PUBLIC DEBT AND MACROECONOMIC PERFORMANCE IN INDIA

By

DEBI PRASAD BAL

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Debiprasad Bal.
(Signature)

Debi Prasad Bal
(Student Name)

LA11P 1001
(Roll No)

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Dr. Badri Narayan Rath
Department of Liberal Arts
Indian Institute of Technology
Hyderabad
India

Dr. BADRI NARAYAN RATH
Associate Professor & Head
Department of Liberal Arts
Indian Institute of Technology Hyderabad
Kandi-502 285, Medak (Dt), Telangana, India

Approval Sheet

This thesis entitled Public Debt and Macroeconomic Performance in India by **Debi Prasad Bal** is approved for the degree of Doctor of Philosophy from IIT Hyderabad.

(VINISH KATHURIA) IIT BOMBAY

-Name and affiliation-

Examiner

Dr. Umakant Dash IIT Madras

-Name and affiliation-

Examiner

(Badri. N. Rath) IITH.

-Name and affiliation-

Adviser

(Anjan Giri) IITH

-Name and affiliation-

Chairman

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Debiprasad Bal

Dedicated to

My Beloved Parents

Abstract

The fiscal scenario of the central government in India has been unsustainable particularly during the post-liberalization era primarily because of heavy public expenditure. Therefore, public debt plays an important role in order to match between expenditure and revenue collection of the government, which in turn could affect the overall macroeconomic performance. The economic consequences of high fiscal deficits results in heavy public debt during post-reform periods as compared to pre-reform periods. On the other hand, the reduction in economic growth particularly from 2010-11 poses challenge in reducing the public debt as a percentage to GDP. The novelty of the present thesis can be highlighted in three ways. First, there is hardly any study in India which examines the non-linear relationship between public debt and economic growth. The trends in public debt and economic growth from 1970-71 to 2013-14 show an oscillatory pattern, which motivated us to examine the non-linear relationship between debt and growth. Second, this thesis not only examined the non-linear relationship between public debt and economic growth but also made an attempt to identify the key channels through which debt can affects the economic growth. Third novelty of this thesis is related to calculating the optimum debt for India. Though the Governor of the Reserve Bank of India recently made a statement that India is safe as far as public debt is concerned, but there is hardly any study which tells up to what level of public debt to GDP, India is at comfortable zone. In other way, if India targets to achieve 8 to 10 percent growth, then what should be the optimum level of public debt? We made an attempt to fill the research gap. Finally, even if the countries combined central and states debt are around 70 percent to GDP, is it creating a burden for society. This study tried to answer this question by measuring the debt burden.

The results derived from 2SLS model trace that the public debt positively affects the economic growth in the short-run, but shows a negative relation in the long-run. Further, this thesis found the existence of a non-linear impact of public debt on economic growth. The channels through which public debt significantly affect

the economic growth are public investment, and total factor productivity. The results showed that increase in public debt raises the public investment in the short-run, whereas, higher debt to GDP ratio reduces the total factor productivity. Then, we identified the key determinants that affect the public debt in India. We found that economic growth, real interest rate, and gross fiscal deficit significantly determine the public debt of India. By using these variables as input, this study calculated the optimum debt using Genetic Algorithm technique. The results indicated that the optimum debt of India ranges between 61-64% of GDP, beyond which it might create an adverse impact on the economy. Since the average public debt as a percentage to GDP in post-reform periods was more than 65% thus, this study in the final stage examined whether the public debt creates burden on society. We observed a positive response of interest payment due to shock of gross fiscal deficit. Further, the result concluded that a higher the level of public debt indicates higher level of interest payment. Therefore, this creates monetary burden for the Indian economy. The results also found that the shock of interest payment negatively affect the development expenditure. This indicates that government spend its revenue to repay the interest payment by cutting down from developmental expenditures. Thus, the level of public debt which bears interest payment perhaps could lead the debt burden of the country. From policy perspectives, though India is one of the better countries in the world in terms of debt management and certainly not in dangerous zone, but the higher fiscal deficits particularly during post reform period may push the debt to GDP ratio beyond threshold level. The increase in internal debt will lead to put pressure on interest rate which could lead to crowding out effect. The government must be conscious when the public borrowings are used in the revenue expenditure.

NOMENCLATURE

ADB	Asian Development Bank
ADF	Augmented Dicky-Fuller
AIC	Akaike Information Criterion
AR	Auto Regressive
ARDL	Auto Regressive Distributed Lag
ARMA	Auto Regressive Moving Average
C-D	Cobb-Douglas
CEMAC	Central African Economic and Monetary Community
CUSUM	Cumulative Sum Control
DEA	Data Envelopment Analysis
DF	Dicky-Fuller
DS	Difference Stationary
ECM	Error Correction Model
EMU	Economic and Monetary Union
FDI	Foreign Direct Investment
FRBM	Fiscal Responsibility and Budget Management
GA	Genetic Algorithm
GDP	Gross Domestic Product
GFD	Gross Fiscal Deficit
GMM	Generalized Methods of Moments
GNI	Gross National Income
GNP	Gross National Product
HIPC	Heavily Indebted Poor Countries
H-P	Hodrick–Prescott
H-Q	Hannan_Quinn Information Criterion
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IMF	International Monetary Fund
IS-LM	Investment-Saving and Liquidity Preference-Money Supply
IV	Instrumental Variable

NFI	Net Foreign Investment
NSSF	National Small Saving Fund
OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Square
Q-Q	Quantile-Quantile
RBI	Reserve Bank of India
REER	Real Effective Exchange Rate
RIR	Real Interest Rate
SDR	Special Drawing Rights
SME	Small and Medium Enterprise
S&P	Standard and Poor
SVAR	Structural Vector Autoregressive
TFP	Total Factor Productivity
TS	Trend Stationary
VEC	Vector Error Correction
WAEMU	West African Economic and Monetary Union
WDI	World Development Indicators
2SLS	Two Stage Least Square

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Chapter I
Introduction

1.1. Background and Motivations of the Study

The continuation of high levels of fiscal deficit irrespective of adoption of Fiscal Responsibility and Budget Management Act (FRBM) pose a serious danger to macroeconomic stability in India. The high levels of fiscal deficit force the government to go for more borrowing, which leads to accumulation of the public debt both in terms of internal as well as external debts. Thus, public debt plays a crucial role for overall macroeconomic performance of a nation like India. It helps the government to facilitate the economic growth by investing in infrastructural project and social welfare sectors even with minimum taxation capacity of the people. The key macroeconomic variables such as inflation, interest rates, current account deficits and fiscal deficit could be the reasons for pulling down the economic growth below targeted 10 percent. Though the Indian government is trying to reduce the fiscal deficit through promoting FDI and disinvestment, the government faces a big challenge in sustaining a lower fiscal deficit mainly because of high subsidies on food and fertilizer. The economic consequences of high fiscal deficits and low economic growth forced the government to go for heavy internal as well as external borrowings, which raised the question of debt sustainability. The fiscal deficit takes place in India because of deteriorating revenue deficit. The resource mobilization through taxation and non-taxation has failed to match the capital expenditure of the government. Hence, the government borrowing fills the gap between revenue receipts and capital expenditures of the central government. Over the recent years, the absolute size of the public debt with compensation of high interest not only resulted in the rise of the financial burden of the central government, but also downgraded the credit worthiness of India from BBB- to BB+ in 2011 and this

continued to remain negative till 2014 (Standard and Poor credit rating agency, 2015).

