as in case of Chamley (1986). A small modification is made in the existing theoretical framework by segregating government expenditure (g) into g_1 and g_2, productive and 'less productive' expenditure respectively.

Assumptions

The assumptions of the model are as follows. Firstly, the economy is stationary. Thus the model does not encompass an environment of ongoing growth, so that all dynamics are transitory. Secondly, the framework is the representative agent framework where the agent maximizes his utility by choosing a certain level of personal consumption which enters in his utility function. Thirdly, the effects of some specific parts of government expenditure as a productive input, rather than as a

consumptive good are modelled. Thus, g_1 represents productive public expenditure and g_2, represents the less productive public expenditure. Fourthly, the household and the production sectors may not be left consolidated, so that the private sector of the economy is modelled as a representative composite worker-entrepreneur. Finally, the representative agent gets positive, but diminishing marginal utility from the consumption of private goods, capital is assumed not to depreciate and the tax rate is not more than sixty six per cent.

Model

The representative agent's problem is to maximize the concave utility function where *c* represents consumption and *l* represents labour supply as presented in Turnovsky (2000).

$$\int_0^{\infty} U(c,l)e^{-\beta t}dt \qquad \textbf{(1)}$$

$$U_c > 0 \;\; U_{cc} < 0$$

This is subject to an accumulation equation, based on the law of motion of capital stock, *k*, private consumption, *c*, tax rate, *τ*, and output, *y*. This equation can be expressed as:

$$\dot{k} + \dot{b} = r(1-\tau_k)(k+b) + w(1-\tau_w)l - c \qquad \textbf{(2)}$$

$k(0) = k_0$ represents the initial conditions

Based on the optimality conditions obtained using inter-temporal dynamic optimization, and substitution of *c, l* in the utility function, the indirect utility function is generated as represented in equation (3) below

$$U\left[c(\lambda, w(1-\tau_w), l(\lambda, w(1-\tau_w)\right] \equiv V\left[\lambda, w(1-\tau_w)\right] \qquad \textbf{(3)}$$

The policymaker's optimal productive government expenditure problem is assumed to maximize the welfare of the representative agent, subject to (i) the economy-wide resource constraint, (ii) the government's budget constraint and (iii) the representative agent's optimality conditions.
Formally, this is modified in this paper as follows:
Maximize

$$\int_0^{\infty} V\left[(\lambda, w(1-\tau_w))\right]e^{-\beta t}dt \qquad \textbf{(4)}$$

subject to

$$\dot{k} = f(k,l) - c - g \qquad \textbf{(5)}$$

$$\dot{b} = g + r(1-\tau_k)b - \tau_k rk - \tau_w wl - \phi g_1 \quad \textbf{(6)}$$

In (5) and (6), $g = g_1 + g_2$

For the purpose of dynamic optimization, the following Langrangean expression can be constructed:

$$H \equiv e^{-\beta t}V\left[\lambda, w(1-\tau_w)\right] + \eta_1 e^{-\beta t}\left[f(k,l) - c - g - \dot{k}\right] +$$
$$\eta_2 e^{\beta t}\left[g + r(1-\tau_k)b - \tau_k rk - \tau_w wl - \phi g_1 - \dot{b}\right] + \quad \textbf{(7)}$$
$$\eta_3 e^{-\beta t}\left[(\beta - r(1-\tau_k))\lambda - \dot{\lambda}\right] + ve^{-\beta t}r(1-\tau_k)$$

where η_i are the costate variables associated with the accompanying dynamic constraints. The multiplier associated with *b*, represents the marginal social value of public debt. It is also equal to the marginal value of replacing lump-sum taxation by distortionary taxation, that is, the marginal excess burden of taxation. Atkinson and Stern (1974) show how in a second best context such as this, this variable is negative. The first order conditions after deriving for *k*, *b*, λ and g_1 are as follows:

$$\eta_1 f_k - \eta_2 \tau_k r = -\dot{\eta}_1 + \beta\eta_1 \quad \textbf{(8)}$$

$$\eta_2 r(1-\tau_k) = -\dot{\eta}_2 + \beta\eta_2 \quad \textbf{(9)}$$

$$\frac{\partial V}{\partial \lambda} - \eta_1(f_l l_\lambda - c_\lambda) - \eta_2 \tau_w w l_\lambda = -\dot{\eta}_3 + \eta_3(1-\tau_k)r \quad \textbf{(10)}$$

$$-\eta_1 + \eta_2 g_1 - \phi = 0 \quad \textbf{(11)}$$

From equation (11), the following relation can be obtained

$$\phi = \eta_2 g_1 - \eta_1 \quad \textbf{(12)}$$

The first three equations are the dynamic efficiency conditions with respect to *k*, *b* and *λ* respectively; the last equation is the optimality conditions with respect to g_1

Equation (12) points to an inverse relationship between the components of productive public expenditure that helps in bringing public debt on a convergent path and the marginal social value of a unit of capital. This means that beyond the optimal point, increasing productive public expenditure can 'crowd out' private investment. However, to analyse which components of public expenditure can be of g_1 type, an empirical analysis using Indian data is performed, as detailed in the section below.

IV. Empirical Analysis

The extant literature on public debt sustainability in the Indian context is substantive. Most studies point to a possible unsustainable path of the public debt situation in India due to the inclination of the policy makers to focus on subsidies and other grant based expenditures. Chakravarty(2012) shows that the spending on subsidies in India has been almost the same since 1991 (2.3per cent) and that among a sample of 27 emerging countries, India's general government debt ratio was among

the highest. Also, the debt/GDP ratio reduction, between 2003 and 2008 was at 9.2 per cent which is lower by 15 per cent when compared to the rest of the sample. Ahya *et al.* (2006) demonstrate similar results and state that the Indian public expenditure composition needs to be revisited as its focus is mainly on subsidies that have led to macroeconomic problems such as high real interest rates, low productivity of investments and slow growth.

