How Does Public Debt affect the Indian Macro-economy? A Structural VAR Approach

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Abstract

This study investigates the macroeconomic effects of public debt in India using a Structural Vector Autoregression (SVAR) framework for the period from 1980 to 2017. The objective of this study is to examine the impact of several types of public debt on economic growth, investment, interest rate and inflation in India. The results of the Impulse response functions show that public debt has an adverse impact on economic growth, a positive impact on long-term interest rate and a mixed response (both negative and positive) on investment and inflation in India. It is also found that the domestic debt has a more adverse impact on the economy than external debt in India. The estimated variance decomposition analysis shows that much of the variations among selected macro variables are explained by public debt and growth in India. The study suggests that public debt, especially the domestic debt should be controlled and used in a more productive manner in order to have a favourable impact on the economy.

Keywords: Public Debt; Internal Debt; External Debt; Economic Growth; Structural VAR Approach; India.
JEL Classification Codes: H63, O40, C40.

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1. Introduction

Management of public debt is a global challenge being faced by the governments of many developing and developed countries. The macroeconomic effects of public debt have always been a debated issue in the literature. India has persistently faced a high ratio of public debt to GDP during the past decades, which is far higher than the different Finance Commissions' long-term target of debt to GDP ratio (below 60 per cent).[1] This rising trend has generally been accompanied by an expansion in the size of governments. Persistence of high debt to GDP ratio implies that public debt, especially domestic debt, has become an important means of financial resources mobilization of the Indian Government to meet its growing expenditure needs. In India, domestic debt makes up nearly 95 per cent of the aggregate public debt, while external debt constitutes a very little share in total public debt.[2] Accumulation of public debt might result in higher policy uncertainties and affect economic growth through its impacts on various macro variables like interest rate, inflation, investment etc. in an economy (Islam and Hasan, 2007). India has also been trying to adopt the fiscal consolidation path based on the implementation of 'Fiscal Responsibility and Budget Management' (FRBM) Act, 2003 and the recommendation of the FRBM Review Committee in 2017. In this context, the study intends to address these following crucial questions: Does public debt affect economic growth in the Indian economy? Does public debt enhance or reduce gross investment in India? Has public debt any impact on interest rate India? Is there any relationship exist between public debt and inflation in India?

The burden of public debt depends on how the funds, mobilized through public debt, are used. If public debt is wasted on relatively unproductive activities (like financing current expenditure), it becomes a dead weight due to its adverse effects on capital accumulation, as well as productivity.[3] Hence, it reduces economic growth. On the other hand,

[1] All the reports of the Eleventh, Twelfth, and Thirteenth Finance Commission, the report of the fiscal responsibility and budget management (FRBM) Review committee, and the study by Rangarajan and Srivastava (2005) uniformly targeted a debt/GDP below or close to 60 per cent mark to ensure the long-term prospect of stability and growth in India (Pradhan, 2014).

[2] It is calculated by using the data from Handbook of Statistics on Indian Economy (HBS) of Reserve Bank of India (RBI).

[3] When a debt is used to finance a project which brings revenue/income to the Government is considered as productive debt and not a burden on the Government. For example, loans used for the construction of railways, roads, irrigation, power project, establishment of heavy industries etc. However, if a debt does not yield any income/ revenue in future, for example, financing war, current expenditure etc., it is considered as unproductive debt and a dead weight upon the Government.

if the resources raised by the Government through borrowings are spent on developmental activities like capital formation, they raise the productive capacity of the country. Thus, they are not burdensome.[4] An important channel through which the accumulation of public debt can affect economic growth is that of long-term interest rates. Higher long-term interest rates, resulting from more debt-financed Government budget deficits, can crowd out private investment, thus dampening potential output growth. A large public debt might create debt overhang, a situation in which investment is reduced or postponed since the private sector anticipates that the returns from their investment will serve to pay back creditors (Krugman, 1988).

Enormous theoretical and empirical literature is prevalent which predominantly studied the impact of public debt on economic growth. Many of those studies find a negative impact (Geiger, 1990; Cunningham, 1993; Schclarek, 2004; Abofu and Abula, 2010; Panizza and Presbitero, 2014) and while others find a non-linear relationship between debt and economic growth across developing and developed countries (Smyth and Hsing, 1995; Cohen, 1997; Pattillo et al., 2002; Clements et al., 2003; Cecchetti et al., 2011; Checherita and Rother, 2010). Another strand of literature focused on the sustainability of public debt among countries (Buiter and Patel, 1992; Bohn, 1998; Afonso, 2005; Neck and Haber, 2012; Pradhan, 2016; Kaur and Mukherjee, 2012). Islam and Hasan (2007) empirically examined the effects of government debt on the interest rate, price, output and capital formation in the USA during the period between 1946 and 2000. Their study concluded that public debt increases inflation, with adverse effects on capital formation and real output. Much controversy surrounds the quantitative effects of government debt and deficits on long-term real interest rates. Laubach (2009) studied the impact of public debt and deficit on interest rate as the form of treasury yields. This study finds a significant relationship between government debt and interest rate. Fosu (1996) investigated the impact of external debt on growth and investment in sub-Saharan African countries over the 1970-1986 periods. This study finds that the burden of debt (measured as debt service or outstanding), is harmful to economic growth. Moreover, debt has a weak effect on investment levels and it is negatively affected the productivity in Sub-Saharan Africa.

The macroeconomic effects of public debt have always been a debated issue in the literature. Most of the empirical studies investigated the impact of public debt mostly in advanced and emerging countries. The empirical literature on the impact of public debt on major macroeconomic variables is scarce in India. Most of the earlier studies focused either the issue of debt sustainability or impact of debt on growth in India. The effect of

[4] It could contribute to the growth of income, additional revenue collection and improves the repayment capacity of the Government.

public debt on major macro variables is limited in India. With this motivation, the study assesses empirically the macroeconomic effects of public debt for India over the period from 1980-81 to 2017-18. Specifically, the main goal is to investigate the impact of public debt on four major macro variables, i.e., interest rate, investment, inflation and economic growth in India.

The study contributes to the existing literature on debt and Indian macro-economy in several ways. First, this study analyses the impacts of both the combined Central and State Governments' public debt, and the Central Government's public debt separately on the selected macro variables. Second, it has also examined separately the effects of domestic debt and external debt of the respective Governments, because the composition of public debt, share of external debt, risk characteristics of public debt, etc., might play a crucial role for maintaining sustainability and stability of the economy. This kind of analysis has not been carried out before. It is very worthwhile to understand how different types of public debt do affect the macroeconomy. It might help policymakers in framing their debt-management policy. Third, overall it finds that high public debt act as a burden for the economy, while domestic debt has a more adverse influence on the macro variables than external debt in India. Fourth, this study uses a sophisticated appropriate econometric tool such as Structural Vector Autoregression (SVAR) approach to gauge these dynamic linkages between public debt and other selected variables using the most recent period data of Indian economy.

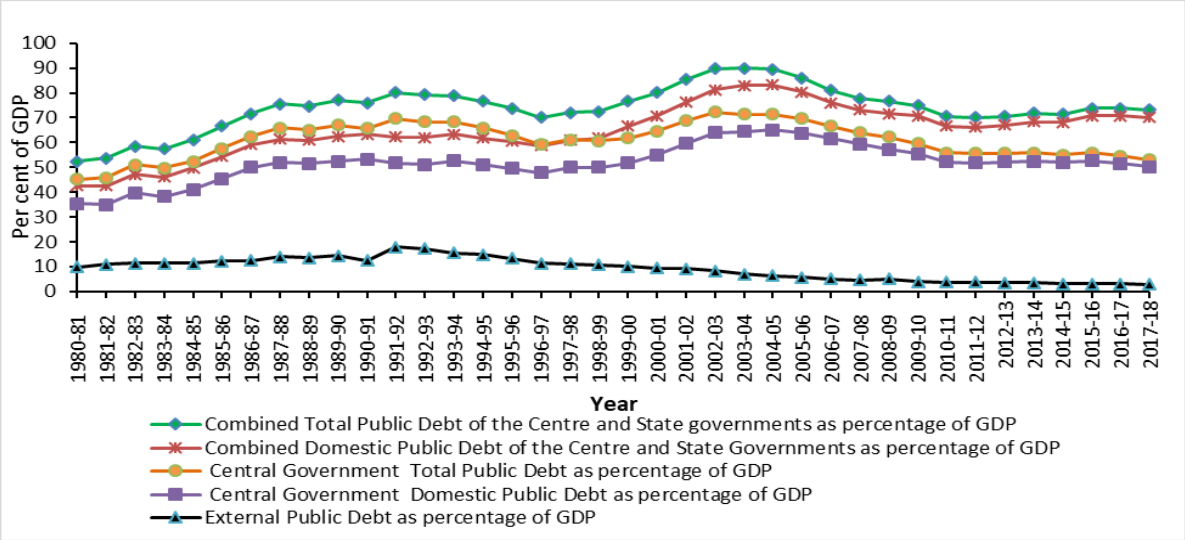
The organization of the paper is as follows. The trends in public debt are analyzed in section 2. Section 3 offers a brief review of the literature. The analytical framework of the study is discussed in Section 4. The data source and the methodology used in the study are provided in Section 5. The estimated empirical results are analyzed in Section 6. Finally, the conclusions and policy implications are presented in Section 7.

2. The Trends of Public Debt in India

Figure 1 displays the trends of the public debt of the Central Government and Combined public debt of the Central and State Governments[5] in India during FY 1980-81 to 2017-18.