Thus, the high level of fiscal and revenue deficit clearly shows the mismatch between capital receipt and revenue expenditure of the government. Therefore, to meet the increasing level of revenue expenditure, the government depended either on internal or external debt which is a major source of financial mobilization in the fiscal policy. These borrowings, which include both the principal along with the interest payment need to be repaid in the future course of time, as a result it creates financial burden for the government. Further, this rising level of public debt and interest payment not only aggravates the fiscal deficit but also affects other macroeconomic performance of the economy. Subsequently, public debt does affect the monetary policy through raising the interest rate which leads to inflation and thereby affects the economic growth of the country.

Further, the current fiscal scenario of India incentivizes calculation of the optimum public debt, as its' relevance in achieving higher economic growth is very crucial particularly for countries with high fiscal deficit. Therefore, this thesis makes an attempt to estimate the optimal public debt for India. Finally, this thesis focuses on the actual burden of public debt. The rising level of the ratio of India's public debt to GDP particularly after the financial crisis has become a debatable issue in the recent period. One of the reasons behind of this is the excessive burden of public expenditure that needs to be financed through borrowing.[1] So, the accumulation of public borrowing can create both financial and real burden to the people. In order to meet the repayment of debt and interest charges, government typically increases the tax level. The report of Panandiker (2010) says that interest payments have swelled and consumed 46 percent of the tax revenue of the government in 2010-11. The interest payment as a share to total revenue remains at 43.7 percent in 2014-15.

[1] Panandiker, The Burden of Public Debt; Reuters; 2010

Hence, this will cause financial burden for the people (David, 1990). It is also observed that the increasing level of taxable income may cause adverse effects on the willingness to work and save.

As a result, public debt plays an important role for macroeconomic performance of any economy. The financial position of the central government in India is unsustainable in the recent years, which has a greater potential of creating macroeconomic instability. Apart from the rising level of aggregate central borrowing, the internal borrowing has more share in terms of GDP and it is accumulating rapidly in recent years.

1.2. Importance of Public Debt on Economic Growth

A voluminous study in the literature examines the impact of public debt on economic growth. The findings of those studies are based on the relation between public debt and economic growth are observed to be ambiguous. The classical economists such as Smith (1977) and Mill (1845) pointed out that the public debt is negatively affects to the economic growth. However, Ricardian Equivalence theory states that public debt are neutral with respect to economic growth (Ricardo, 1951). The Keynesian theory supports that Government should go for higher public debt to achieve higher economic growth in the short-run. Further, the debt overhang theory suggested that if future debt will be larger than the country's repayment ability then the expected debt-service costs will discourage future domestic and foreign investment, and is thus harmful for growth (Reinhart et al., 2010).

There are few empirical studies which shows the impact of public debt on economic growth in India. The studies such as Singh (1999), Rangarajan and Srivastava (2005), Kannan and Singh (2007), and Goyal (2013). The main findings of these studies are mixed in nature. Although the findings of examining the impact

of public debt on economic growth differ among these studies, all the studies assume a linear relationship between public debt and economic growth. But, there are studies which investigate the presence of non-linear relationship between public debt and economic growth by using cross-countries data. Few prominent studies by Reinhart and Rogoff (2009, 2010); Kumar and Woo, (2010); Cecchetti et al. (2011); Checherita-Westphal and Rother, (2012); Furceri and Zdienicka, (2012); Herndon et al. (2013); and Kourtellos et al. (2012) have found non-linear relationship between public debt and economic growth.

1.3. Review of Literature

The theoretical literature starting from the classical economist such as Smith (1977, p.878) and Mill (1845, p.230), explained that public debt is negatively affects the economic growth of a nation. The Ricardian Equivalence theory argues that the repayment of debt will take place through future taxation, which means individuals will increase their savings by buying bonds issued by the government, and hence public debt has neutral effect on economic growth. Similarly, Keynesian and Neoclassical models explained that an increase in government debt that makes households wealthier would stimulate both output and employment and finally lead to higher interest rate. Thus, driving up of interest rate would finally crowd out private investment and negatively affects the long-run economic growth.

The empirical studies, such as Diamond (1965), Friedman (1983), Schclarek (2004), Islam and Hasan (2007), Kumar and Woo (2010), Forslund et al. (2011), and Batool and Zulfiquar (2013) have concluded that public debt negatively affects economic growth. In contrast to these studies, Ludvigson (1996) showed deficit financing through government expenditure by raising the debt, which increases output and consumption. Aschauer (2000) pointed out that government debt is useful to finance productive public capital, which can have positive effect up to a certain

threshold, but a negative effect beyond it. On the other hand, Evans (1985, 1987), Barro (1987), Deravi, Hegji and Moberly (1990), Seater (1993), and Gulley (1994) concluded that public debt has neutral effect on economic growth, and thus supported the Ricardian Equivalence theory. However, there are few studies in India which focus on the relationship between public debt and economic growth. Some studies related to public debt in India are highlighted here. Singh (1999) investigated the relationship between domestic debt and economic growth during the period 1959–1995, and concluded that there is no effect of domestic debt on economic growth. Rangarajan and Srivastava (2005) argued that large fiscal deficit and interest payment to GDP adversely affect growth. They also explored that public debt negatively affects the economic growth. Mallick (2005) found that the central public debt in India adversely affects the consumption. Kannan and Singh (2007) showed that public debt and high level of fiscal deficit adversely distresses interest rate, output, inflation and trade balance in the long run. In contrast, Goyal (2013) showed that high debt ratio tends to increase the economic growth.

Amongst the existing literature, studies conducted by Schclarek (2004), Kumar and Woo (2010), and Checherita–Westphal and Rother (2012) have empirically analyzed the channels through which public debt can significantly affects the economic growth. In this context, Schclarek (2004) found that for the emerging countries the private capital accumulation is the main channel, whereas, for advanced countries, the private saving is the important channel though which public debt affects the economic growth. Kumar and Woo (2010) concluded that investment is the main channel through which public debt is significantly affects the economic growth for advanced economics. Furthermore, they recognized that the public debt is not found to be significantly affected by total factor productivity. Checherita–Westphal and Rother (2012) found that private saving, public investment, and total factor productivity are the channels through which public debt is non-linearly affecting the economic growth.

In the context of determining public debt, Ferraro and Rosser (1994) argued that the level of poverty is one of the major determinants of external indebtedness. Rodrik and Velasco (1999) showed that per capita GDP and size of the financial system positively determine the short term debt, but foreign trade does not significantly determine debt either in the short run or long run. Buch and Lusinyan (2000) examined the determinants of short-term debt of Organisation for Economic Co-operation and Development (OECD) member countries and concluded that the level of economic development, financial development and share of loan to banks are the major determinants of debt. Afonso (2003) discovered that per capita GDP, external debt, level of economic development, default history, real growth rate and inflation rate are the major indicators for examining the credit worthiness of a country by credit rating agencies. World Bank (2005) showed that primary fiscal deficit, real GDP growth rate, real interest rate, and change of exchange rate regime are the major determinants of public debt to GDP ratio. Burger and Warnock (2006) concluded that low inflation rate, rule of law and country size, GDP growth rate and fiscal balance are the major determinants of public debt. Claessens *et al*. (2007) illustrated that fiscal burden, flexible exchange rate, and GDP share on total deposits determine the local currency government bond market. Forslund *et al*. (2011) stated that macroeconomic imbalances, country size and level of development, crisis and external shock, openness, and exchange rate regime are the major determinants of public debt.