Literature supportive of the Indian public debt situation includes Asher (2012) who reiterates the IMF style method of checking for debt sustainability according to which the Indian debt/GDP ratio will fall from 64.1per cent in 2010 to 61.2 per cent in 2016. The most part of this debt is internal and public sector financial institutions are the key holders, thus there is less exposure to market risks. However, he warns that the primary deficit is persistent, and maintaining a large differential between real interest rate and GDP Growth will become more difficult. Kaur, Mukherjee (2012) show that the relationship between public debt and growth in non-linear in India using an estimation based on inter-temporal budget constraint and fiscal policy response function. They do observe a cointegration between revenue and expenditure, and that the primary balance responds in a stabilizing manner to the increase in debt but even they are sceptical of the persistent primary deficit. Buiter and Patel (2004), using the stationarity tests developed by Phillips and Perron (1988) and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS, 1992) argue that while deficits in India are large, the risk of a deficit-induced crisis is minimal. Jha and Sharma (2004) analysed this issue by using cointegration tests for public expenditure and revenue. Their empirical analysis suggests that the revenue and expenditure series are I(1) and cointegrated with regime shifts. Thus, Indian public debt may not be unsustainable. While the above two studies employed data solely for the Central Government, Goyal, Kundarapakam *et al.* (2005) analysed the same issue for all levels of government. They test for stationarity of public debt as in Buiter and Patel (2004) employing the cointegration test developed by Gregory and Hansen (1996) allowing for structural breaks. The fiscal stance of the Central and the State Government at the individual level is unsustainable but it is weakly sustainable for the combined finances as inter-governmental financial flows are netted out.

As against this result, Parker and Kastner (1993), Cashin, Olekalns and Sahay (1998), Olekalns and Cashin (2000), Callen (2001), Reynold (2001), Lahiri and Kannan (2002), Rangarajan and Srivastava (2003), Ram Mohan, Dholakia and Karan (2005), Buiter and Patel (2006) analyse fiscal sustainability and majority indicate unstable future path of debt-GDP ratio. Thus, research on the subject of public debt sustainability for India, based on analysing revenue and expenditure series of the government, as outlined above have not shown much consensus.

Before embarking on the results of the empirical analysis, it would be useful to look at the division of expenditure powers between the Central and State Government in India, by virtue of the Federal Structure. India's federal structures are an important aspect of its political and economic system. The Indian Constitution, in its Seventh Schedule, assigns the powers and functions of the Centre and the States. The schedule specifies the exclusive powers of the Centre in the Union list;

exclusive powers of the States in the State list; and those falling under the joint jurisdiction are placed in the Concurrent list. The functions of the central government are macroeconomic stability, international trade and relations and those having implications for more than one state. According to the Indian constitution, current disbursements and defence expenditure are the responsibility of the Central Government, while the State Government is assigned infrastructural, social and health disbursements. Hence, the State Governments have more opportunities to engage in capital expenditure with respect to the Central Government. This could be one reason as to why the Capital expenditure levels to GDP of the Centre and general Government are lower in comparison to the State Governments. This is vice versa for public debt.

Data Sources and Descriptive Analysis

The empirical analysis is based on annual data series obtained from the Handbook of Statistics on the Indian Economy (2013), National Accounts Statistics published by the CSO[2] and various issues of Indian Public Finance Statistics. The time period covered in the analysis is from 1980-2013 and all figures are in Rs. billion. Table 1 summarizes the variables and their respective sources. The three main variables used in the analysis are public debt, current public expenditure and capital public expenditure. However, since we want to analyse both nominal and real values of each of these variables, GDP and GDP deflator are used to obtain the ratio to GDP values and real values of the variables respectively. The analysis is done for the Consolidated General Government, Central Government and the State Government separately. The Consolidated Government public debt is defined as the sum of all the internal liabilities of the Central and State Governments together. The internal liabilities of the Centre consist of internal debt, market loans and other accounts. Instead, the internal liabilities of the State Governments consist of market loans, compensation and other bonds, WMA (Ways and Means Advances) from the RBI and loans from banks and other institutions. Public expenditure components are classified under current and capital expenditure heads to avoid multiple expenditure components. Other expenditure categories, for which the classification is not clear, are excluded from the analysis. For the Central Government, the capital expenditure consists of capital expense, capital outlay, capital defence expenditure and expenditure on loans and advances. On the other hand current expenditure consists of revenue expenditure, revenue defence expenditure, interest payments and subsidies. Since, the State Governments do not have the authority to spend on defence expenditure, the component of defence expenditure in both current and capital expenditures are nil. The summation of expenditures for State and Central Governments for each category is the consolidated general government expenditure.

To obtain ratios to GDP of public debt and the expenditure components, we divide the respective variables by the GDP at current market prices. In case of the State Governments, we make use of NSDP at current market prices. Further, to obtain real public debt and real expenditure

[2] Central Statistical Organization, India

components, we divide the given nominal variable by the GDP Deflator, obtained by dividing GDP market prices by GDP constant prices with 2005 as the base year. More specifically, Real variable = (Nominal Variable /GDP Deflator)*100. All the data series are transformed into logarithms to account for possible non linearity and achieve stationarity in variance.

Figures 1, 2 and 3 in the appendix show the time path of components of government expenditure and public debt, as nominal variables (percentage to GDP) and real values respectively for the Centre, General Government and State Governments respectively. In case of the Centre and the General Government, the Debt/GDP ratio is sixty and eighty per cent for the Central and General Government respectively. This is much higher when compared to the Debt/GDP for the State Government; thirty two per cent.

Methodology

Testing for causality or for cointegration between the two variables is done in three steps. The first step is to verify the order of integration of the variables since the causality tests are valid if the variables have the same order of integration. Standard tests for the presence of a unit root based on the work of Dickey and Fuller (1979) and KPSS (1992) are used to investigate the degree of integration of the variables used in the empirical analysis. The second step involves testing the cointegration using Johansen's (1992, 1995) multivariate method to estimate the long-run relation between debt to GDP ratio (b_t) and Capital expenditure (g_1). Under this approach, a system of n endogenous variables can be parameterized into a vector error correction model:

$$\Delta X_t = \mu + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-2} + ... + \Gamma_{k-1} \Delta X_{t-k+1} + \Pi X_{t-k} + \varphi D_t + u_t \quad \textbf{(13)}$$

where X_t is an $(n \times 1)$ vector; Γ_i and Π are $(n \times n)$ coefficient matrices; D_t are deterministic components, such as seasonal and impulse dummies; μ is a constant term; k is the lag length ; and u_t is a vector of normally and independently distributed error terms. In our system, $X_t = [b_t, g_1]$ is a (2×1) vector, and Γ_i and Π are (2×2) coefficient matrices. A cointegrated system implies that $\Pi = \alpha\beta'$ is reduced rank, r, for $r < n$.

The third step involves utilization of the vector error-correction modelling (VECM) and testing for exogeneity. Engle and Granger (1987) exhibit that, in the presence of cointegration, there always exists a corresponding error-correction representation, which implies that changes in the dependent variables are a function of the level of disequilibrium in the cointegration relationship, captured by the error-correction term.