[5] It is calculated by consolidating the liabilities of the Central Governments and the State Governments, netting out inter-governmental transactions. FY refers to financial year which ranges from April to March in India.

Figure 1: Trends in Indian Public Debt



Source: Authors calculation using the Data from HBS of RBI

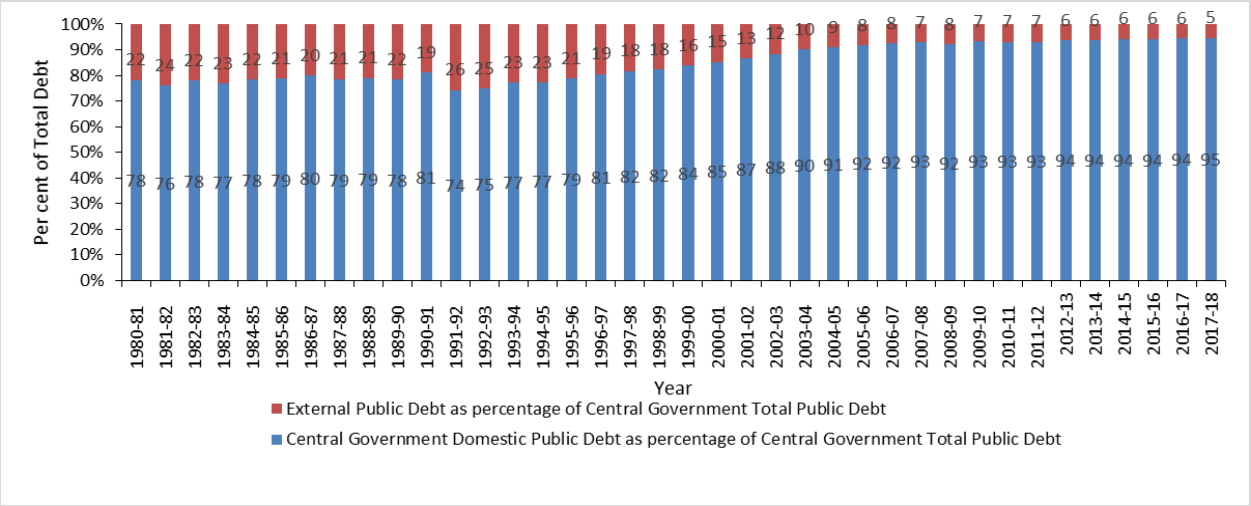
Total public debt can be classified into two heads, i.e., Internal/Domestic debt and External debt. The total public debt of the Central Government as a percentage of GDP has gone up from 45 per cent in FY 1980-81 to more than 53 per cent in FY 2017-18 (Figure 1). The average of Central Government's total public debt as a percentage of GDP in the 1980s, 1990s, 2000s, and 2010-2017 was 56.27 per cent, 64.36 per cent, 67.08 per cent, and 55.26 per cent respectively. It reached a maximum of 72.34 per cent in 2002-03 and recorded minimum of 45.26 per cent in 1980-81. Similarly, the domestic debt of the Central Government as a percentage of GDP has increased from 35 per cent in 1980-81 to more than 50 per cent in 2017-18. It recorded maximum 65.07 per cent in 2004-05 and minimum of 34.86 per cent in 1981-82. It is also found that the external debt[6] as a percentage of GDP has been decreasing from nearly 10 per cent in 1980-81 to less than 3 per cent in recent years. The average external debt as a percentage of GDP was 12.19 per cent in 1980s, 13.47 per cent in 1990s, 6.49 per cent in 2000s and 3.38 per cent during 2010-17. After the new economic policy introduced during 1991-92, external debt has shown consistently a declining trend.

A similar pattern of the trend is also observed for the combined total public debt and combined domestic public debt during 1980-81 to 2017-18 (Figure 1). Combined total public debt has shown an increasing trend from 1980-81 to 1991-92 due to fiscal stress

[6]Article 293(1) of the Indian Constitution empowers State Governments to borrow only from domestic sources. Thus, State Governments are not empowered to contract external debt and those intended for State government projects are on lent to states in India. Most of the external debt is from multilateral institutions like IDA, IBRD, ADB etc. which are of long term, at fixed interest rate, and largely on concessional terms.

and high primary deficits. Then, the debt position was slightly improved during 1992-93 to 1996-97 because of the major structural reforms were undertaken in 1991-92 to tackle the balance of payment crisis faced. The debt liabilities again accumulated sharply up to 2003-04 due to an increase in expenditure linked to the fifth pay commission award and sluggish revenue growth during that period. The public debt has shown a declining trend since 2003-04 due to the adoption of fiscal consolidation path by the enactment of the Fiscal Responsibility and Budget Management (FRBM) Act, 2003 as well as high rate of nominal economic growth. The public debt to GDP ratio has stabilized in recent years. The slight increasing trend of it after 2012-13 might be due to various domestic and global factors. The combined domestic debt has a similar pattern as the combined total public debt during the same period.

Figure 2: Domestic Debt and External Debt as a percentage of Total Debt



Source: Authors calculation using the Data from HBS of RBI.

External debt constituted only 5 per cent share in total public debt of the Central Government in recent year. Domestic debt constitutes a major part of (nearly 95 per cent in recent years) total public debt in India (Figure 2). The share is also almost similar in combined total public debt in India. Thus, the above trend analysis shows that public debt in India has increased during the study period. The government relies profoundly on domestic borrowing as domestic debt constitutes a major part of the total public debt, while the share of external debt in the total public debt has declined over time. Therefore, it would be very interesting to verify the macroeconomic impact of various types of public debt in India.

3. Review of literature:

The extent of literature empirically verified the sustainability of public debt in a global context (Trehan and Walsh, 1988; Bohn, 1998; Afonso, 2005; ADB, 2010). In the case of Germany, Fincke and Greiner (2011) find that public debt is not sustainable in West Germany. In the case of Austria, Neck and Haber (2012) suggest that Austria may attain the sustainability of public debt by increasing the level of primary surplus. In the case of India, Mohan et al. (2005) investigate the government's debt sustainability, by using decomposition analysis. They suggest that if the government follows the recent trend, as a result, both Central government and the combined Central and State Government's debt would stabilize below the level set by the Eleventh Finance Commission at the end of 2009–2010. However, Pradhan (2016) argues against the presence of Ricardian equivalence in the case of India, highlighting that the fiscal policy is harmful to generational welfare neutrality.

There is an extensive external debt burden created by the structural problem of most of the economies, which produces a significant problem to attain rapid and sustainable growth and development. In a cross-country study, Hansen (2001) finds strong positive evidence on the impact of aid on growth and investment rate. However, he also suggests that there is a negative effect of debt and debt services on growth and investment. This study provides complex evidence on the relationship between external debt and aid flows, and macroeconomic effectiveness. Pattillo et al. (2011) found a non-linear impact of external debt on economic growth during 1969-98, using a panel data of 93 developing countries. They suggested the average impact of debt on growth becomes negative when debt is at about 160-170 per cent of exports or 35-40 per cent of GDP. Moreover, Checherita and Rother (2010) examine the impact of public debt on economic growth in twelve Euro area countries over a period of about 40 years from 1970-2009. The study showed a non-linear negative impact of government debt on economic growth. However, Geiger (1990) finds the negative relationship between the debt burden and economic growth, in the case of Latin America. Further, Cunningham (1993) suggests that the growth of public debt and economic growth are negatively related in the heavily indebted developing nations. In the case of Nigeria, Adofu and Abula (2010) find that public debt negatively influences economic growth and they suggest the government should increase their tax revenue through reform to resolve the outstanding public debt.

Panizza and Presbitero (2014) found a negative relationship between public debt and economic growth in OECD countries. They suggested that there was no link between debt and growth when they corrected the endogeneity problem, by using an instrumental

variable approach. Sheikh et al. (2010) studied the impacts of domestic debt on economic growth and also observed the impact of domestic debt servicing on economic growth in Pakistan applying the ordinary least square (OLS) technique for the period of 1972 to 2009. The study indicated that the negative impact of domestic debt servicing on economic growth is stronger than the positive impact of domestic debt on economic growth. Muhdi and Sasaki (2009) examined the roles of external and domestic debt in Indonesia's macroeconomic situation by applying OLS estimation for the period 1991 to 2006. The study showed a positive effect of the rising trend of external debt on both investment and economic growth. Woo and Kumar (2015) studied the impact of high public debt on long-run economic growth for a panel of advanced and emerging economies. Their empirical results found an inverse relationship between initial public debt and subsequent growth. Reinhart and Rogoff (2010) provided evidence of a negative link between public debt and growth by examining economic growth at different levels of government debt in a sample of forty-four countries spanning about two hundred years. They argued that growth slows down by about 1 percentage point when debt to GDP ratio exceeds 90 per cent threshold. However, Herndon, Ash and Pollin (2014) replicated the same Reinhart and Rogoff (2010) study and found that GDP growth deteriorated even higher (2.2 per cent) when countries crossed the threshold of 90 per cent of debt to GDP ratio. Karagol (2002) investigated the long-run and short run relationship between economic growth and external debt service for Turkey during 1956-1996. The study found a negative short run impact on economic growth and a unidirectional relationship between debt service and economic growth.