The literature, such as Smyth and Yu (1995) found that the optimal debt ratio for debt held by the public is 38.4 percent and for total debt is 48.9 percent. Prskawetz *et al*. (1998) calculated the optimum level of public debt for European Union to be 60 percent of GDP. Pattillo and Poirson (2004) showed that debt-to-GDP ratio of 35–40 percent is optimum for 93 developing countries for the period 1969–1998. Mati (2005) estimated that a debt-to-GDP ratio of 38 percent is optimum for Indonesia, while Ostry *et al*. (2010) estimating the optimum level of public debt

for 23 advanced countries concluded that the threshold point of long run debt ratio is 63 percent of GDP. Reinhart and Rogoff (2010) showed that when gross external debt reaches 60 percent of GDP, the annual growth declines by about 2 percent and when the levels of external debt exceed 90 percent of GDP, the growth rates decrease to half. Kumar and Woo (2010) showed that 90 percent of GDP is the threshold level at which debt has a negative impact on growth. Caner *et al*. (2010) examining the threshold point for 99 developing economies during the period 1980–2008 concluded that a public debt-to-GDP ratio of 77 percent is optimum for these economies. Topalova and Nyberg (2010) estimated the optimum level of public debt for India and suggested that debt ratio between 60–65 percent of GDP is ideal for targeted economic growth. Checherita and Rother (2012) showed that a debt-to-GDP ratio of 90–100 percent has negative impact on growth. Further, Greenidge *et al*. (2012) showed that as the debt level reaches 55–56 percent of GDP, it exerts a negative impact on the growth of Caribbean countries. To sum up, the review literature based on optimum level of public debt indicates that the ranges could vary across the countries.

The literature on burden of public debt such as Domar (1944) explained the concept of public debt. He found that if the growth rate of national income is constant and the growth rate of public debt is rising then public debt is burden for the country. Further, he has shown the rising level of national income will respond simultaneously to the growth rate of public debt. It is because of the rising level of national income lead to rising level of the tax collection. Therefore, it makes the burden to the country. Lerner (1948) showed that the national debt is neither benefit nor burden for the country. Subsequently, Musgrave (1959) purposed the burden of public debt for future generation via reduction in private investment. The study by Bowen et al. (1960) defined the burden of debt in terms of life time consumption expenditure of different generation of tax payer. They concluded that debt burden will be shifted to future generation. Similarly, Modigliani (1961) defined the burden

of public debt in the context of loss of capital formation and reduction of potential future income. Hence, it is a burden for the future generation.

Similarly, the empirical studies by Cunningham (1993), Steigum (2001), Kaas and Von Thadden (2004), Ganelli (2005), Josten (2006), shows that public debt is burden for the economy. Similarly, Erbil and Salman (2006) stated that debt is burden for the country. Ogawa and Ono (2010) found that debt is not only burden for the future generation. Cecchetti et al. (2011) have also found that public debt is burden for the economy.

On the other hand, Evans (1985, 1987), Deravi, Hegji and Moberly (1990), Seater (1993), and Gulley (1994) have concluded that public debt has neutral effect on economic growth. They supported the Ricardian Equivalence theory. Batool and Zulfiquar (2013), Forslund et al. (2011), Kumar and Woo (2010), Islam and Hasan (2007), Schclarek (2004), and Friedman (1983) have demonstrated that public debt has negative impact on economic growth. Similarly, few studies in India, such as Singh (1999), Jha and Shrama (2004), Rangarajan and Srivastava (2005), Kannan and Singh (2007), and Goyal (2013), have explained that public debt has a negative impact on economic growth which could cause for burden in the long run.

1.4. Overview of Public Debt in India

Public borrowing plays an imperative role for financing the economic development in India. India raised the loan to meet a part of the war expenditure in the First World War. In that context, Indian money market responded well. The borrowing was successful because of sound cooperation between government and banks. Indian government introduced the Treasury bill which is a short term debt in the year 1917. Most of the loans were short and intermediate term in nature and under 10 years of the maturity. Subsequently, the floating debt increased because of budget deficit

during the period 1918 to 1929 (Barman, 1978). For repaying the debt with interest, India adopted a sinking fund in the end of March 1924. This method of debt repayment clearly indicates that Indian government maintains its expenditure from taxation and wants to avoid public borrowing. Further, some changes in the structure of debt were observed during the period of Second World War. The marketable debt followed the declining trend from 32 percent to 19 percent from end of March 1938 to end of March 1945. Similarly, the share of long term securities has showed an increasing trend from 26 percent in 1939 to 44 percent in 1946 (Barman, 1978).

The level of the public debt considerably increased after the end of Second World War. It was because of the high level of inflationary situation that prevailed in the economy owing to the war. Therefore, the policy maker suggested increment in the level of savings and reduction in the consumption expenditures. For this reason, various small saving schemes such as, the interest free bonds, prize bonds, and defense savings were implemented. After independence, India faced many economic problems such as lack of funds, deficits of budget, heavy inflationary pressure, unstable monetary mechanisms, and high speculations in commodity market (Barman, 1978). In addition to the above problems, the Indian commercial banks sold the government securities to public, which further aggravated the inflation. As a result, the Indian economy underwent a stagnant growth around three to four percent since independence era till 1980s. Thereafter, for tackling several macroeconomic problems like high inflation, low economic growth and high fiscal deficit, the government adopted a fiscal policy to boost the growth as well as create stability in the economy.

The current scenario of the public (combined Centre and State governments) debt as a percentage to GDP has increased in India particularly from 2011. The central government debt amounted to 44.3 percent of GDP during 1980–1981, increased to 69.7 percent during the fiscal year 1991–1992. Similarly, the combined

debt of central and state governments was 52.4 percent of GDP in 1980–1981, but it increased to 80.1 percent in 1991–1992. The public debt scenario of the Indian government in the post-reform period was worse than in the pre-reform period. In the post-reform period, the central government debt was 68.3 percent of GDP in 1992–1993, and it further increased to 72.3 percent in 2002–2003, which slightly started declining in the consecutive years till 2010–2011 (Handbook of Statistics on Indian Economy, 2012). Further, it is noticed that the average public debt of the central government during the post-reform period was 65 percent, which was higher than the debt of the pre-reform period (58 percent). It is also observed that the total public debt as a percentage of GDP increased from 45 percent at the end of March 1970 to 66 percent at the end of March 2013 (Handbook of Statistics on Indian Economy, 2013). It is also observed that India's stock of total public debt (both internal and external debt), which includes both centre and state, has increased to Rs.0.21 trillion at the end of March 1970 to Rs.75 trillion at the end of March 2013. The government was paying the interest of Rs.2.2 trillion in the end of March 2009, while income from investment and loans was only Rs.711 million in the same period (Panandiker, 2010). The government of India was paying the interest of Rs.5.3 trillion, which is around 5.12 percent of GDP in 2013-14.

To sum up, the combined debt of both central and state government as a percent to GDP in India was increasing in most of the periods. In addition to debt, the interest on debt was consistently increasing. The Indian government was trying to repay the debt particularly the external debt in 2000s because of high economic growth. But, overall growth drastically declined after the global financial crisis; however, the debt-to-GDP ratio started increasing particularly after 2012. The continuous rise in combined centre and state debt as a percentage to GDP particularly from 1974 to 2004, and again from 2012 onwards motivated us to reassess the linkage between public debt and economic growth.

1.5. Research Gaps

The ambiguity in the literature about the relationship between public debt and economic growth raised the question of reassessing this issue for India. Though, there are certain factors which generally influence the debt of any nation, it is crucial to identify the key factors which could affect the increasing public debt in the short-run as well as in the long-run. Most of the existing literature on public debt pertaining to advanced economies suggests that high public debt is not a serious issue for sustaining high economic growth. Those economists who are in favour of this statement argue that the higher public debt will expand the gross fixed capital formation of a country through rise in capital expenditure. But, the recent financial crisis has changed the perception differently. The advanced countries including the USA and the European Union's share of public debt to total GDP in percentage has increased over the years, particularly during the post-financial crisis periods. However, those countries are showing a declining in the growth rates. Therefore, the issue of rising public debt for sustaining high economic growth is a major research question that needs to be revisited. India is not an exception to the global financial turmoil, and economic growth of the country is drastically declining from 2008 onwards. Hence, the impact of public debt on economic growth and the channels through which the public debt affects the economic growth in the case of India need to be analyzed. There is hardly any study in India which emphasis how public debt affects the private saving, public investment, household saving and total factor productivity. Checherita et al. (2012) discusses the importance of these variables through which public debt affects the economic growth. Thus, this thesis fills the gap by addressing this issue.