As a preliminary analysis before proceeding with cointegration, we calculate the Karl Pearson's coefficient of correlation between g_1 and b_t for the Centre, State and General Government respectively. Column 2 of Table 2 in A.1.2 shows the results in tabular form. Public debt/GDP and

capital expenditure/GDP share an inverse relationship for the Central and General government, while the coefficient in case of the State Government is too low to be interpreted while the opposite holds for public debt/GDP and current expenditure/GDP. In case of real variables, the relationship between all components of government expenditure and debt is direct and the correlation is significant.

Based on the above results and the findings of the extant empirical literature, we proceed with the further analysis, interpreting the results only for real variables. However, the results with ratio to GDP variables are also reported.

Limitation of using current and capital expenditure as key components of public expenditure

As per the most commonly used classification of public expenditure, the key components of public expenditure are current (consumption spending, interest payments, transfer payments) and capital expenditure. As stated in Kannan et al. (2007), components of current expenditure (pensions, subsidies) could be influenced by particular social and distributional objectives while capital expenditure is considered to be an integral avenue for achieving the developmental objectives. Thus, based on the classification of public expenditure in Devarajan, Swaroop, Zou (1996), the public expenditure in this paper has been classified into current and capital expenditures based on the fact that the latter generate productive capacity in the long-run.

This two-fold distinction between components of public expenditure is also compatible at the empirical level for developing countries as disaggregated data on public expenditures may not be as easily available. Future research could focus on addressing this issue and for devising a more holistic classification of public expenditure which is compatible with the level of disaggregation available in data on developing countries on the lines of work done for developed regions. For instance, Grisorio, Prota (2015) go beyond this traditional classification of public expenditures to discuss the relationship between fiscal decentralization and composition of public expenditure in Italy. They classify public expenditure into five categories: consumption, investment, personnel expenditure, current transfer and capital transfers.

Working towards this more holistic classification of public expenditure, based on a functional classification, can help in taking into account the indirect and intangible effects of development expenditure such as spending on human capital. In such a case, as per the availability of data at the empirical level, expenditure can be classified as “less-productive” (social welfare) and “productive” (investment to enhance human capital, infrastructure, and development expenditure) based on the classification presented by Bleany et al. (2001) which can be further adapted to the experience of a developing economy such as India.

Analysis and Findings

In this sub-section, using the annual data for India or the period 1980-2013, the stationary properties of productive current expenditure/GDP, capital expenditure/GDP, public debt/GDP, real current expenditure, real capital expenditure and real public debt and the order of integration of the data for the Centre, State and the Consolidated General Government respectively is analysed. Based on the order of integration, the hypothesis of a long-run relationship between real public expenditure and real public debt using bivariate cointegration systems and employing the Engle and Granger (1987) methodology is tested. Third, estimating the cointegration coefficients, the long-run equilibrium relation is defined. The deviations from this equilibrium represented by the residuals of the cointegrating vector are included in error correction models to capture the mutual response of real public debt and real capital expenditure in disequilibrium.

a) Unit Root Tests

The univariate time-series properties of productive current expenditure/GDP, capital expenditure/GDP, public debt/GDP, real current expenditure, real capital expenditure and real public debt are examined using the unit root tests developed by KPSS (1992) and the augmented Dickey Fuller (1979). The KPSS tests the null of stationarity, whereas the ADF tests the null of the unit root. If the KPSS test rejects the null but the ADF test does not, both tests support the same conclusions; that is, the series in question is a unit root process.

Results of the ADF and KPSS tests are reported in A.1.2 in Table 3 show that in the case of Consolidated General Government and the Central Government, the ADF tests (either constant or trend) cannot reject the unit root null in any of the indexes (ratio/log level) and the KPSS tests reject the null of stationarity for all indexes. At the first differences, the ADF reject the possibility of a unit root for all the variables while the KPSS tests (either constant/trend) support the hypothesis of stationarity. Thus, ADF and KPSS tests confirm that debt, current expenditure and capital expenditure (real and ratio to GDP) are I(1) at 5 per cent level of significance for the Central, State and Consolidated General Government.

b) Cointegration Tests

Since the cointegration procedure is sensitive to a lag length used, we conduct a series of nested likelihood ratio tests on the first-differenced VARs to determine the optimal lag length prior to performing cointegration tests. These are done by using Hayashi, Sims (1980) like-likelihood (LR) tests and multivariate Akaike information criterion (AIC). Under the LR tests, we begin with a maximum lag Length (k-max) of 7 and sequentially test down, deleting one VAR lag at a time until the

deleted lags are jointly significant. As shown in column three of Table 4, the optimal lag length is different for each variable.

Table 5 in A.1.2 shows the Engle granger test results for all the variables. No cointegration is found between current public expenditure and public debt for each of the levels of government (Central, State and Consolidated General Government). Hence, these results are not reported in the paper. Cointegration between real public debt and real public expenditure is then tested for and analysed for Central, State and general government expenditures.

For the consolidated General government and the Central Government, the OLS regression points to direct and significant relationship between real capital expenditure and public debt and is in line with the results of the preliminary correlation analysis. Similar results are found in case of the State government as well. However, the constant term is not significant in the case of the state government.

After testing for a significant linear regression, the residuals of the regression are analysed and are found to be significant for all levels of government. From the above, we infer from the fact that real capital expenditure and real public debt are I(1) and that there is a long-run equilibrium relationship between the two time series and the existence of causality in at least one direction. Furthermore, the deviations of these variables from the equilibrium are stationary, with finite variance, even though the series themselves are non-stationary and have finite variance.

c) ECM Model

To check for the validity of the cointegration relationship and to check for the direction of causality and the correction in disequilibrium, if any, ECM techniques using the Engle and Granger framework is applied. Table 6 in A.1.2 shows the results of the ECM representations. The Durban – Watson statistic is found to be significant for Consolidated, State and Central Governments respectively. However, the coefficient of the cointegration is significant only in case of the General and Central Government with low standard errors. The negative sign suggests that changes in real capital expenditure may not necessarily adjust in the same direction to the previous period's deviation from equilibrium.

The coefficient represented in the second last column of Table 6 represents the error correction coefficient and shows that in case of consolidated general government and the Central Government, the level of adjustment / disequilibrium corrected in the public debt to GDP is by a change in the capital expenditure. Thus, the causality is observed from the side of real capital expenditure. Additionally, a 1 per cent increase in real capital expenditure corrects disequilibrium in real public debt by 0.01 percentage points, in the long run for the Consolidated General Government.

In case of the Central Government, an increase of 1 per cent in real capital expenditure, corrects disequilibrium in real public debt by 0.03 percentage points in the long run.