In the case of India, Rangarajan and Srivastava (2005) indicated that large structural primary deficit and higher interest payment might be adversely affecting growth and suggested that the adverse effects of public debt on growth need to be brought down from the higher level. Singh (1999) explored the relationship between domestic debt and economic growth in India by applying cointegration technique and Granger causality test for the period of 1959-95. The study supported the Ricardian Equivalence Hypothesis (REH) between domestic debt and growth in India. Similarly, Kannan and Singh (2007) find that public debt and fiscal deficit are negatively influencing interest rate, output, inflation and trade balance in the long run. However, Goyal (2013) finds a positive relationship between public debt and economic growth. Kaur and Mukherjee (2012) examined the impact of debt on economic growth along with the debt sustainability in India. They found that public debt in India is sustainable and also found a statistically significant non-linear relationship between public debt and growth in India. The sustainability of public debt in India is studied by addressing the issue of a regime shift, co-integration and

other techniques, etc., (Jha and Sharma, 2004; Goyal et al., 2004). In the case of India, Bal (2014) examined the impact of public debt on the interest rate, output and gross fixed capital formation during 1998Q4-2012Q4. This study finds that public debt has a positive influence on output and gross fixed capital formation. These present studies are limited and ambiguous, particularly, in the case of India. Therefore, it is interesting to study the impact of public debt on Indian macro-economy.

4. The Analytical Framework

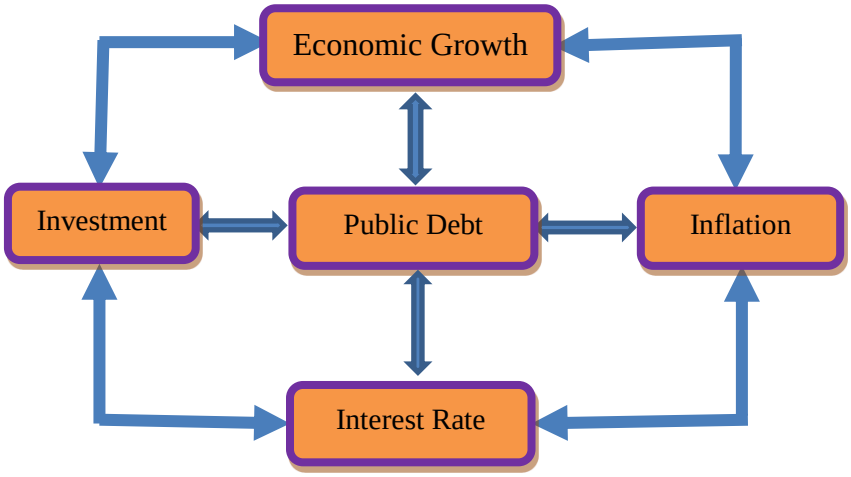
Different theoretical arguments are discussed in the literature regarding the impacts of public debt on the economy as follows. In a Keynesian approach, a rise in the public debt induced by bond financed fiscal policy will enhance the level of income, aggregate demand, investment and output in the economy. As per Keynesian approach, if the household sector perceives Government bonds and securities as net wealth, then it will further increase private consumption expenditures, transaction demand for money, interest rate and prices because of higher aggregate demand than supply in the short run. Further, it will enhance investment in the economy through the accelerator effect. Thus, overall, public debt has a favourable impact on the economy.

However, according to the classical or traditional view, an increase in public debt has an adverse impact on the economy based on the crowding out controversy. The basic argument is that by possessing Government bonds and securities, the consumers would consider themselves to be wealthier and therefore would resort to higher spending. In the short run, higher consumer spending would raise the demand for goods and services and thus raise output and employment. The higher aggregate demand results in a higher price level in the short run. As the marginal propensity to consume is higher than marginal propensity to save, the increase in private savings falls short of Government dissaving. It increases the real interest rate in the economy. Then, the higher interest rate would discourage investment and thus crowds out private investment. An increase in the higher interest rate would also attract the inflows from abroad, which results in greater foreign debt. The lower domestic savings mean a smaller capital stock. The lower investment eventually leads to lower steady-state capital stock and a lower level of output. Therefore, public debt is considered as a burden to the economy as the overall impact would be smaller total output, eventually lower consumption, and reduced economic welfare in the long run (Meltzer, 1951; Modigliani, 1961).

The Ricardian equivalence theory argues that public debt has no real impact on the economy (Barro, 1974). Bearing in mind that consumers are rational, forward-looking

and perfect capital mobility, the discounted sum of future taxes is equivalent to the current deficit. The rational consumer-facing current deficits save for a future rise in taxes and consequently, total savings in the economy are not affected. A decrease in Government dissaving is matched by an increase in private savings. So, the shift between taxes and deficits does not produce aggregate wealth effects. Thus, due to unchanged total savings, interest rates, investment and national income are also unaffected.

Chart 1: Analytical Framework



Following the above theoretical arguments, the impact of public debt on crucial macro variables can be explained in chart 1.

A fresh public debt requires the Government would have to issue bonds and securities and it may offer an interest rate that is attractive to investors. Ceteris paribus, the increased supply of bonds and securities may exert downward pressure on the prices of the Government bonds and securities. Hence, it drives up interest rates, which would curtail any private investment that is not self-financed. Higher long-term interest rates, resulting from more debt-financed Government budget deficits, can crowd out private investment, thus paves the way for dampening potential output growth. Similarly, excessive public borrowing may lead to a reduction of the supply of loanable funds from the banking system to the private sector in a developing economy. Public sector competes with the private sector for scarce physical and financial resources in these economies. Hence, it may lead to crowding out of private sector investment in the economy, which adversely affects economic growth. High and rising public debt due to unsustainable fiscal policies might induce seigniorage financing which consequently affects inflation in an economy. The income and wealth effect of the rising public debt leads to a rise in aggregate demand and inflation in the economy (Keynesian approach). However, all of these above macro

variables are endogenous in nature. For example, a high-interest rate also helps in a rise in public debt; investment does affect economic growth and vice-versa. Inflation does influence growth, interest rate, investment etc. Due to this interrelationship among these variables, the study intends to examine the objective by using a VAR framework, which treats each variable as endogenous in the system.

$$y_t = a + \beta y_{t-p} + u_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where, yt = f (public debt, inflation, interest rate, economic growth and investment). The other notations are explained in the next section.

5. Data and Methodology

5.1: Data

The objectives of the study are examined by using annual time series data covering the period from 1980-81 to 2017-18. The variables, namely, gross domestic product at factor cost (GDP), gross capital formation (GCF), total public debt of the Centre, domestic public debt of the Centre, external public debt of the Centre, combined total public debt of the Centre and state Governments, combined domestic public debt of the Centre and States, long term interest rate and inflation rate, are considered in the study. Per capita GDP is taken as a proxy for economic growth and GCF as a percentage of GDP is taken as a proxy for investment. All types of public debt are taken as a percentage of GDP. The growth rate of GDP deflator is considered as a proxy for the Inflation rate. Annual (Gross) Redemption Yield of long term Government of India Securities (15 years and above) is used as a proxy for the rate of interest. The real interest rate is calculated by subtracting the inflation rate from the nominal interest rate. All variables are measured in real terms by using GDP deflator. All variables except inflation rate and interest rate are converted to natural log. The detailed description of the variables used in the study is given in Table 1. The summary statistics of the selected variables are presented in Table 2 (see appendix). The data on these variables are obtained from 'Handbook of Statistics on Indian Economy' of Reserve Bank of India (RBI). Various suitable econometric methods like unit root tests, ARDL Bounds test and Structural VAR methods are used to examine the objectives of the study.

5.2: Methodology

The Structural Vector Autoregression (SVAR) methodology is adopted to examine the dynamic relationship between public debt and other relevant macro variables in India. The VAR approach was criticized as being devoid of any economic content and its atheoretical nature, which eventually led to the development of the SVAR model. The

SVAR methodology can accommodate the contemporaneous and dynamic relationships among macroeconomic variables, which are broadly consistent with the economic theories and stylized observed facts. It recovers the structural parameters from a reduced form of the VAR model. Hence, it helps in policy decisions by providing sensible solutions to various economic issues and problems.

Table 1: Description of the selected variables

Variables	Description
LPD	Log of the combined total public debt of the Centre and State Governments as a percentage of GDP
LDPD	Log of the combined domestic public debt of the Centre and State Governments as a percentage of GDP
LCPD	Log of the total public debt of the Centre as a percentage of GDP
LCDPD	Log of the domestic public debt of the Centre as a percentage of GDP
LCEPD	Log of the external public debt of the Centre as a percentage of GDP
INF	Inflation rate
RI	Real interest rate
LPG	Log of per capita GDP
LGC	Log of gross capital formation

5.2.1: SVAR Model

The relationships between public debt, inflation, interest rate, economic growth and investment are examined within an SVAR framework as follows.

$$y_t = f\{ u_t^{LPD}, u_t^{INF}, u_t^{RI}, u_t^{LPG}, u_t^{LGC} \} \quad \text{..... (2)}$$

Since the structural shocks in equation (2) are unobservable, additional identifying restrictions are necessary to uncover the underlying structural shocks in the model. The main purpose of SVAR estimation is to obtain non-recursive orthogonalisation of the error terms for impulse response analysis. A five-variable VAR[7] model has been considered in order to extract the five structural shocks.

In matrix notation,

$$B_0 y_t = a + B(L) y_{t-p} + u_t \quad \text{..... (3)}$$

[7] The order of the unrestricted VAR has been determined as one according to the Schwarz information criteria (SBC), Akaike information criterion (AIC) and Hannan-Quinn information criteria (HQ) and stability condition was satisfied. The lag selection criteria is presented in Table 3 (Appendix).

Where, y_t is a 5x1 vector, a is a 5x1 vector of constants, u_t is a 5x1 structural disturbances vector. Here, u_t is serially and mutually uncorrelated, while p refers to the number of lags.