Further, the current fiscal scenario of India where the economic growth has reduced in last three years and which created a pressure on the government for accepting high fiscal deficit. The high fiscal deficit caused for rise in public debt in

2012-13, and 2013-14. Though several studies in India has examined the sustainability of public debt, but hardly any studies except Topalova and Nyberg (2010) which find the optimum level of debt for India. Therefore, the present study makes an attempt for calculating the optimum public debt as its relevance for targeting higher economic growth, which is very crucial particularly for countries with high fiscal deficit. Before calculating the optimum level of public debt, the study examines the key determinants of public debt in India. It is because the determinants of public debt in India will give us a direction related to ways of tackling the debt scenario and effective use of public borrowings. As per our knowledge is concerned, we did not came across any study which focuses on the determinants and optimum level of public debt in India. Although the literature, such as Topalova and Nyberg (2010), discussed about the optimum level of public debt, they undertook a cross country analysis and India was one of the countries in their study. They estimated the optimum debt for India through baseline scenario and debt simulation method. However, this study estimated the optimum level of public debt by using genetic algorithm approach which itself added contribution to this thesis.

The next research question is related to the burden of public debt. Though India is not a default country, the recent ranking given by some of the credit rating agencies' put forward the major question about the debt repayment worthiness of the nation. The sharp deterioration in the current account deficit is supposed to be the major driving force for decline in the fiscal health as reflected by the deterioration in fiscal and primary deficit. The average annual fiscal deficit post global financial crisis in India is around 4 percent which is in higher side. High fiscal deficits with low economic growth in recent years anticipate higher government borrowings in the coming years. Thereby, the degree of public debt burden on interest payments is a fascinating research issue which needs to be examined.

1.6. Objectives of the Study

In light of the above discussion, the objectives of the thesis are as follows:

1. To analyse the trends, composition and structure of India's public debt;
2. To investigate the impact of public debt on economic growth and to analyze the channels through which public debt affects the economic growth;
3. To estimate the optimum level of public debt in India;
4. To examine whether public debt causes burden for India.

1.7. Analytical Tools

This study has used preliminary statistics such as growth rates, shares and figures for anlysing the trend, structures, and composition of public debt in India. In order to examine the second objective, this study has used both two stage least square (2SLS) and OLS techniques. The application of 2SLS method requires the following two steps:

1. In the first step, appropriate instrumental variables are created for the model;
2. In the second step, those instrumental variables are replaced in the place of actual variables that are used in OLS model.

Similarly, the estimation of optimum level of public debt for India is calculated by using both the auto regressive distributed lag (ARDL) model and Genetic Algorithm approach. The ARDL model includes lagged dependent variables and current as well as lagged independent variables in the model. This model shows the long run as well as short run relation among the variables. The major advantage of this model is that it removes the endogenity problem in the model and allows us to determine the factors which influence the dependent variables of the model. In the

next step, we used the Genetic Algorithm for calculating the optimum level of public debt. This genetic algorithm is based on the natural selection as well as on the idea related to Darwin's natural selection criterion. This criterion states that one who is fit will survive, that is, "survival of the fittest". Therefore, the Genetic Algorithm mimics the nature and gives optimum results as well as produces the global optimum point instead of local optimum value.

Finally, the measurement on burden of public debt is based on Bohn (1998) hypothesis. We applied the Bohn (1998) hypothesis using the structural vector autoregressive (SVAR) approach to check whether public debt causes burden for India. The SVAR model is derived from reduced VAR model and then with the application of the economic theory, this study imposed restrictions in the set of reduced form equations. Finally, the model looks at the innovation accounting which comprises both impulse response function and variance decomposition that helps in identifying the response of particular variable because of structural or un-structural shock of other variables. The model gives us the appropriate value on a particular shock which is a major advantage of this model.

1.8. Relevance of the Study

The relevance of the study stems from broadly three important factors. First, even though there are ample number of studies which examined the linkage between public debt and economic growth in India, hardly any study that has focused on the channels through which public debt can affect the economic growth. Based on the review literature, we considered private saving, household saving, public investment and total factor productivity channels. Theoretically, public debt could affect private saving either positively or negatively. If public debt of a country increases then countries like India where the government borrow heavily from the internal sources, as a result long-term interest rate will increase, which motivates the private to save

more. But if the increased public debt resulted in raising the tax rate of the government then it reduces the private savings. Theoretically, higher level of public debt would reduce the total gross investment of any nation through crowding out effect. Most of the developing countries raise their public debt in order to increase the gross fixed capital formation by spending on productive expenditure, which increase the total factor productivity in the short-run. But in the long-run if public debt increases continuously then it will have the detrimental effect on total factor productivity. Hence, this study is important to reevaluate the capturing of the relation among them. Therefore, from the policy point of view, the government is able to identify the key channels of public debt which can help in maintaining the target level of public debt-to-GDP ratio for the country. Second, debt sustainability is an important issue in the recent period in India. However, there are hardly any studies which examine the optimum level of debt-to-GDP ratio in India. Finally, the impact of debt on economic growth varies in time horizon; therefore, it is imperative to examine the burden of public debt in Indian context, as the per capita debt is steadily increasing. With this rising level of per capita debt, it is expected that the repayment can be made by imposing high level of taxation on the future generation, and hence the Ricardian Equivalence theory prevails in the case of India.

1.9. Data Description and Sources

The study used the annual data covering the period from 1970-71 to 2013-14. The nominal values of the relevant variables were deflated by using suitable price indices, in order to get real values of the variables. The price indices were converted to a single base year for maintaining homogeneity. The annual growth rate of GDP at factor cost at constant price is defined as economic growth. The total liabilities-to-GDP ratio includes both domestic and external liabilities which were treated as public debt-to-GDP[2] ratio. The real effective exchange rate of the thirty six based

[2] Dipplelsman et al. IMF Staff Discussion Note, 2012.

trade weighted average was treated as the exchange rate. The sum of export and import as a percentage to GDP is defined as the trade openness, and the real interest rate was calculated using Fisher index formula, which is the difference between nominal interest rate and the expected inflation rate. The average of 15 years bond yield is treated as the long term nominal interest rate, and all these data were collected from the Handbook of Statistics on Indian Economy published by Reserve bank of India (RBI). The data of M2/GDP represents as the India's financial development, the annual percentage of population growth, the domestic credit to private sector as a percentage of GDP, and the debt service payment as a percentage of export is treated as the debt service payment. All these data were collected from World Development Indicators (WDI) published by World Bank. The data of debt service payment as a percentage of export was available from 1978-79, but the study needed the data from 1970-71, so the study extracted the previous year data from backward trend interpolation method in excel 2007-08. The data of tax-GDP ratio is the proxy for the government revenue and this data was collected from the Indian Public Finance Statistics of 2013–2014, which is published by ministry of finance, Government of India. The private corporate saving is taken as a proxy for private saving. The private saving, household saving, the gross total saving, and the public sector gross fixed capital formation taken as percentage of GDP. The total gross fixed capital formation as a percentage of GDP, which includes both public sector and private sector, is taken as a proxy for total investment. The data of private saving, household saving, public investment and total investment were collected from the economic survey of 2013–2014 published by the Government of India.