Optimal point of Capital Expenditure – Simulation exercises

The theoretical model in this paper looks at the relationship between public expenditure composition and public debt. The second order conditions resulting from the model point to a disequilibrium correction in public debt as the proportion of 'productive' public expenditure in total public expenditure is increased until the optimal point. Beyond this optimal value, there is a 'pronounced' crowding out of private investment.

Based on the resulting second order condition, it is evident that the key macroeconomic variables that determine the optimal composition of public expenditure and the amount of disequilibrium correction (*phi*) are dependent on marginal social value of capital (*neta 1*), marginal social value of debt *(neta 2*), and the level of capital expenditure in the economy (g_1).

Based on the above, a numerical simulation exercise is carried out as represented in Figure 4. In the figure 4, *neta 2* and *neta 1* are plotted on the x-axis and y-axis respectively. The four panels simulate the second order condition of the theoretical model with the values of g_1 as 0.3, 0.5, 0.2 and 0.9 respectively. For higher values of g_1 (0.5 and above), the plotted linear equation is steeper and the intercept is higher. Hence, as the value of g_1 increases, *neta 1* adjusts faster to *neta 2*. Further, if *neta 2* is constant, as *phi* increases, *neta 1* increases. This, in turn, indicates that at higher levels of 'productive' public expenditure, marginal social value of capital is more sensitive to marginal social value of debt and the 'crowding out' on private investment will be stronger. However, this 'crowding out' is offset by the increase in *phi*, which impacts the disequilibrium in public debt. In the case of India, increasing the proportion of g1 to greater than 0.5 may be detrimental to private investment based on this single equation model.

However, a more sophisticated estimate of this 'optimal' value may be obtained by means of multi-variable macroeconomic model such as the one proposed by Rangarajan and Srivastava (2005) as outlined in Section 2 of this paper.

V. Discussion and Policy Implications

Debt sustainability has become a very vibrant issue in the current world scenario with many industrialized countries succumbing to unsustainable budget deficits and debt levels. However, the approach towards implementation of austerity measures is focussed on wage and expenditure cuts. In this paper, the relationship between productive public expenditure and public debt is analysed using a single-equation model based on inter-temporal optimization. This is followed by an empirical

exercise that using Indian government data analyses whether specific components of public expenditure do share a long-run relationship with debt and if some of these expenditures help in correcting disequilibrium in public debt in the long run. This empirical exercise is placed in the context of the Indian debt sustainability debate wherein extant literature has shown mixed results with regard to sustainability of Indian public debt. Numerical simulations based on the second-order conditions resulting from the theoretical exercise are also presented.

Public expenditure is classified as productive and 'less-productive' based on the rationale that a proportion of the productive public expenditure ($phi*g_1$) reduces divergence in the public debt in the long-run. The paper also discusses the limitation of using this classification of expenditure as productive and 'less productive'. The 'second-order' conditions resulting from the model demonstrate that as *phi* increases, the marginal social value of a unit of capital reduces. Thus, beyond its optimal level, an increase in *phi* could still affect public debt inversely; however, this will be at the cost of 'crowding out' of private investment. This is also in line with the discussion by Devarajan, Swaroop, Zou (1996) about the optimal level of productive expenditure, where a shift towards an 'objectively' more productive type of expenditure, may not raise the growth rate if its initial share is too high.

To test the theoretical representation and to understand which kinds of public expenditure are 'productive' in nature, an empirical analysis using Indian Public Finances data (1980-2013) is performed. The empirical analysis of the paper shows that real capital expenditure of the Indian government shares a long-run relationship with real public debt with error correction while no long-run relationship is observed between current expenditures and public debt. The cumulative analysis of the paper's findings also points towards a possible complementarity between public and private investment stimulus/capital expenditures for reducing public debt in the long run. The results of the numerical simulations also point to similar results.

The above findings become even more relevant for developing countries where the volatile sovereign debt condition forces governments to succumb to austerity measures that are based on expenditure cuts. The theoretical model demonstrates that apart from the fact that certain components of public expenditure contribute to future growth of output, they contribute to a more stable debt trajectory only if the economic scenario is such that it stimulates private investment. The fact that capital public expenditures emerge as 'productive' expenditure in the empirical exercise on Indian data, reiterates the point that policy makers in countries such as India must work towards an investment climate whereby private investment is promoted along with higher capital expenditure to fight sovereign debt woes for the long-run.

In summary, the papers findings show that random expenditure cuts cannot help in stabilizing the levels of public debt. Instead, the quality of expenditure cuts matters. When fiscal consolidation is

implemented focus should be on cutting current expenditures as far as possible and increasing capital type expenditures along with stimulating private investment for a smoother repayment path.