The matrix B_0 is described by

$$B_0 = \begin{bmatrix} 1 & B_{12} & B_{13} & B_{14} & B_{15} \\ B_{21} & 1 & B_{23} & B_{24} & B_{25} \\ B_{31} & B_{32} & 1 & B_{34} & B_{35} \\ B_{41} & B_{42} & B_{43} & 1 & B_{45} \\ B_{51} & B_{52} & B_{53} & B_{54} & 1 \end{bmatrix}$$

By pre-multiplying B_0^{-1} in both sides of the equation (3), the following reduced form is obtained:

$$A(L)y_t = c + \varepsilon_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where $c = B_0^{-1}\alpha$; ε_t is the vector of errors from the reduced form VAR models; $\varepsilon_t = B_0^{-1}u_t$. Thus, the structural disturbances (u_t) and the reduced form errors (ε_t) are related by $u_t = B_0\varepsilon_t$; $A(L) = B_0^{-1}B(L) = I_n - A_1L - A_2L^2 \ldots\ldots\ldots A_pL^p$. The impulse response functions will be given by $A(L)^{-1}B_0^{-1}$ and to make B_0 invertible, at least $(n*(n-1))/2$ restrictions have to be imposed to exactly identify the system. In order to identify the effects of structural shocks, the study has imposed a number of restrictions on the parameters of the matrices B_0.

5.2.2: Restrictions

The following assumptions have been made regarding the structural shocks: Shocks to other variables in the system have no effects on public debt (LPD). It is assumed to be a policy variable, which appears to be the most exogenous variable to the system. Inflation (INF) is assumed to be affected by shocks to public debt and itself. Public debt implies that the Government injects more money into the economy, which leads to an increase in aggregate demand in the economy. Similarly, by possessing Government securities, households feel wealthier which enhances their demand for goods and services. The higher aggregate demand results in a higher price level in the economy. The real interest rate is assumed to be affected by shocks to public debt, inflation and itself. As debt financing causes a supply of fresh Government securities in the securities market. The increased supply of Government securities (ceteris paribus) would put downward pressure on the

prices of these Government securities. Hence, it drives up domestic interest rates. A connection between inflation and interest rate is based on the Fisher effect. Growth is assumed to be affected by shocks to public debt, inflation and itself. The relationship between public debt and growth is clearly discussed in the introduction. A moderate and stable inflation rate accelerates economic growth by enhancing investment, creating a favourable business environment, export competitiveness etc., while persistence of high inflation rate may lead to uncertainty about the future profitability of investment projects. Thus, the borrowing requirements and public debt burden would induce interest rates on Government securities, which may attract further capital inflows. It is assumed that shocks to public debt (crowding out/in), inflation, interest rate, and growth are assumed to affect investment.

The system of equations derives by putting these restrictions can be specified as follows:

$$e_t^{LPD} = \beta_{11} u_t^{LPD} \quad \text{.......... (5)}$$

$$e_t^{INF} = \beta_{21} u_t^{LPD} + \beta_{22} u_t^{INF} \quad \text{.......... (6)}$$

$$e_t^{RI} = \beta_{31} u_t^{LPD} + \beta_{32} u_t^{INF} + \beta_{33} u_t^{RI} \quad \text{.......... (7)}$$

$$e_t^{LPG} = \beta_{41} u_t^{LPD} + \beta_{42} u_t^{INF} + \beta_{43} u_t^{LPG} \quad \text{.......... (8)}$$

$$e_t^{LGC} = \beta_{51} u_t^{LPD} + \beta_{52} u_t^{INF} + \beta_{53} u_t^{RI} + \beta_{54} u_t^{LPG} + \beta_{54} u_t^{LGC} \quad \text{.......... (9)}$$

The imposed restrictions can be presented in a matrix form, i.e.

$$\begin{bmatrix} e_t^{LPD} \\ e_t^{INF} \\ e_t^{RI} \\ e_t^{LPG} \\ e_t^{LGC} \end{bmatrix} = \begin{bmatrix} * & 0 & 0 & 0 & 0 \\ * & * & 0 & 0 & 0 \\ * & * & * & 0 & 0 \\ * & * & 0 & * & 0 \\ * & * & * & * & * \end{bmatrix} \begin{bmatrix} u_t^{LPD} \\ u_t^{INF} \\ u_t^{RI} \\ u_t^{LPG} \\ u_t^{LGC} \end{bmatrix} \quad \text{.......... (10)}$$

6. Empirical Analysis

6.1: Testing for Unit Roots

The first step in time series analysis is to check the stationarity properties of the variables. It is detected by using both Augmented Dickey-Fuller (ADF) and Phillips-Perron

(PP) tests. The null hypothesis of both ADF and PP tests states that the series is non-stationary [presence of unit root or I(1)], while the alternative hypothesis implies that the series is stationary [I(0)]. If the absolute computed value exceeds the absolute critical value, then we reject the null hypothesis and conclude that the series is stationary and vice-versa. The results of the unit root tests for the selected variables are reported in Table 4. All the variables, except interest rate, are non-stationary in their levels and become stationary at first difference. It shows that the selected interest rate is a level stationary. Both the ADF test and PP test produce similar results for the selected variables. Thus, the results of unit root tests confirm that the selected variables are a mix of both I(0) and I(1).

Table 4: Results of Unit Root Test

Variables	ADF Test		PP Test		Decision
	Level	First Difference	Level	First Difference	
LPD	-2.42	-3.95**	-2.11	-3.89**	I(1)
LDPD	-2.46	-4.01**	-1.84	-4.09**	I(1)
LCPD	-1.98	-4.70***	-1.99	-4.78***	I(1)
LCDPD	-2.30	-4.95***	-1.63	-5.09***	I(1)
LCEPD	-2.43	-7.26***	-2.43	-7.16***	I(1)
INF	-2.84	-7.88***	-2.93	-7.88***	I(1)
RI	-3.08**	-6.31***	-3.08**	-6.31***	I(0)
LPG	-1.63	-5.16***	-1.32	-5.10***	I(1)
LGC	-2.37	-8.29***	-2.49	-8.35***	I(1)

Note: ***, ** and * denotes 1 and 5 per cent levels of significance respectively.

6.2: ARDL Bounds Test

After testing the unit roots, it is desirable to understand whether there exists any cointegration relationship among the selected variables. As the selected variables are of the mixed order of integration, i.e., I(0) and I(1), the study has applied the Autoregressive distributed lag (ARDL) bounds testing approach to test the long-run relationship among the selected variables. The bounds test imposes a linear restriction on the coefficient of one period lagged level of variables. The null and alternative hypotheses are as follows:

$H_0 = b_1 = b_2 = b_3 = b_4 = b_5 = 0$ (No long-run relationship)

$H_1 = b_1 \neq b_2 \neq b_3 \neq b_4 \neq b_5 \neq 0$ (Long-run relationship exists)

Where,

b_i is the coefficient of one period lagged level of variables of the chosen models. The computed F-test will be compared with the critical tabulated values given by Pesaran et al. (2001). Here, According to Pesaran et al. (2001), the lower-bound and upper-bound critical values assume that the explanatory variables are integrated to the order of zero [I(0)] and integrated to the order of one [I(1)], respectively. If the estimated F-values is smaller

than the lower critical bound value, then null hypothesis of no long-run relationship is accepted, whereas, if the estimated *F*-statistic is higher than the upper bound critical value, then the alternative hypothesis of long-run relationship is accepted. However, if the estimated F-statistic falls in between lower and upper bound critical value, then the result is inconclusive. The computed results are reported in Table 5.

Table 5: Results of Bound tests

ARDL Model	F-Stat.	ARDL Model	F-Stat.
LPD=f(INF,RI,LPG,LGC)	2.96	LPG=f(LPD, RI, INF, LGC)	1.32
LDPD=f(INF,RI,LPG,LGC)	3.19	LPG=f(LDPD, RI, INF, LGC)	1.24
LCPD=f(INF,RI,LPG,LGC)	3.24	LPG=f(LCPD, RI, INF, LGC)	2.14
LCDPD=f(INF,RI,LPG,LGC)	3.24	LPG=f(LCDPD, RI, INF, LGC)	1.69
LCEPD=f(INF,RI,LPG,LGC)	1.78	LPG=f(LCEPD, RI, INF, LGC)	1.44
INF=f(LPD,RI,LPG,LGC)	2.08	LGC=f(LPD, RI, INF, LPG)	3.42
INF=f(LDPD,RI,LPG,LGC)	2.63	LGC=f(LDPD, RI, INF, LPG)	3.72
INF=f(LCPD,RI,LPG,LGC)	2.09	LGC=f(LCPD, RI, INF, LPG)	3.49
INF=f(LCDPD,RI,LPG,LGC)	2.13	LGC=f(LCDPD, RI, INF, LPG)	3.52
INF=f(LCEPD,RI,LPG,LGC)	2.31	LGC=f(LCEPD, RI, INF, LPG)	3.23

Critical Value Bounds of the F-Statistic					
10 per cent		5 per cent		1 per cent	
I(0)	**I(1)**	**I(0)**	**I(1)**	**I(0)**	**I(1)**
3.03	4.06	3.47	4.57	4.4	5.72

The results show that the calculated F-statistics of all the selected models are smaller than the upper bound critical values found by Pesaran et al. (2001) at the five per cent level. Hence, the null hypothesis of no long-run relationship between the variables is not rejected at 5% significant level. Therefore, it may be concluded that there is no long-run relationship between these variables. In the next section, the short-run dynamics among the variables are estimated using the SVAR framework.