Similarly, to estimate the optimum level of public debt, this thesis collected the data for the variables real GDP, the real interest rate, real effective exchange rate (that is used to calculate the exchange rate misalignment), total public expenditure of the centre and state government (used to calculate the government size), current

account deficit, and gross fiscal deficit. All the variables are collected from the various issues of the *Handbook of Statistics on Indian Economy* published by RBI.

Finally, in order to show the burden of public debt, the data such as the percentage of total liabilities to GDP which included both external and internal liabilities is taken as proxy for public debt (pd_t) to GDP ratio. The study took the data of the gross primary deficit (gpd_t) and the data of interest payment (ip_t) as a percentage of GDP for calculating the difference between gross fiscal deficit and gross primary deficit as a share of GDP and the data of percentage of GDP at factor cost. All these data were collected from the database on Indian economy published by RBI, and the development expenditure ($devt_t$) as a share of GDP is collected from various issue of economic survey. Finally, the output gap (og_t) is calculated as the difference between actual output and the potential output. The real GDP at factor cost with 2005 base period is defined as the actual output. The potential output is calculated using the Hodrick Prescott (HP) filter. The data of annual real GDP at factor cost was collected from the Handbook of Statistics on Indian Economy published by RBI.

1.10. Scope of the Study

The study of public debt analysis is confined with the annual data covering the period between 1970 and 2013. A better analysis can be performed by undertaking a quarterly analysis. However, owing to the unavailability of the data of certain key macroeconomic variables, this study did not proceed with much higher frequency data. Further, the study only focused on combined central and state debt as a percentage to GDP. This study further concentrated at aggregate level without discussing the interstate debt growth dynamics. Finally, while estimating the debt burden, this study confines the present generation without considering the impact of public debt to future generations.

1.11. Chapter Scheme of the Study

This thesis is organized into seven chapters. The first chapter explains the background of the study and gives the statement of the problem. In this chapter, the thesis highlights both theoretical as well as empirical review of literature, focuses on the current scenario of public debt in India, motivation of the study, research issue, objectives, methodology, scope of the study and relevance of the study. The second chapter briefly discusses thematic review of both theoretical and empirical literature pertaining to all the three objectives. Chapter three presents an idea on the current scenario of public debt, composition and structure of the public debt, trends and growth rates of key indicators related to public debt in India. The impact of public debt on economic growth and its channels is described in chapter four. The chapter five delineates the estimation of optimum level of public debt in the case of India. The burden of public debt is carried out in chapter six, and the summary and policy implications are specified in the last chapter.

Chapter II

Review of Literature

2.1. Introduction

Public debt is one of the important issues of discussion by the policy makers at any given point of time in India. This is primarily because of rising level of public debt from 36.84 percent in 1960 to 66.24 percent in 2013. Further, India government is facing high level of fiscal deficit, revenue deficit, high inflation, and low rate of economic growth in recent period. Therefore, it raises basically three classic questions related to public debt: (1) How does public debt affect the economy? (2) What should be the optimum level of debt for India? and (3) Is public debt becoming a burden for the Indian economy? The debates of public debt on these issues are fascinating and useful from policy perspective. The discussion on the linkage between public debt and economic growth creates ambiguity. First group of study concludes that the public debt is bad and detrimental for the nation; second group of study finds public debt has neutral effect; and the third group of study concludes that debt has a positive impact on economic growth as long as it used for productive purpose. Hence, with this ambiguous view on public debt, this study examines all these above mention three fundamental questions and analyzes both the theoretical as well as empirical studies.

The rest of the chapter is organized as follows: Section 2.2 presents the analysis of theoretical literature on public debt. The theoretical review on public debt focuses on the different school of thoughts that can give us clear ideas on public debt. The different schools of thoughts are basically divided into three categories. The first represents Classical views, the second represents Keynesian views and the third represents post–Keynesian views on public debt. Section 2.3 examines the

empirical literature on public debt. In this section, this study undertakes thematic review based on objectives of the thesis. The last section discusses the summary of both theoretical and empirical literature on public debt.

2.2. Theoretical Review on Public Debt

This section elaborates theoretical review pertaining to public debt starting from classical school of thoughts to post–Keynesian economic thoughts. Further, the sub-sections also delineate the existence of traditional controversies, and Pigovian as well as Kaldor effects of public debt.

2.2.1. Classical Views on Public Debt

The theoretical literature starting from Mercantilist in the eighteenth century prefers public debt as they had faith on government. However, in the nineteenth and in early part of the twentieth century, the classical economists pointed out that the public debt is unfavorable and harmful for the nation because of their lack of faith in government. In this context, Mill (1929) stated that "Government borrowing was harmful because it destroys capital which could otherwise be used for productive employment." Similarly, Smith (1977) stated that public debt is wasteful and unproductive and said, "a certain portion of the annual produce turned away from serving in the function of a capital to serve in that of a revenue; from maintaining productive laborers to maintaining unproductive ones, and to be spent and wasted, generally in the course of the year, without even the hope of any future reproduction." Subsequently, Say (1964) said that "There is this grand distinction between an individual borrower and a borrowing Government that, in general, the later borrows capital for the purpose of barren consumption and expenditure." He believed that public debt is burden for the future generation. In addition to this,

David Hume even opposed and stated, "Nations once they began to borrow would be unable to desist until they reached the point of bankruptcy."[3]

The Ricardian argued about the unproductiveness and wasteful nature of public debt. He characterized national debt as "One of the most terrible scourges which was ever invented to afflict a nation."[4] He further argued that repayment of debt will take place through future taxation, which means individuals will increase their savings by buying bonds which Government issued. Hence, public debt has neutral effect on economic growth. Consequently, Malthus, Mill, Sidgwick, and Cairnes had argued that public debt has mixed effect on economic growth. As Malthus (1836) stated "The national debt is not the evil which is generally supposed to be. Those who live on the interest from the national debt, like statesmen, soldiers and sailors contribute powerfully to distribution and demand, they ensure that effective consumption which is necessary to give the proper stimulus to production. Therefore, the debt, once created, is not great evil."[5]

Further, Adms (1958) stated that "a loan calls for no immediate payment from the people the lenders are satisfied, since they have secured a good investment." Bastable (1903) wrote that "A loan is voluntary and supplied by willing givers, taxation is levied on the willing and unwilling alike. To make things smooth for the present at the cost of the future is not the duty of the wise and farseeing Statesman." He even argued that if the burden of public debt is shifted towards the future than there are no differences between public and private debt as well as between internal and external debt. Leroy–Beaulieu (1883) said "A loan will be useful or harmful to the society in general depending on whether the State preserves and usefully employs the proceeds or wastes or destroys the capital which the renters

[3] Groves, H. M.: Financing Government, 1958, p.565.
[4] Ricardo, Funding System, Cambridge, 1951, p.197.
[5] Principles of Political Economy (London, 1836), p.409.

have given up." Consequently, the modern theory on public debt has borrowed the ideas from Classical economists and reassesses the concept of public debt.

2.2.2. Keynesian Views on Public Debt

Great Depression of 1930s raised a question mark on these traditional views and provided a way to form a new theory on public debt. In this context, Keynes criticized the thought of classical economist on public debt and pointed out the need of public debt for achieving economic development. The modern theory of public debt was scientifically provided by Keynes through his book 'General Theory of Employment, Interest and Money' that was written in 1936. According to him, "The absolute size of the national debt does not matter at all, and that, however large the interest payments that have to be made, these do not constitute any burden upon society as a whole." Keynes explained that the increase in level of public debt can help to solve the problem of inflation of the nation through curbing present consumption and encouraging savings. According to Keynesian theory, if the private sector perceives government securities as net wealth, the deficit will further amplify private consumption expenditures, transaction demand and interest rates, and prices. The effects of expansionary fiscal policy on capital formation may be strengthened through the accelerator effect. Further, the Keynesian economists stated that public debt can have potential to use the unutilized resources and to generate employment, thereby, resulting in increase of the national income. Therefore, they concluded that the public debt is not burden for the nation.