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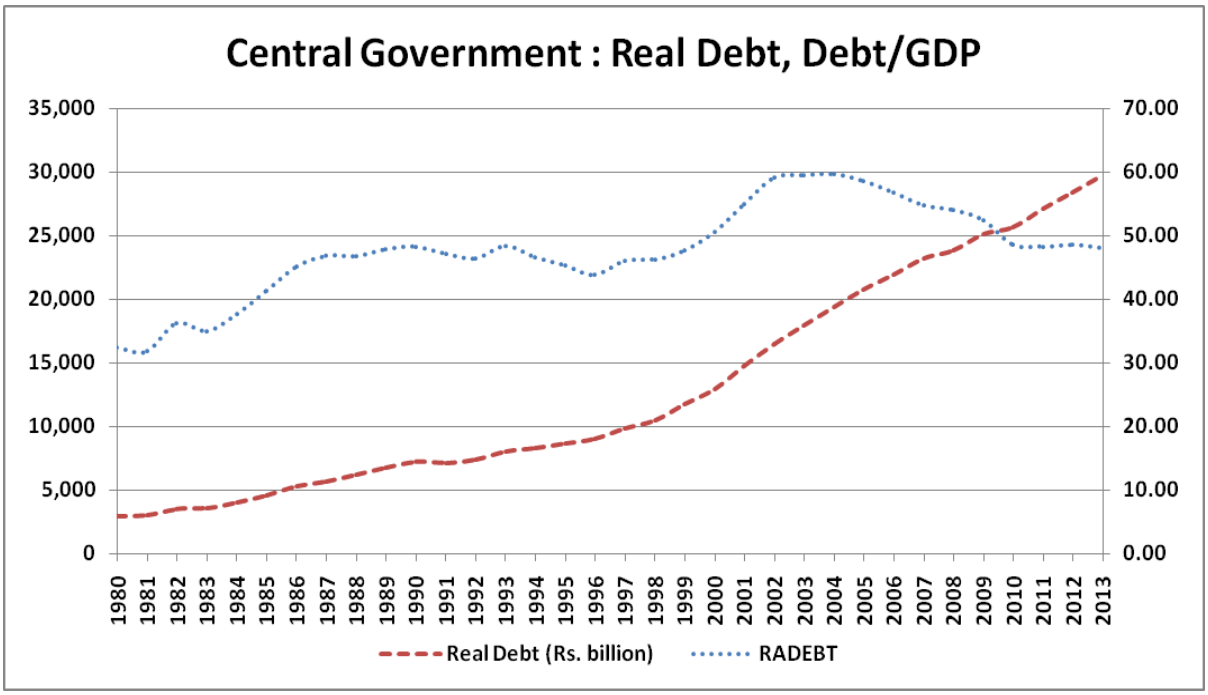
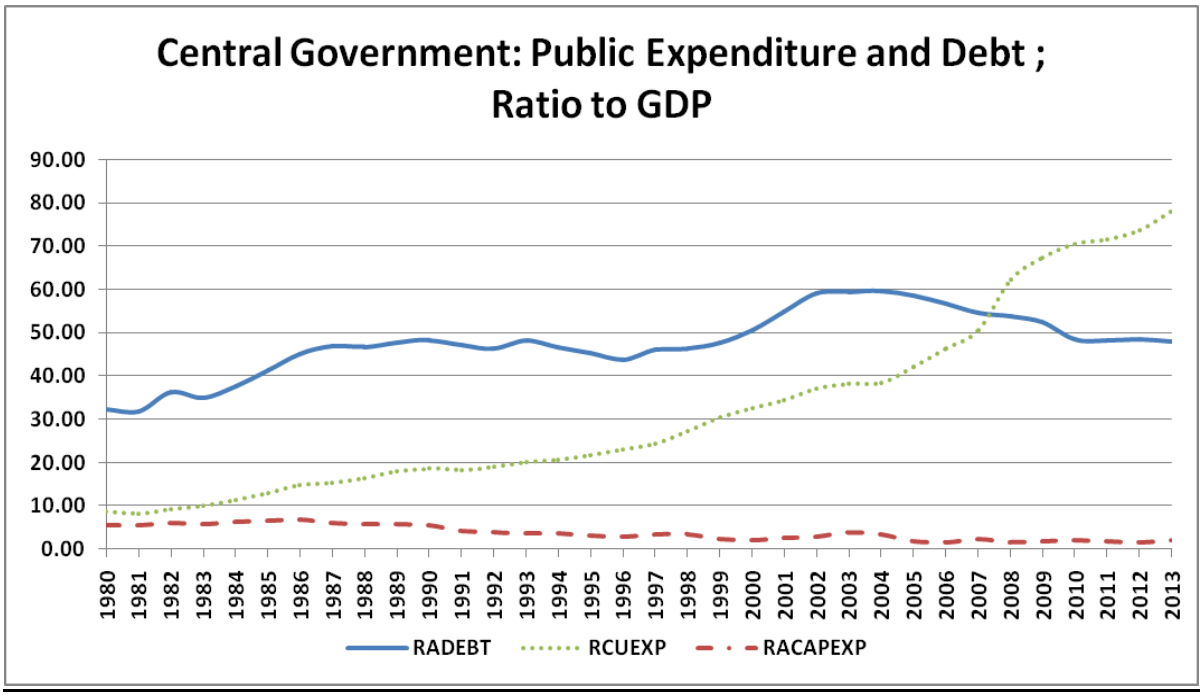
Appendix A

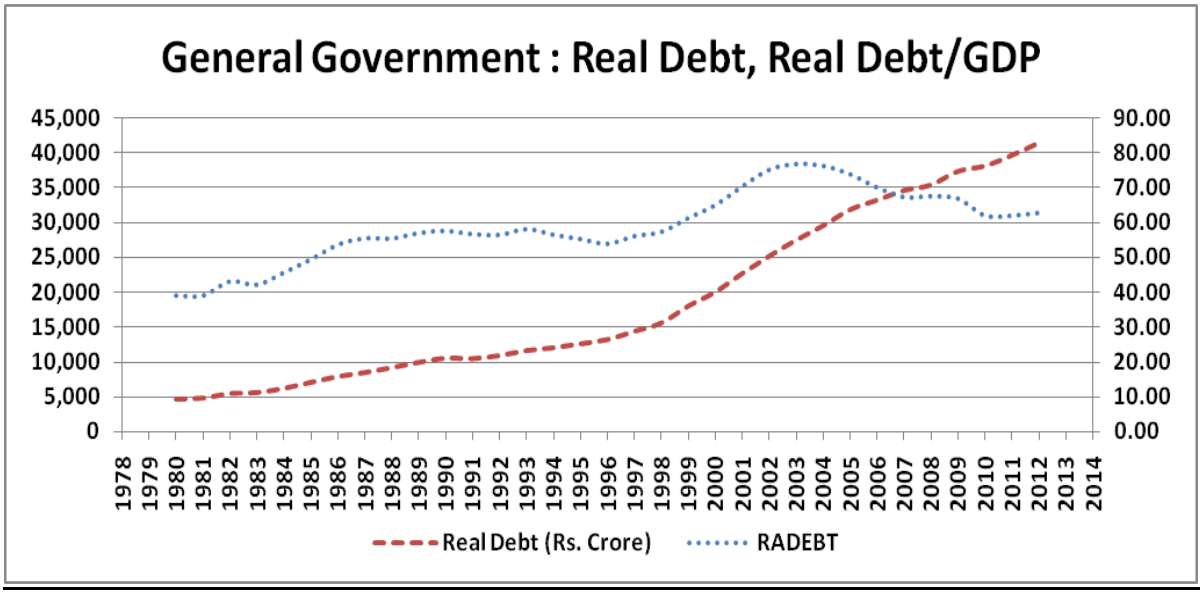
Figure No. 1: Central Government (Major Fiscal Variables)