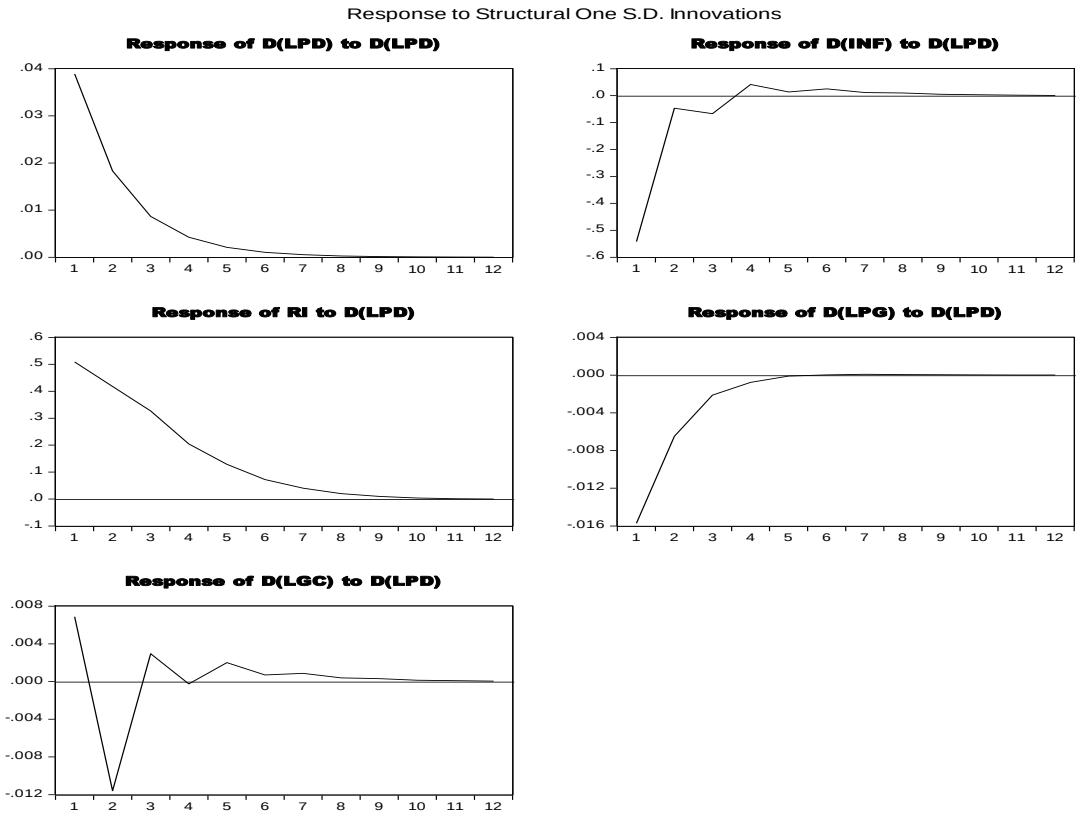
6.3: Impulse Response Functions

The ARDL bounds test showed that there is no long run relationship between these variables. Then, the SVAR approach is applied to examine the short-run dynamics among the variables. The estimated results of Impulse Response Functions (IRF) and the forecasted error variance decompositions are presented over twelve-period horizons. The IRF trace over time the effects of structural shocks on the endogenous variables. Following AIC, SC and HQ criteria, it has chosen the optimum of lag 1 for all the selected models.

Figure 3 and Figure 4 show the impulse responses of the selected variables when one standard deviation innovation is given to combined Government total public debt (LPD)

and combined Government domestic debt (LDPD) respectively. The results (Figure 3) show that shock to LPD has a negative effect on growth and inflation up to the fourth period, while it has a positive effect on the real interest rate and itself. However, it has a mixed response on investment, i.e., both positive and negative in the successive periods. The one standard deviation shock to LDPD has also an almost similar pattern of effects on the selected variables (Figure 4). The reaction of economic growth to both LPD and LDPD shocks is negative, but after a period of five/six years, the effects die away. The shock to both of these public debts has a strong and long-lasting positive impact on the real interest rate. Public debt has a negligible impact on inflation and investment in the longer horizon. Thus, the results confirm that public debt has an adverse impact on economic growth and raises the interest rate in the Indian economy.

Figure 3: Impulse Response Function for Combined Government Total Public Debt



After analyzing the public debt at combined Government of both Centre and States, it would be very interesting to verify how these major variables react to the public debt at the Central Government level. Figure 5, figure 6 and figure 7 show the impulse responses of the selected variables, when one standard deviation innovation is given to the total

public debt (LCPD), the domestic debt (LCDPD) and the external debt (LCEPD) respectively. The IRF results show that all types of public debt of the Central Government have an adverse effect on the growth of the economy, similar to the above previous findings. A shock to LCPD and LCDPD has a positive impact on the real interest rate, while a shock to LCEPD has a negative effect on the real interest rate. It also confirms that shocks to all types of public debt have mixed and very negligible response on investment and inflation. The impact of external debt has some volatile impact on investment as the funds raised from external sources might be used in a productive manner like infrastructure development, capital formation etc. In the next section, we analyze the magnitude of the response of selected variables to a shock in different types of public debt in the next section.