In the investment-saving and liquidity preference-money supply (IS-LM) model, Keynesian economists pointed out that an increase in government debt induced by deficit–financed fiscal policy will increase the level of income, the transaction demand for money balances, and prices. This will cause the rate of interest on bonds to rise with a fixed money supply. According to the Keynesian

theory, if the private sector perceives government securities as net wealth, the deficit will further amplify private consumption expenditures, transaction demand and interest rates, and prices. The effects of expansionary fiscal policy on capital formation may be strengthened through the accelerator effect. On the other hand, monetarists have argued that the macroeconomic effect of debt finance is crowding out private investment through increase in the levels of interest rates. In addition, De Leeuw and Holloway (1983) showed that using a theoretical model when the stock of government securities are substituted for capital stock in the public's asset portfolio, government debt in the long run has a crowding-out effect by reducing capital stock, which may curtail further growth. The study by Bahmani and Payesteh (1994) concluded that public debt increases long term interest rate, which is in support of the Keynesian hypothesis. Conversely, Evans (1985, 1987), Barro (1987), Deravi, Hegji and Moberly (1990), Seater (1993) and Gulley (1994) found no evidence linking government debt and interest rates; they tended to support the Ricardian Equivalence hypothesis.

2.2.3. Post–Keynesian Views on Public Debt

The debate on public debt is not settled and Buchanan (1958) stated that "the real sacrifice of private goods and services, that is real income, allegedly occurs during this initial period, and this sacrifice stems, not from the debt per se, but rather from the decisions of the government to undertake the public expenditure in question. In this particular respect, the financing of a public expenditure by borrowing is little different from financing it by taxation. In either case, the real burden is borne currently. Any shifting of the primary real burden of public expenditure over time by changing the method of financing is impossible." Therefore, he concluded that the public debt does not transfer the burden to future generation and both public and private debts as well as internal and external debt are different from each other.

Further Buchanan (1958), stated in his book, Public Principles of Public Debt that "The time honored controversy over the burden of the National Debt has flared up once more. The view that the National Debt is no burden on the economy and that the real cost of government expenditure, no matter how financed cannot be shifted to future generations has been on the retreating under a powerful attack by the contributions of Buchanan, Meade and Musgrave." In these lines, he exclaimed that the primary real burden of the public debt is shifted to future generation, and there is no difference between public debt and private debt as well as between internal and external debt. He also noted that imposing a tax is also burden to the society. As the debt finance postponed levying taxes, hence, there is every possibility to shift the burden to future generations. Musgrave (1959) purposed that the burden of public debt for future generation will be generated through the reduction in private investment. He stated that "If the taxpayer wishes to spread his burden, he may secure a tax or consumer loan and thus obtain command over resources that otherwise would have gone into capital formation. The outcome will be similar to that of public loan finance, the only difference is that private rather than public debt is issued. Public loan finance may then be thought of as a means of enabling individual taxpayer to secure tax credit at equal term. By placing payment on a pay-as-you-go basis, loan finance remains a significant instrument of policy even though it does not increase the total availability of resources".

Further, Bowen–Davis–Kopf (1960) supported the views of Buchanan (1958) on burden of public debt and mentioned some of the points which are not mentioned by him. Although Buchanan pointed out the burden of public debt, but he did not explain the shifting of public debt from generation to generation. Hence, based on this background, Bowen–Davis–Kopf (1960) analyzed the burden of public debt. According to them, the burden of the debt is defined in terms of life time consumption expenditure of different generation of tax payers. They concluded that debt burden will be shifted to future generation.

Vickery (1961) supported the Bowen–Davis–Kopf analysis and showed the effects of debt finance on the future level of real income for the society as a whole. Scitovsky (1961) argued that "the burden of public debt can be shifted if by burden is meant what individuals consider a burden: the balance of private costs and private benefits, corrected for changes in disposable income occasioned by the public debt." Similarly, Modigliani (1961) defined the burden of public debt in the contest of loss of capital formation and reduction of potential future income. He argued that debt finance will crowding out the investment, and tax finance will crowding out the consumption.

2.2.4. Traditional Controversies

2.2.4.1. Ricardian Equivalence Theorem

The Ricardian Equivalence theory argues that repayment of debt will take place through future taxation, which means individuals will increase their savings by buying bonds issued by the Government, and hence, public debt has neutral effect on economic growth. The theorem basically is based on the following conditions:

(a) Perfect capital markets with no-borrowing constraints;
(b) Non distortionary taxes;
(c) Perfect certainty about future taxes; and
(d) Equal planning horizon for private and public sectors.

With these conditions, the theorem proved that both tax finance and debt finance are equal. Buchanan criticized this theorem, and stated, "This Ricardian Equivalence does not suggest, however, that the objective pattern of cost payments remains the same over the two alternatives. Taxation and debt issue remain different, not similar, financing institutions for the simple reason that taxes require a transfer of

resource services from the individual to the fiscal during the initial period, whereas debt issue postpones such transfer until later periods." Buchanan (1968) exposed the fallacious nature of this proposition, and observed, "This conception of national debt contains a fundamental flaw in its failure to translate opportunity cost or burden from aggregate components into something that is meaningful to individual members." According to him, "The core of the fallacy lies in the equating of the community as unit in some aggregated national accounting sense, with the individuals in the community in some political sense as participants, direct or indirect in collective decision making." It is belief that domestic debt does not has macroeconomic consequence which is illusory.

2.2.5. Pigou Effect and Kaldor Effect on Public Debt

Pigou (1943) pointed out that a large public debt implies holding of large government securities. This indicates reduction in the willingness to save. It is because of the existence of sufficient amount of securities held by them. Therefore, it leads to increase in spending on luxurious goods. This rising trend might be beneficial in the times of depression, but it can aggravate the economy at the times of prosperity. It is because it adds to the inflationary potential in the economy.

The existence of large public debt also has adverse effect on willingness to work, save, invest, and accumulate. This effect is known as Kaldor effect. In this context, Lerner (1964) observed that "an increase in the national debt can make the owners of government bonds less wishing to work. One of the reasons for working, the earning of money to put away, for the rainy day is weakened, because there is more put away already for rainy days." It indicates that public debt adversely affects the incentive to invest. It is because the government will impose heavy tax on the community for repaying the debt. Additionally taxes also reduce the net yield from investment, after taxes, and make socially useful investments unprofitable to the

investor. This effect may be minimized, however, by balancing losses and profits for tax purpose. Nevertheless, the opportunity of loss offset is not universal so that the interest payment on the national debt, by making taxation necessary for the prevention of inflation, interferes with the efficiency of the economy by discouraging useful investments." However, it is difficult to measure the effect of public debt on willingness to work, save, invest, and accumulate.

Further, Lerner (1955) states that the excess of price over marginal cost must be treated as a tax. He argued that, "This tax is almost certainly more harmful than the tax which the government would impose to offset the excessive kinds of taxes available to private investor, the attempt to avoid the evils of national debt turns to be a case of avoiding a shower by jumping into the lake." De Leeuw and Holloway (1983) showed using a theoretical model that when the stock of government securities are substituted for capital stock in the public's asset portfolio, government debt in the long run has a crowding-out effect by reducing capital stock, which may curtail further growth. Bahmani–Oskooee and Payesteh (1994) concluded that public debt increases long term interest rate with the support of the Keynesian hypothesis. Engen and Hubbard (2005) theoretically pointed out that the level of interest rate is determined by the level of capital stock, which depends on public debt, and thus it is the result of the impact of the amount of government debt. The change in the interest rate is affected by the government budget deficit, which is essentially equal to the change in the government debt. Kinoshita (2006) theoretically argued that when government postpones taxation, it leads to imposing of future tax in the next generations. This implies that the tax cut today is worth more than the present discounted value of all future taxes. In this way, the current generations perceive part of the debt as net wealth and increase consumption by running down physical capital. Hence, increase in debt level and shifting of wealth across generation lead to decline in the capital accumulation, and thereby escalate the interest rate.