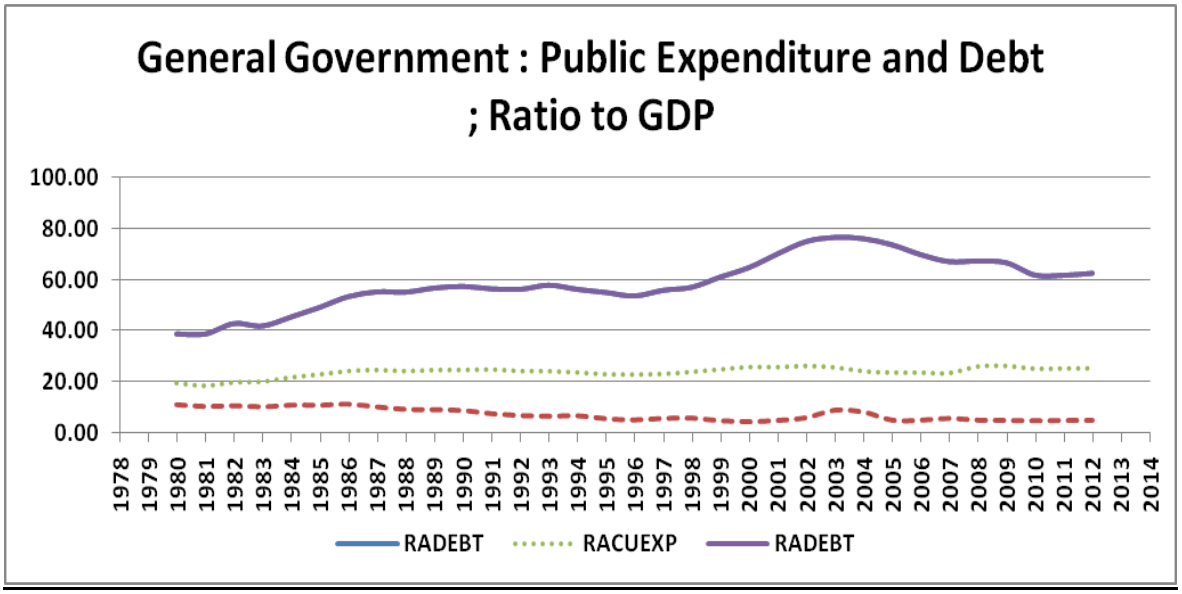




Source: Authors Elaboration on RBI data as mentioned in Table 1
Notes: RADEBT refers to Debt/GDP, RCUEXP refers to Current exp/GDP and RACAPEXP refers to Capital expenditure/GDP

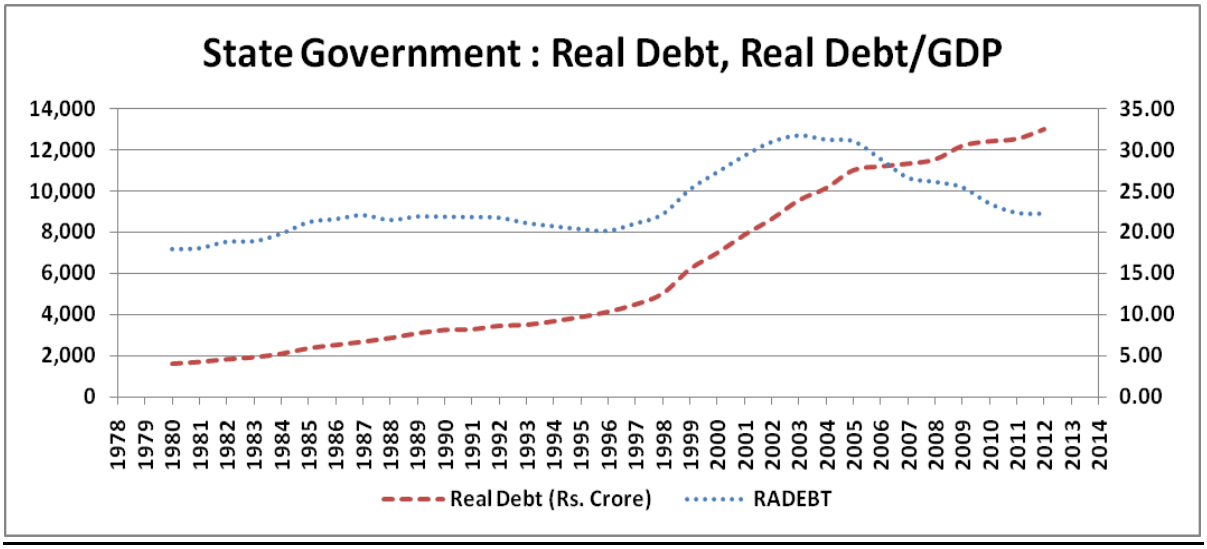
Figure No. 2: General Government (Major Fiscal Variables)

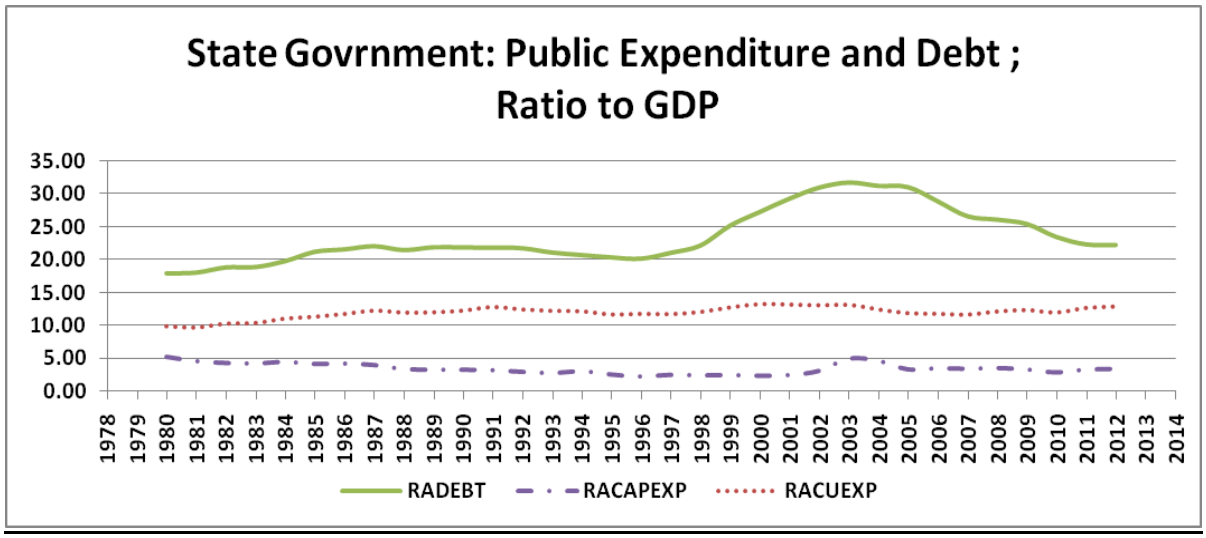




Source: Authors Elaboration on RBI data as mentioned in Table 1)
Notes: RADEBT refers to Debt/GDP, RACUEXP refers to Current exp/GDP and RACAPEXP refers to Capital expenditure/GDP