Figure 4: Impulse Response Function for Combined Government Domestic Public Debt

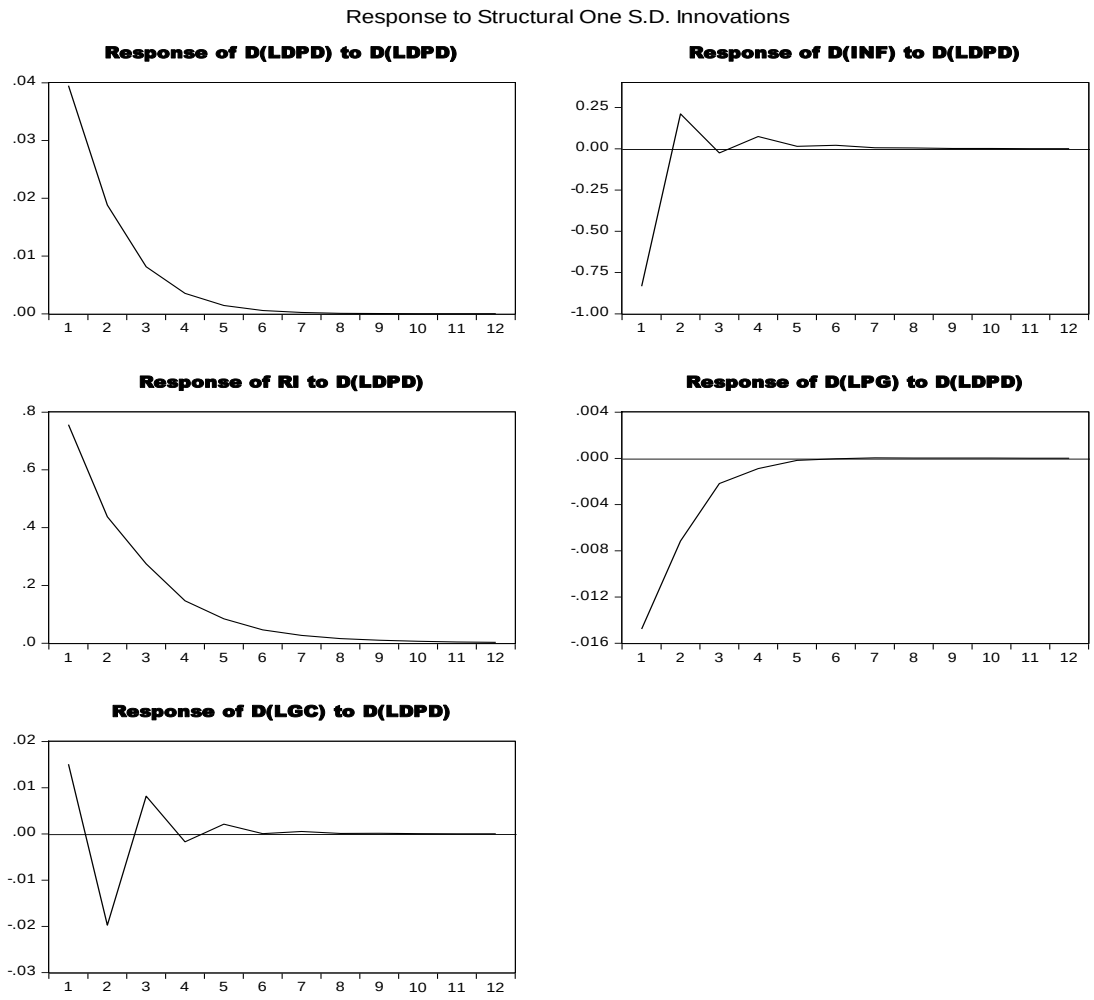


Figure 5: Impulse Response Function for Central Government Total Public Debt

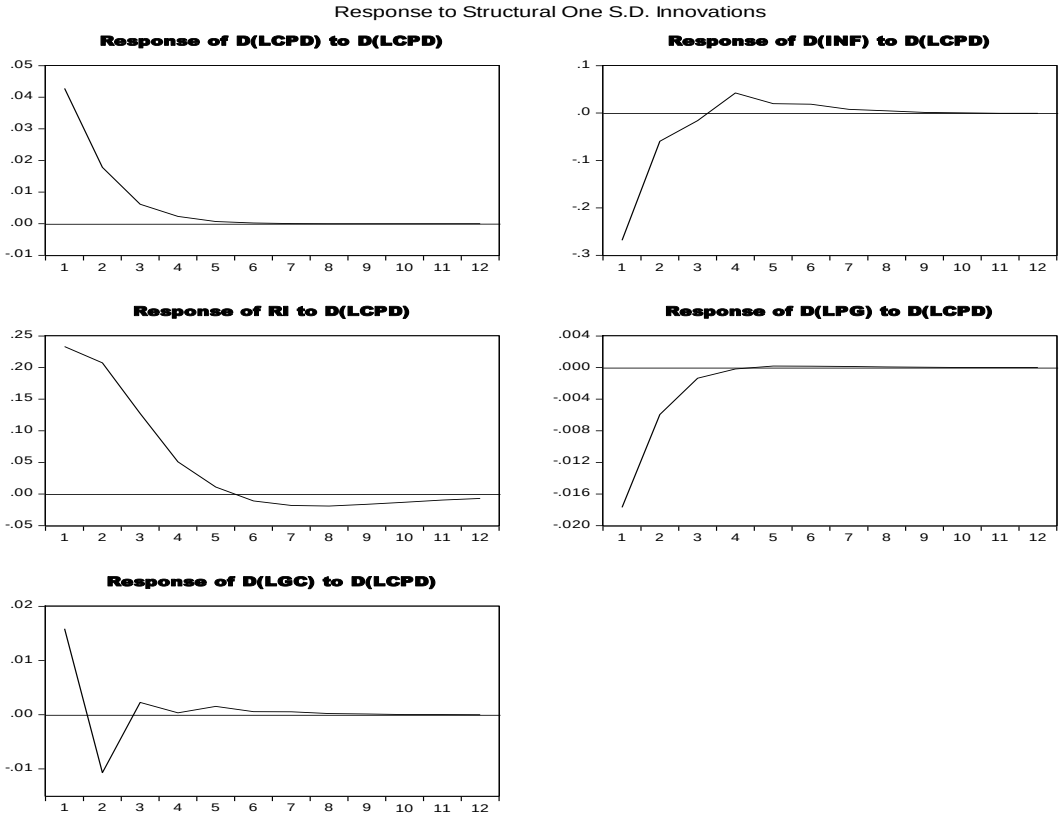


Figure 6: Impulse Response Function for Central Government Domestic Public Debt

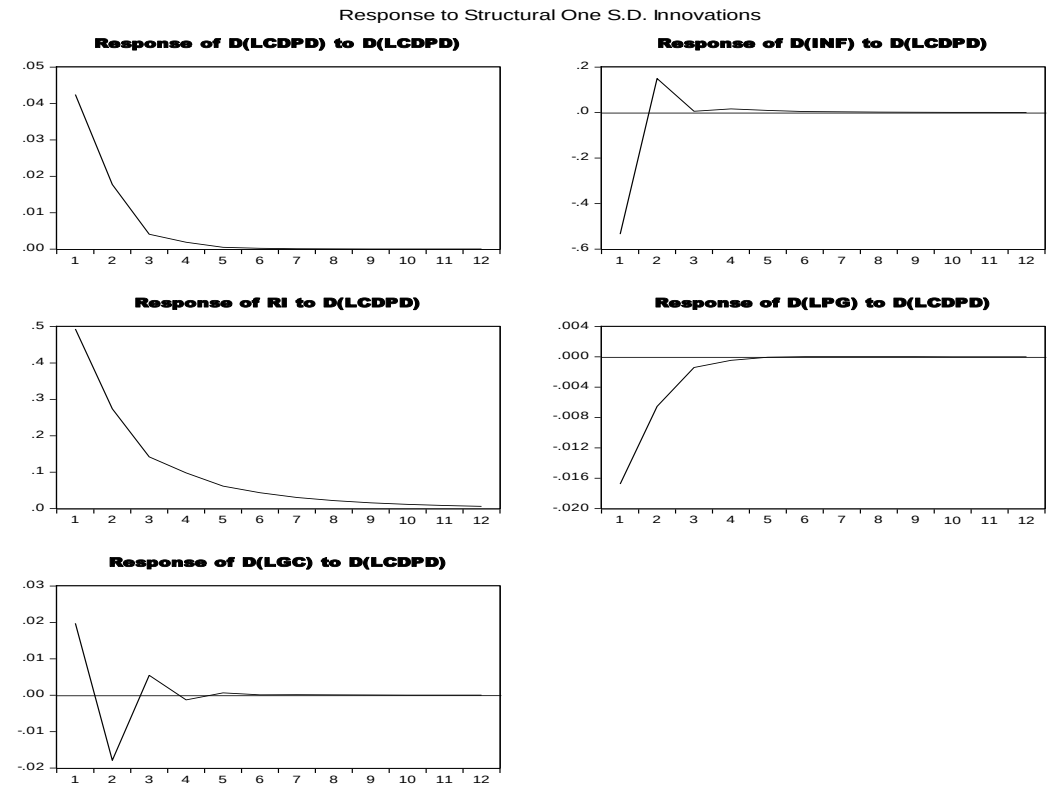
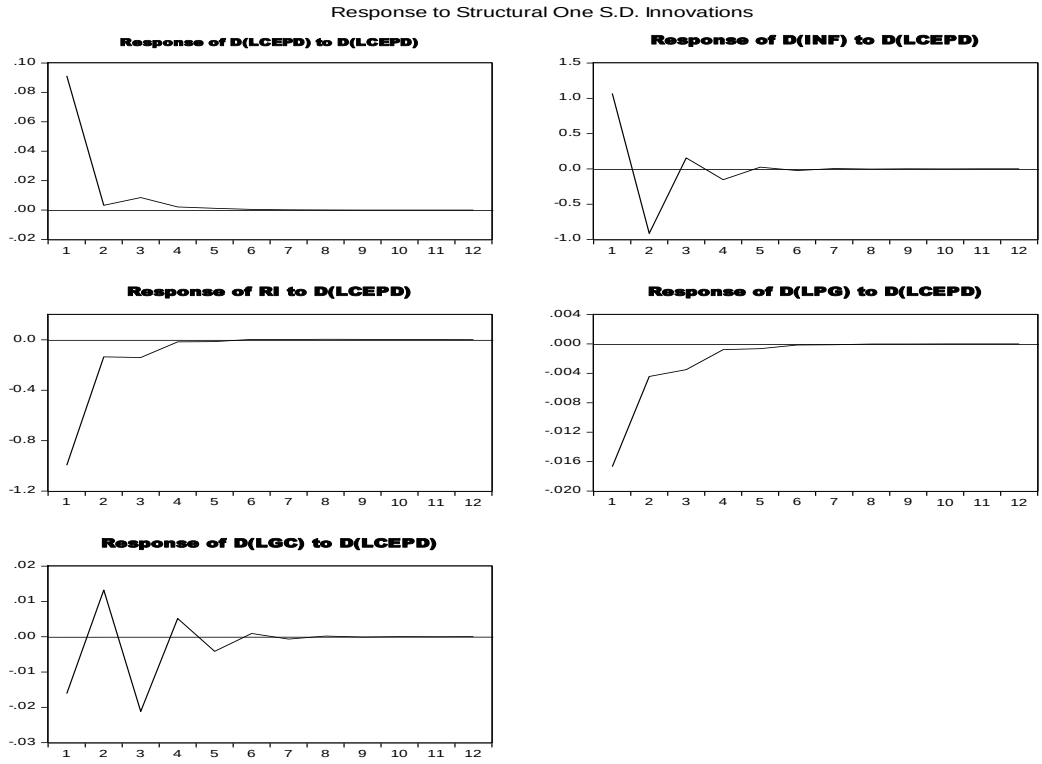


Figure 7: Impulse Response Function for Central Government External Public Debt



6.4: Magnitude of Impulse Response Analysis

Table 6 and 7 explain the size of one standard deviation shock to various public debt on selected macro variables for the first three annual years.

It is clearly seen that the impact of a shock to LDPD is larger on inflation, real interest rate, growth and investment than a shock to LPD. The similar findings are observed while analysing the impact on public debt of the Central Government, i.e., a shock to LCDPD has a larger effect than a shock to LCPD. Thus, it finds that domestic debt has a more adverse impact than total public debt which includes external debt. A shock to LCEPD has a negative impact on the real interest rate. External debt is less harmful than the domestic debt in India.

Table 6: Magnitude of Shocks to Public Debt on Selected Macro Variables

	D(INF)		RI		D(LPG)		D(LGC)	
Period	D(LPD)	D(LDPD)	D(LPD)	D(LDPD)	D(LPD)	D(LDPD)	D(LPD)	D(LDPD)
1	-0.542	-0.833	0.509	0.757	-0.016	-0.015	0.007	0.015
2	-0.047	0.211	0.418	0.438	-0.006	-0.007	-0.012	-0.020
3	-0.067	-0.025	0.327	0.275	-0.002	-0.002	0.003	0.008

Table 7: Magnitude of Shocks to Central Government Public Debt on Selected Macro Variables

	D(INF)			RI		
Period	D(LCPD)	D(LCDPD)	D(LCEPD)	D(LCPD)	D(LCDPD)	D(LCEPD)
1	-0.268	-0.534	1.069	0.233	0.493	-0.995
2	-0.060	0.150	-0.914	0.207	0.274	-0.135
3	-0.016	0.006	0.155	0.127	0.142	-0.141
	D(LPG)			**D(LGC)**		
Period	D(LCPD)	D(LCDPD)	D(LCEPD)	D(LCPD)	D(LCDPD)	D(LCEPD)
1	-0.018	-0.017	-0.017	0.016	0.020	-0.016
2	-0.006	-0.007	-0.004	-0.011	-0.018	0.013
3	-0.001	-0.001	-0.003	0.002	0.005	-0.021

Overall the IRF results show that various types of public debt especially domestic debt act as a burden on the economy as it has a negative impact on economic growth in India. The results support the traditional view of the negative relationship between total public debt and economic growth. Indian public debt induces interest rate, while it has a moderate effect on both inflation and investment. Hence, there is a need for controlling high public debt in India. Next section is devoted to the analysis of sources of variation among the selected variables.