2.3. How Public Debt Affect the Economy?

This is clear from the theoretical review of the classical, neoclassical, Keynesian and post-Keynesian economists that public debt affect the economy. Further, Elmendorf and Mankiw, (1998) showed that debt policy affects the economy in both short run and long run. They explained the concept of debt by considering the case of deficit budget, and then linked the budget deficit with national saving as well as focused on the impact of change in national saving on other macroeconomic factors.

2.3.1. Short Run Effect of Debt Policy

Let's assume that there is budget deficit by holding spending constant and reduction of tax revenue. In this situation, the disposable income of the household income raises and it may increase the lifetime wealth. Therefore, the conventional analysis stated that the increase in disposable income leads to increase in lifetime of wealth which results in deceleration the aggregate demand for goods and services. This rising level of aggregate demand for goods and services increase the national income in the short run (Keynesian analysis). The reasons behind this are the sticky wages, sticky prices, or temporary misperceptions, and shifts in aggregate demand affect the utilization of the economy's factors of production. This Keynesian perspective on running budget deficit and assuming the debt policy can be worked as a medicine when the economy faces recession. However, the conventional analysis on shifting the aggregate demand because of the debt policy can be worked in the long run.

2.3.2. Long Run Effect of Debt Policy

Elmendorf and Mankiw, (1998) explained the long run impact of public debt and the effect of deficit budget with spending constant and reduction of tax policy on the economy, by taking several national accounting identities. Let, Y denotes national

income, C denotes private consumption, S denotes private saving and T denotes taxes less government transfer payment. The private sector's budget constraint implies that:

$$Y = C + S + T \qquad (2.1)$$

Further, national income also equals to national output, which can be divided into four types of spending, i.e.

$$Y = C + I + G + NX \qquad (2.2)$$

Where, I is the domestic investment, G is government purchases of goods and service and NX is net exports of goods and service. Combining all these identities yields:

$$S + (T-G) = I + NX \qquad (2.3)$$

This identity states that the sum of public saving and private saving must be equal to the sum of investment and net export.

Another, important identity is a nation's current account balance. The capital account balance; if it is negative which called net foreign investment (NFI). Thus, the identity is:

$$NX = NFI \qquad (2.4)$$

Therefore, international flows of goods and services must be matched by international flows of funds. Substituting this identity into the other two identity yields:

$$S + (T - G) = I + NFI \qquad (2.5)$$

The left side of this equation shows national saving as the sum of private and public saving, and the right side shows the uses of these saved funds for investment at home and abroad. This identity can be viewed as describing the two sides in the market for loanable funds.

Now, Elmendorf and Mankiw (1998) assumed that if G increases and T is constant, this identity may continue to be satisfied in several complementary ways, that is, private saving may rise, domestic investment may decline, and net foreign investment may decline. Let us consider each of the possibility briefly. The first possibility is private saving may rise. In this case, the conventional analysis is that private saving rises, but is less in comparison to public savings. So, the national saving declines, and hence, the total investment at home and abroad must decline as well. Second, the reduction of domestic investment over a period of time will result in a smaller domestic capital stock, which in turn implies lower output and income. With less capital availability, the marginal product of capital will be higher, which in turn will raise the interest rate. At the same time, labour productivity will decrease, and hence, average real wage and total labor income will also decline. Finally, there is the possibility of reduction in foreign investment over a period of time because of less capital availability with domestic resident and more capital availability on foreign residents. Thus, in both the case the net foreign investment decline. So, this decline in net foreign investment must match with decline in net export. Therefore, it results in trade deficit of goods and services.

2.4. Empirical Review of Literature

This section focuses on reviewing the empirical works based on four broad themes, viz., the effects of public debt on economic growth, the determinant of public debt, the optimal level of public debt and the burden of public debt in case of India and other countries. The empirical literature, such as Phelps and Penner (1987) studied in the case of American debt situation, pointed out that there was considerable decline in the US public saving because of high level of public debt in the 1980's. The private saving has also been affected. However, there were certain advantages to the US economy due to debt and reduction in price level, increases the supply of labour, reduce the tax rate, and tax incentive in 1981 as these assisted in reduction of the recession. Although this high level of public debt has major advantages, but it has lost the potential national income and forms a budgetary deficit.

2.4.1. Review on the Linkage between Public Debt and Economic Growth

The traditional view is explained as an increase in the public debt negatively impacts economic growth. In this regards, Boskin (1987) studied the impact of domestic debt on private savings in US economy where he observed decline in the rate of savings. He concluded that the growth of domestic debt is the major cause of decline in the US saving rate. Cunningham (1993) showed the effects of debt burden on economic growth in 16 indebted developing countries. He used an augmented Cobb-Douglas (CD) production function from 1971 to 1979. The result derived from panel regression model indicates that debt positively affects the economic growth for the heavily indebted countries. Lin (1994) examined the effect of government debt on the real exchange rate in an overlapping generation model. This paper stated that the debt and exchange rate are depending on the capital elasticity of output. Higher capital elasticity of output leads to depreciation in the real exchange rate when there is increase in the level of government debt.

Furthermore, this paper concluded that when the debt level is low the appreciation of real exchange rate exhibits lower capital elasticity of output. Ludvigson (1996) studied the various ways through which government liabilities affect the macroeconomic factors aggregates in a standard general equilibrium growth model. This study observed a positive relation between investment and output in deficit financed policy and explained the deficit financing policy through government debt can raise the output by increasing the investment, and hence, the output is increased through increase in the level of consumption which in turn to raises the investment leading to increase in capital formation. The result also shows that if the Government follows first order autoregressive process then the shock of government debt leads to crowding out of the private investment. Finally, this paper depicted that the distortionary tax finance may lead to decline in the output, consumption, and investment.

Singh (1999) stated that an increase in government debt is capable of finding the consumer wealthier, and this leads to higher spending in the short run. This increase in aggregate demand of goods and services, in view of sticky prices in short run will raise the output and employment. High marginal propensity to consume than the marginal propensity to save leads to decrease in private saving which is less than the government dissaving. This leads to increase in the real interest rate in the economy which encourages capital inflow from abroad in the short run. However, this rising level of real interest rate would discourage investment, and thus, crowding out the private investment in the long run. Low domestic savings mean a small capital stock. The capital inflow from abroad would leads to high foreign debt. The high aggregate demand results in a high price level which adjusts over time, and the economy returns to a neutral rate of output. Low investment would eventually leads to a poor steady state capital stock and low level of output. Therefore, the overall impact when considering the long period would be smaller than the total output and eventually reduces consumption and welfare.

Schclarek (2004) explored the relation between external debt and economic growth for 59 developing and 29 industrial countries. This study was undertaken from the period between 1970 and 2002. This paper also showed the channels through which external debt affects the economic growth. The empirical results derived from Generalize Method of Moment (GMM) estimators shows that the external debt is inversely related to economic growth for developing countries, and insignificant relationship is observed in the case of industrial countries. Finally, the paper concluded that the channels of capital accumulation are significantly affecting by external debt, whereas the channels of total factor productivity and private saving rate are limited evidence of external debt and thereby economic growth.