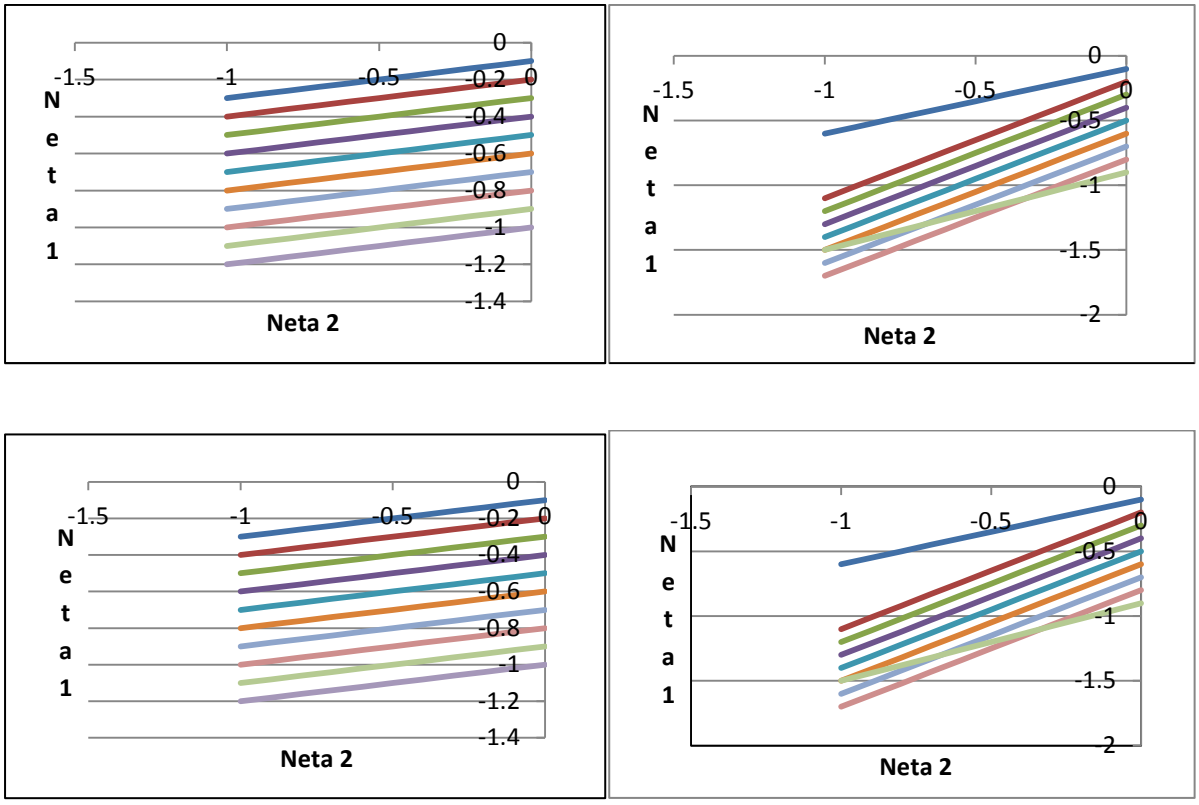
Figure No. 3: State Government: Major Fiscal Variables





Source: Authors Elaboration on RBI data as mentioned in Table 1
Notes: RADEBT refers to Debt/GDP, RACUEXP refers to Current exp/GDP and RACAPEXP refers to Capital expenditure/GDP

Figure No. 4: Numerical Simulations – g_1 0.3, 0.5, 0.2, 0.9 respectively



Source: Authors elaboration on Indian Economy data

Appendix B

Table No.1: Description of Variables

Variables used	Type of Government	Source
Capital Expenditure	Centre, State and General Government	RBI Handbook of Statistics on Indian Economy 2013-14)
Current expenditure	Centre, State and General Government	RBI Handbook of Statistics on Indian Economy 2013-14) & CSO National Accounts statistics)
Public Debt	Centre, State and General Government	RBI Handbook of Statistics on Indian Economy 2013-14)
GDP	Centre and General Government	RBI Handbook of Statistics on Indian Economy 2013-14)
NSDP	State Government	Indian Public Finance Statistics 2013-14)
GDP Deflator	Centre, State and General Government	IMF Online Statistics on Indian Economy 2013-14

Source: Author's elaboration on data sources mentioned in Table 1

Table No. 2: Karl Pearson's correlation coefficient of Current and Capital expenditure with Public Debt

	General Government		**Central Government**		**State Government**	
	Current Exp & Debt	**Capital Exp & Debt**	**Current Exp & Debt**	**Capital Exp & Debt**	**Current Exp & Debt**	**Capital Exp & Debt**
Ratio /GDP	0.79	-0.63	0.75	-0.63	0.62	-0.08
Real Variables	0.97	0.92	0.98	0.67	0.96	0.94

Note: A negative value of this coefficient indicates an inverse relationship and vice versa. Normally correlation coefficients of a value higher than 0.9 are considered spurious. All analysis has been carried out with log values. Hence variables analyzed are LogDebt/GDP), LogCapital exp/GDP), LogCurrent Expenditure/GDP), LogReal Debt), LogReal Capital Expenditure) and LogReal Current Expenditures).

Source: Author's elaboration on RBI data as mentioned in Table 1

Table No. 3: Augmented Dickey-Fuller and Kwiatkowski, Phillips, Schmidt, and Shin Tests for Capital Public Expenditure and Public Debt (Real and Ratio to GDP Variables)