6.5: Variance Decomposition Analysis

A variance decomposition is a useful tool that provides information about the relative importance of each of the shocks in the system. It measures the proportion of the movement of a variable due to shocks to itself and to shocks to other variables. Table 8 to 12 report percentage of the forecast error variance of selected variables due to shocks in the structural VAR model for one to three year, sixth year and twelfth-year horizon in the future.

The results indicate that 98 per cent of the variation in total public debt (both combined and Central Govt.) is explained by its own shock. In the case of domestic and external debt, much of the variation is explained by its own shock followed by growth, inflation and interest rate. Further, it shows that much of the variation in inflation is explained by itself, growth and domestic public debt, a very small variation is explained by interest rate and investment. Then, the variation in the real interest rate is largely affected by inflation, itself, growth and public debt. Similarly, more than 90 per cent of the variation in economic growth is due to shock in public debt and itself. The rest of the variation is explained by inflation, interest rate and investment. Finally, the variation in investment is explained more by itself, growth, inflation and public debt, with a negligible amount

explained by the interest rate. In a longer horizon, the influence of growth, inflation and public debt has been increasing towards the variation in investment.

Table 8: Variance Decomposition with Total Public Debt

Period	S.E.	D(LPD)	D(INF)	RI	D(LPG)	D(LGC)
Variance Decomposition of D(LPD):						
1	0.04	98.55	1.00	0.45	0.01	0.00
2	0.04	98.73	0.83	0.37	0.07	0.00
3	0.04	98.75	0.81	0.37	0.07	0.00
6	0.04	98.64	0.87	0.41	0.08	0.00
12	0.04	98.61	0.88	0.42	0.08	0.00
Variance Decomposition of D(INF):						
1	1.88	8.29	73.16	1.73	15.57	1.25
2	2.06	6.99	65.33	1.59	22.70	3.40
3	2.07	7.02	65.05	1.58	22.46	3.89
6	2.08	6.99	64.77	1.70	22.56	3.99
12	2.08	6.99	64.75	1.72	22.55	3.99
Variance Decomposition of RI:						
1	1.72	8.78	49.24	24.50	17.19	0.29
2	2.03	10.52	48.68	28.15	12.32	0.33
3	2.21	11.05	48.93	29.21	10.53	0.29
6	2.34	11.02	48.31	29.90	10.50	0.26
12	2.35	10.97	48.21	29.92	10.64	0.26
Variance Decomposition of D(LPG):						
1	0.02	52.36	3.35	0.42	43.81	0.06
2	0.02	54.52	3.21	0.45	41.63	0.19
3	0.02	54.09	3.32	0.46	41.89	0.23
6	0.02	53.98	3.41	0.52	41.85	0.24
12	0.02	53.95	3.44	0.54	41.83	0.24
Variance Decomposition of D(LGC):						
1	0.08	0.77	0.67	1.31	4.18	93.08
2	0.09	2.40	10.25	2.54	3.40	81.41
3	0.09	2.34	11.41	2.43	6.98	76.84
6	0.09	2.37	11.73	2.46	7.06	76.38
12	0.09	2.38	11.76	2.48	7.06	76.32

Table 9: Variance Decomposition with Total Domestic Public Debt

Period	S.E.	D(LDPD)	D(INF)	RI	D(LPG)	D(LGC)
Variance Decomposition of D(LDPD):						
1	0.04	93.78	2.31	1.53	2.39	0.00
2	0.04	94.77	1.94	1.26	2.02	0.00
3	0.05	94.49	1.98	1.31	2.22	0.01
6	0.05	94.00	2.09	1.44	2.47	0.01
12	0.05	93.97	2.10	1.45	2.48	0.01
Variance Decomposition of D(INF):						
1	1.86	20.08	39.52	0.91	39.18	0.31
2	2.18	15.57	28.84	2.53	52.31	0.75
3	2.18	15.55	28.87	2.52	52.20	0.86
6	2.19	15.57	28.77	2.54	52.25	0.87

12	2.19	15.57	28.78	2.55	52.23	0.87
Variance Decomposition of RI:						
1	1.62	21.70	28.35	9.87	40.07	0.00
2	1.96	19.87	34.09	18.54	27.49	0.01
3	2.16	18.05	36.40	22.12	23.42	0.01
6	2.34	15.90	37.53	24.87	21.69	0.01
12	2.36	15.61	37.64	25.17	21.57	0.01
Variance Decomposition of D(LPG):						
1	0.02	44.92	1.61	1.57	51.89	0.01
2	0.02	49.48	1.44	1.42	47.62	0.04
3	0.02	49.25	1.50	1.39	47.81	0.05
6	0.02	49.17	1.63	1.48	47.68	0.05
12	0.02	49.13	1.66	1.51	47.64	0.05
Variance Decomposition of D(LGC):						
1	0.08	3.61	5.38	0.00	12.51	78.50
2	0.09	8.23	9.17	0.05	12.31	70.25
3	0.09	8.20	8.49	0.45	19.18	63.67
6	0.09	8.23	8.52	0.49	19.38	63.38
12	0.09	8.23	8.53	0.49	19.38	63.36

Table 10: Variance Decomposition with Central Government Total Public Debt

Period	S.E.	D(LCPD)	D(INF)	RI	D(LPG)	D(LGC)
Variance Decomposition of D(LCPD):						
1	0.04	98.06	0.73	0.33	0.36	0.52
2	0.05	97.58	0.72	0.30	0.53	0.87
3	0.05	97.40	0.71	0.30	0.74	0.86
6	0.05	97.24	0.78	0.32	0.79	0.87
12	0.05	97.23	0.78	0.32	0.80	0.87
Variance Decomposition of D(INF):						
1	1.87	2.07	64.41	0.99	31.81	0.72
2	2.07	1.76	53.83	0.84	41.86	1.71
3	2.08	1.75	53.92	0.84	41.56	1.94
6	2.10	1.79	53.44	0.89	41.89	1.99
12	2.10	1.79	53.44	0.91	41.88	1.99
Variance Decomposition of RI:						
1	1.71	1.86	43.85	22.93	31.26	0.10
2	2.00	2.43	47.45	26.97	23.07	0.09
3	2.18	2.39	49.98	27.98	19.57	0.08
6	2.35	2.11	50.98	28.11	18.74	0.07
12	2.37	2.09	50.87	27.95	19.02	0.07
Variance Decomposition of D(LPG):						
1	0.02	68.36	0.25	0.04	31.16	0.19
2	0.02	67.56	1.35	0.14	30.48	0.47
3	0.02	65.65	1.30	0.14	32.42	0.49
6	0.02	65.19	1.33	0.16	32.83	0.49
12	0.02	65.15	1.36	0.17	32.82	0.49
Variance Decomposition of D(LGC):						
1	0.08	4.04	3.02	0.42	13.67	78.85
2	0.09	4.91	10.65	0.87	12.80	70.78
3	0.09	4.55	10.60	0.82	18.36	65.66

6	0.09	4.54	10.86	0.84	18.55	65.21
12	0.09	4.55	10.88	0.85	18.55	65.18

Table 11: Variance Decomposition with Central Government Domestic Public Debt

Period	S.E.	D(LCDPD)	D(INF)	RI	D(LPG)	D(LGC)
Variance Decomposition of D(LCDPD):						
1	0.05	85.29	5.79	2.56	5.74	0.62
2	0.05	86.43	5.10	2.21	5.10	1.16
3	0.05	84.19	5.15	2.41	7.13	1.12
6	0.05	83.60	5.45	2.51	7.32	1.11
12	0.05	83.55	5.48	2.52	7.33	1.11
Variance Decomposition of D(INF):						
1	1.79	8.87	34.45	1.51	55.08	0.09
2	2.19	6.45	23.53	2.71	67.24	0.07
3	2.19	6.43	23.65	2.70	67.13	0.09
6	2.19	6.43	23.61	2.70	67.17	0.09
12	2.19	6.43	23.62	2.71	67.16	0.09
Variance Decomposition of RI:						
1	1.58	9.77	28.24	10.03	51.95	0.02
2	1.92	8.64	38.51	17.63	35.12	0.11
3	2.14	7.42	42.90	20.25	29.35	0.09
6	2.37	6.31	46.22	21.88	25.52	0.07
12	2.41	6.13	46.66	22.09	25.04	0.07
Variance Decomposition of D(LPG):						
1	0.02	60.63	0.66	0.07	38.54	0.10
2	0.02	62.48	0.91	0.06	36.33	0.22
3	0.02	60.64	0.91	0.11	38.13	0.22
6	0.02	60.48	0.92	0.11	38.27	0.22
12	0.02	60.46	0.94	0.13	38.26	0.22
Variance Decomposition of D(LGC):						
1	0.08	6.11	13.99	0.03	21.13	58.74
2	0.09	9.50	14.51	0.09	22.89	53.02
3	0.09	8.81	12.91	0.45	30.44	47.38
6	0.09	8.80	12.90	0.48	30.62	47.19
12	0.09	8.80	12.91	0.49	30.62	47.19

Table 12: Variance Decomposition with Central Government External Public Debt

Period	S.E.	D(LCEPD)	D(INF)	RI	D(LPG)	D(LGC)
Variance Decomposition of D(LEXDBGDC):						
1	0.10	79.50	7.15	6.24	6.94	0.18
2	0.11	72.72	7.38	7.06	12.47	0.38
3	0.11	72.83	7.34	7.04	12.40	0.38
6	0.11	72.44	7.63	7.18	12.36	0.38
12	0.11	72.39	7.68	7.20	12.35	0.38
Variance Decomposition of D(INF):						
1	1.80	35.10	63.19	0.43	0.06	1.22
2	2.07	46.25	48.13	0.69	1.85	3.08

3	2.10	45.39	46.68	1.02	3.48	3.43
6	2.11	45.52	46.34	1.06	3.60	3.48
12	2.11	45.50	46.35	1.07	3.60	3.48
Variance Decomposition of RI:						
1	1.75	32.50	46.58	20.54	0.04	0.34
2	2.15	21.81	52.33	24.74	0.75	0.36
3	2.32	19.18	54.62	25.20	0.68	0.32
6	2.45	17.19	56.32	25.57	0.63	0.29
12	2.46	17.01	56.48	25.58	0.63	0.29
Variance Decomposition of D(LPG):						
1	0.02	60.41	6.63	0.22	32.66	0.09
2	0.02	57.59	9.63	0.26	32.30	0.22
3	0.02	58.38	9.47	0.25	31.65	0.25
6	0.02	58.30	9.47	0.32	31.66	0.26
12	0.02	58.27	9.50	0.33	31.64	0.26
Variance Decomposition of D(LGC):						
1	0.08	4.05	0.78	1.43	4.05	89.68
2	0.09	5.70	8.89	1.35	4.50	79.57
3	0.09	10.77	8.57	1.26	4.45	74.95
6	0.09	11.14	8.49	1.37	4.91	74.08
12	0.09	11.15	8.51	1.38	4.91	74.05

Overall, the results of the structural decomposition of forecast error variance show that public debt is a policy variable, therefore, it is exogenous in nature. Inflation is largely due to the pressure of aggregate demand through growth and public debt. The interest rate is due to the 'Fisher effect' and rise in aggregate demand. Economic growth is adversely affected by public debt, and finally, investment is also influenced by the rise in aggregate demand.

7. Conclusion and Policy Implications

The effect of public debt on crucial macroeconomic variables has always been a debated issue in the literature. Theoretical arguments comprising of the Classical approach, Keynesian approach and Ricardian Equivalence Approach have a different opinion on the impact of public debt on the macroeconomy. India has a high level of public debt at both the Central Government level and at the combined Central and States Government level. Another issue is that domestic debt constitutes nearly 95 per cent of total public debt in India. It would be very interesting to examine whether the public debt in India is being used in a productive or unproductive way. Therefore, the study addressed four crucial questions as follows: (1) Has public debt any impact on interest rate in India? (2) Is there any relationship exist between public debt and inflation in India? (3) Does

public debt enhance or reduce gross investment in India? (4) Does public debt affect economic growth in the Indian economy? The empirical literature on this issue is very limited in India. Thus, using an SVAR framework, the study assesses empirically the macroeconomic effects of public debt in India from 1980-81 to 2017-18. For a robust analysis, the impacts of both the Combined Central and State Governments' public debt, and the Central Government's public debt on economic growth, investment, interest rate and inflation are analyzed separately. It has also examined separately the effects of domestic debt and external debt of the respective Governments on these macro variables for understanding the issue succinctly.

The results of the unit root tests using the ADF test and PP test find that the selected variables are a mixture of both stationary and non-stationary. Therefore, the most appropriate ARDL bounds testing approach is used to check the co-integration relationship between the variables. The results of the ARDL bunds test confirm that variables don't have any long run relationships. Then, the short run dynamics among the variables are estimated using the SVAR framework with impulse response functions and variance decompositions. Overall, the results of the impulse response functions show that public debts (at the Central Government as well as Combined Governments of both Central and States) have an adverse impact on economic growth in India. The results also show that it has a positive impact on long-term interest rate and a mixed response (both negative and positive) on gross investment and inflation in India. When isolating the total public debt into domestic debt and external debt, it finds that domestic debt has a more adverse influence on the macro variables than external debt in India. Thus, the empirical findings support the classical argument that public debt act as a burden on the economy.

The estimated variance decomposition analysis finds that public debt is a policy variable and independent of other variables. The variables like growth, inflation and interest rate have a very little impact on it. Inflation is largely explained by itself, growth and domestic public debt, while the interest rate is largely affected by inflation, itself, growth and public debt. Public debt explains a high variation in economic growth and very little variations is due to inflation, interest rate and investment. In a longer horizon, the influence of growth, inflation and public debt has been increasing towards the variation in investment. Thus, overall it finds that much of the variations among the selected macroeconomic variables are explained by public debt and growth in India. It appears that the resources generated through public debt are basically used in an unproductive manner rather in a productive way. Hence, the policy implication of the study is that the Government should allocate the resources, generated through public debt, to developmental activities which will increase the productive capacity of the economy.

The study suggests that public debt especially domestic debt should be controlled and used in a more productive manner to have a favourable impact on the economy. Recently India has implemented two major policy reforms to enhance its revenue base, i.e., implementation of Goods and Services Tax (GST) and demonetization of high denominated currency in 2016. These policies, especially GST, have stimulated tax compliance, increased the number of taxpayers under tax brackets and also tax receipts. But, simultaneously the Government of India is also facing the burden of additional public spending due to the recommendations of the 7th Pay commission. Therefore, efforts should be made to improve the revenue base of the economy as an alternative policy strategy to settle the outstanding public debt. Examining the sustainability of public debt and verifying the non-linear relationship between public debt and other major macroeconomic variables require a separate study. These exercises are beyond the scope of the present study and thus, considered as one of the limitations of the study.

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Appendix

Table 2: Summary Statistics of Variables

Statistics	LPD	LDPD	LCPD	LCDPD	LCEPD	INF	RI	LPG	LGC
Mean	4.296	4.158	4.104	3.938	2.072	7.054	3.254	10.059	3.371
Maximum	4.501	4.421	4.281	4.175	2.883	13.738	10.009	10.962	3.723
Minimum	3.959	3.751	3.812	3.551	1.047	1.006	-4.024	9.372	2.982
Std. Dev.	0.127	0.168	0.122	0.149	0.576	2.852	2.875	0.492	0.197
Skewness	-0.903	-0.784	-0.599	-0.852	-0.458	-0.099	-0.161	0.336	0.297
Kurtosis	3.902	3.360	2.650	3.860	1.752	2.526	3.482	1.820	1.961
Observations	38	38	38	38	38	38	38	38	38

Table 3: Lag Selection Criteria for selected Models

Lag	LogL	LR	FPE	AIC	SC	HQ
Y_t = f(LPD,INF,RI,LPG,LGC)						
0	59.76871	NA	2.74E-08	-3.22169	-2.99722	-3.14514
1	116.3984	93.27240*	4.35e-09*	-5.082257*	-3.735469*	-4.622964*
2	134.3703	24.31491	7.28E-09	-4.66884	-2.19973	-3.8268
3	155.6336	22.51413	1.20E-08	-4.44904	-0.8576	-3.22425
Y_t = f(LDPD,INF,RI,LPG,LGC)						
0	59.82651	NA	2.74E-08	-3.22509	-3.00062	-3.14854
1	121.3056	101.2597*	3.26e-09*	-5.370918*	-4.024129*	-4.911624*
2	137.0981	21.36629	6.20E-09	-4.8293	-2.36019	-3.98726
3	160.4968	24.77512	9.04E-09	-4.73511	-1.14367	-3.51032
Y_t = f(LCPD,INF,RI,LPG,LGC)						
0	59.09184	NA	2.86E-08	-3.18187	-2.95741	-3.10532
1	118.1297	97.23886*	3.93e-09*	-5.184101*	-3.837312*	-4.724808*
2	137.7403	26.5319	5.97E-09	-4.86707	-2.39796	-4.02504
3	162.7916	26.5249	7.89E-09	-4.87009	-1.27866	-3.64531
Y_t = f(LCDPD,INF,RI,LPG,LGC)						
0	56.80617	NA	3.27E-08	-3.04742	-2.82296	-2.97087
1	122.8261	108.7388*	2.98e-09*	-5.460360*	-4.113572*	-5.001067*
2	140.7305	24.22354	5.01E-09	-5.04297	-2.57386	-4.20093
3	168.9568	29.88669	5.49E-09	-5.23275	-1.64132	-4.00797
Y_t = f(LCEPD,INF,RI,LPG,LGC)						
0	18.39481	NA	3.13E-07	-0.78793	-0.56347	-0.71138
1	74.32554	92.12120*	5.17e-08*	-2.607385*	-1.260596*	-2.148091*
2	91.80352	23.64669	8.91E-08	-2.16491	0.304199	-1.32288
3	119.5197	29.34654	1.01E-07	-2.32469	1.266748	-1.09991

Note: * indicates lag order selected by the criterion; LR: sequential modified LR test statistic; FPE: Final prediction error; AIC: Akaike information criterion; SC: Schwarz information criterion; HQ: Hannan-Quinn information criterion.

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