	Log Levels				First Differences			
General Govt.	**ADF** Const	**ADF** Trend	**KPSS** Const	**KPSS** Trend	**ADF** Const	**ADF** Trend	**KPSS** Const	**KPSS** Trend
Capital Expenditure/ GDP	-1.3459 (0.594)	-1.5997 (0.769)	0.7477	0.2264	-5.6242 (0.0001)	-5.5915 (0.0004)	0.4048**	0.0405***
Debt/GDP	-2.3514 (0.163)	-2.2158 (0.464)	0.8984	0.3200	-2.9760 (0.048)	-3.2926 (0.0862)	0.2235***	0.0695***
Real Capital Expenditure	0.5957 (0.987)	-1.1117 (0.910)	0.7699	0.2337	-6.3735 (0.0000)	-6.6434 (0.0000)	0.5000*	0.0473***
Real Debt	2.5948 (1.000)	-2.2367 (0.453)	0.6296*	0.1898*	-1.2157 (0.6543)	-4.1632 (0.0153)	0.4530*	0.0862***
Central Govt.	**ADF** Const	**ADF** Trend	**KPSS** Const	**KPSS** Trend	**ADF** Const	**ADF** Trend	**KPSS** Const	**KPSS** Trend
Capital Expenditure / GDP	-0.9210 (0.767)	-1.7090 (0.723)	0.6093	0.2288	-5.6942 (0.000)	-5.5831 (0.000)	0.1250***	0.1246**
Debt/GDP	-1.2759 (0.625)	-1.4565 (0.818)	0.7905	0.2288	-3.5140 (0.014)	-4.0817 (0.015)	0.2461***	0.0668***
Real Capital Expenditure	-2.2846 (0.182)	-3.3524 (0.075)	0.6353*	0.1140	-7.0161 (0.000)	-6.9485 (0.000)	0.1898***	0.1503**
Real Debt	0.6500 (0.988)	-1.7039 (0.725)	0.9085	0.2381	-1.1238 (0.693)	-4.1548 (0.015)	0.5494*	0.0772***
State Govt.	**ADF** Const	**ADF** Trend	**KPSS** Const	**KPSS** Trend	**ADF** Const	**ADF** Trend	**KPSS** Const	**KPSS** Trend
Debt/ GDP	-2.3442 (0.165)	-2.5591 (0.300)	0.449**	0.084***	-2.1863 (0.214)	-2.3386 (0.4023)	0.1724***	0.0926***
Capital Expenditure / GDP	-2.6580 (0.102)	-2.3268 (0.408)	0.2794	0.1606	-5.2316 (0.0002)	-5.2965 (0.0009)	0.2895***	0.2402
Real Debt	0.3693 (0.978)	-0.6904 (0.962)	0.8717	0.2265	-2.5133 (0.122)	-4.9493 (0.0030)	0.3028***	0.1045***
Real Capital Expenditure	0.7382 (0.992)	-1.3836 (0.846)	0.7785	0.2248	-5.1434 (0.0002)	-5.8645 (0.0002)	0.3960*	0.0618***

Note: ADF= augmented Dickey-Fuller 1979); KPSS= Kwiatkowski, Phillips, Schmidt, and Shin 1992). The ADF tests are conducted by setting a lag length k) of 7 as explained in the test. The KPSS tests are reported on the automatic k) selection of 4 since the sample is small. The ADF tests, ADF Const denotes the only constant term in the estimating equation, whereas Trend denotes both the constant term and linear time trend. For ADF Trend log values of variables have been used. Same notations are used for constant and trend in the KPSS model. P-values are reported in brackets

Critical Values:

	ADFConst	**ADF**Trend	**KPSS**Const	**KPSS**Trend
1per cent	-3.73	-4.33	0.739	0.216
5per cent	-2.99	-3.58	0.463	0.146

*** Significant at the 1per cent level

** Significant at the 5per cent level

* Significant at the 10per cent level

***Source*:** Author's elaboration on RBI data as mentioned in Table 1

Table No. 4:.VAR Lag Order Selection Criteria (Ratio/GDP and Real variables)

Government	Variables	Optimal Lag Length	LogL	LR	FPE	AIC	SC	HQ
General Government	**Public debt/GDP and Capital expenditure/ GDP**	6	-56.6	8.935	2.417*	6.361*	7.619	6.72*
	Real Public Debt and Capital Expenditure	6	-109	11.93*	137.961*	10.405	11.663	10.7*
Central Government	**Public debt/GDP and Capital expenditure/ GDP**	5	- 48.9	5.717	0.7264*	5.255*	6.3116	5.56*
	Real Public Debt and Capital Expenditure	3	-112	8.300	42.232*	9.394	10.06*	9.59*
State Government	**Public debt/GDP and Capital expenditure/ GDP**	7	-9.88	8.827	0.1018*	3.067*	4.5194	3.48*
	Real Public Debt and Capital Expenditure	7	-56.2	23.35*	3.6114*	6.636*	8.087*	7.05*

Note: * indicates the criterion according to which the stated lag length is optimal.
Optimal lag length column indicates lag order selected by the criterion
LR: Sequential modified LR test statistic each test at 5per cent level)
FPE: Final Prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Source: Author's elaboration on RBI data as mentioned in Table 1.

Table No. 5: Engle Granger Test for Cointegration (Selected Variables)

Central government-Real Variables				
OLS Regression (debt as dependant variable)		ADF Test (Stationarity of Residuals)	Coefficient (Constant Term)	Coefficient (Independent Variable)
C	-2.1953 (0.0355)	-4.0745 (0.0167)	-98.802	30.1074
Capital expenditure	5.2275 (0.0000)			
General Government-Real Variables				
OLS Regression (debt as dependant variable)		ADF Test (Stationarity of Residuals)	Coefficient (Constant Term)	Coefficient (Independent Variable)
C	-3.8663 (0.0005)	-3.6273 (0.0109)	-86.654	17.274
Capital expenditure	13.0913 (0.0000)			
State Government-Real Variables				
OLS Regression (debt as dependant variable)		ADF Test (Stationarity of Residuals)	Coefficient (Constant Term)	Coefficient (Independent Variable)
C	-0.0649 (0.9486)	-2.5917 (0.0113)	-0.4532	7.4034
Capital expenditure	13.369 (0.0000)			
Note: P-values are reported in the brackets for this test.				

Source: Author's Elaboration on RBI data as mentioned in Table 1.

Table No. 6: Error Correction Model

Central Government	**Durban-Watson**	**Cointegration Coefficient**	**Error Correction Coefficient**	**Adjusting variable**
D Real Capital expenditure)	1.51	-0.2894**	-0.0131**	Capital Expenditure
General Government	**Durban-Watson**	**Cointegration Coefficient**	**Error Correction Coefficient**	**Adjusting variable**
D Real Capital expenditure)	1.27	-0.2802**	-0.0353**	Capital expenditure
State Government	**Durban-Watson**	**Cointegration Coefficient**	**Error Correction Coefficient**	**Adjusting variable**
D Real Capital Expenditure)	1.44	-0.1602	-0.0720	Capital expenditure

Note: The lag lengths used are as per the optimal lag length of Table 4.
*** Significant at the 1per cent level ** Significant at the 5per cent level * Significant at the 10per cent level

Source: Author's elaboration on RBI data as mentioned in Table 1.