Pattillo et al. (2004) showed that the channels through which public debt affects the economy are capital accumulation and total factor productivity. They applied a growth accounting framework taking 61 emerging economics from 1969 to 1998. Their results suggested that higher debt reduces the growth of physical capital and total factor productivity. They also concluded that there is nonlinear relation between debt and various component of growth, and debt negatively affects only the highly indebted countries. Kameda and Naketa (2005) analyzed the impact of public debt on Japanese macroeconomic stability. They constructed three IS-LM dynamic models. The results showed that huge amount of debt violates the stability of Japanese economy. They also confirmed that Japanese government has to raise the consumption tax rate from 5 percent to 15 percent in addition to increase in the income tax rate. Modeste (2005) showed the impact of the foreign debt on exchange rate for the Guyana's economy. This paper used annual data spanning from 1968 to 2000. By using the co-integration and error correction technique, this paper concluded that the public debt and exchange rate are moving together in the long run. It also showed that the key variables such as the changes in domestic credit, the growth in the relative price of crude oil, the growth in export, the tightness of US

monetary policy and the changes in the level of local economy significantly affects the exchange market.

Similarly, Blavy (2006) showed the channels through which public debt affect the total factor productivity of Jamaica. Using panel regression analysis in case of 35 emerging countries, this study found that high public debt is associated with macroeconomic uncertainty and affects the output, and thereby, bounds to the scope of productivity growth. In particular, a doubling in total public debt is leads to reduction of 1.5 percentage in productivity growth. Furthermore, this study concluded that public investment crowded out debt service and adversely affected the productivity growth. Islam and Hasan (2007) empirically examined the effects of government debt on interest rate, price and output formation in the United States during the period between 1946 and 2000. Their study examined the public debt increases inflation with adverse effects on capital formation and real output, which broadly supports the views of the monetarist and partially neo-Ricardian economists.

Kumar and Woo (2010) explored the impact of high level of public debt on long-run economic growth for both advanced and developing countries during the period between 1970 and 2007. The result derived from panel regression approach indicates an inverse relationship which is observed from the relationship between public debt and economic growth. This paper also provide the evidence in favour of nonlinear relationship between economic growth and level of debt, and 90 percent of debt-to-GDP ratio is the threshold level of debt for advanced countries. Furceri and Zdzienick (2011) assessed the short and medium term impact of debt crisis on economic growth. This study further addressed the endogeneity and reverse causality by using two-step GMM system estimator and two steps Generalized Method of Moments (GMM). The study was based on the unbalanced panel of 154 countries from 1970 to 2008. The results showed that the debt crisis is more harmful than the crisis such as bank crisis and currency crisis. Checherita and Rother (2012) found the

channels such as private saving, public investment and total factor productivity through which public debt have been non-linearly affecting the economic growth. Kourtellos et al. (2012) showed the heterogeneous effects of debt on growth. They employed a balanced 10 years panel dataset covering 82 countries over the period 1979–1990, 1990–1999 and 2000–2009. The result derived from structural threshold regression model implied that higher public debt results in lower growth in the low-democracy regime. Baum et al. (2013) investigated the relation between public debt and economic growth of 12 nations of euro area from 1990 to 2010. They used a dynamic threshold panel method in order to capture the non-linear impact of public debt on economic growth. The empirical results concluded that debt is positively affecting the economic growth in the short-run and behaves negatively beyond 67 percent of debt-to-GDP ratio. It also showed that there is significant negative effect of debt beyond 95 percent of debt-to-GDP ratio. The paper further captured a positive relation between interest rate and public debt when the debt-to GDP ratio reached to 70 percent. Antonakakis (2014) examined the relationship between sovereign debt and economic growth for 12 European countries from 1970 to 2013. Using both dynamic and non-dynamic panel data method, the study found that debt is sustainable at 90 percent threshold level in the short run, whereas in the long run both non-sustainable and sustainable debt ratios are above 90 percent over the threshold level as well as non-sustainable debt ratios below the 60 percent. Beyond this threshold level, it effects negatively.

In order to analyze the debt sustainability, the theory such as Domar stability condition, sustainability indicators, present value budget constraints and model based approach cannot be ignored. The Domar stability condition has been defined as:

$$y - r > 0 \qquad (2.6)$$

$$r = (IP_t)/ (OD_t) \qquad (2.7)$$

Where, y = growth of GDP at current prices; r = average interest rate; IP = interest payment; OD = outstanding debt; and t = time period.

The equation (2.6) and (2.7) state that the debt to GDP ratio (d/y) is stable if the nominal GDP growth (g) is more than the nominal interest rate (r) on government debt. The sustainability indicators define sustainability in terms of debt trap. It indicates that if interest payments or repayments or both exceed over total gross borrowings than it is argued that there is a debt trap. By extending this conventional view on debt sustainability, the present value of budget constraint pointed out that the future primary surplus should not be less than the current outstanding liabilities of the government.

The model based on dynamic relation between debt-deficit nexus is set out below:

$$OD_t = \sum_{i=0}^{n} GFD_{t-1} \tag{2.8}$$

$$GFD_t = OD_t - OD_{t-1} \tag{2.9}$$

$$GFD_t = PD_t + IP_t \tag{2.10}$$

$$IP_t = [i(BF_{t-1})] + [i^*(MF_{t-1})] + [i^{**}(EF_{t-1})] \tag{2.11}$$

$$PD_t = (TF_t - IP_t) - (RR_t - IR_t) \tag{2.12}$$

$$TE_t - RE_t + CO_t + NL_t \tag{2.13}$$

$$RR_t = T_t + NTR_t + DISINT \tag{2.14}$$

$$PD_t = (TE_t - IP_t) - RR_t \tag{2.15}$$

Where, OD = outstanding debt; GFD = gross fiscal deficit; PD = primary deficit; IP = interest payment; BF = bond financing; MF = money financing; EF = external financing; TE = total expenditure; RR = revenue expenditure; RE = revenue

expenditure; T = tax revenue; NTR = non tax revenue; DISINV = disinvestment proceeds; CO = capital outlay; and i^* = interest rate.

The objective of the model of debt and deficit relationship is to illustrate the impact of debt on trade balance, interest rate, private investment and consumption. In this context Yakita (2008) analysed the sustainability of public debt, public capital formation and endogenous growth in an overlapping generational model. He found through both the Cobb–Douglas production function and the log-linear utility function that there is an optimum public debt for public investment (and thereby sustainability of deficit policy), and this optimum level of public debt tends to increase the level of public capital. Onaran (2011) examined the effects of a crisis on public debt and its impact on distributional tax and composition of public spending in Western Europe. Similarly, Stockhammer (2011) explored the debt crisis of Greece, Southern Europe and Ireland. He found that the problem of public debt in these peripheral countries could be solved through the German current account surplus. Neck and Haber (2012) analyzed whether Austrian public debt is sustainable or not, and concluded that Austria may achieve sustainability by raising the level of primary surplus.

2.4.2. Determinants of Debt

2.4.2.1. Public Debt and its Determinants

The study such as Root (1990) viewed that a country is poor because it is poor. He showed that the investment-saving gap forces poor countries to depend on external borrowing. Similarly, Ferraro and Rosser (1994) argued that the level of poverty is one of the major determinants of external indebtedness. Guedes and Opler (1996) examined the bonds and notes issued during the period 1982–1993 and showed that size and bond rating are the major determinants of long term debt. Again, Rodrik and Velasco (1999) examined both short and long run public debt of 32 developing

countries and showed that per capita GDP and size of the financial system positively determine by the short term debt, but foreign trade does not significantly determine by debt either in short run or long run. Buch and Lusinyan (2000) examined the determinants of short term debt of OECD member countries and concluded that the level of economic development, financial development (M2/GDP), and share of loan to banks are positively correlated to short term debt. Afonso (2003) examined the sovereign debt rating of two leading agencies—Moody and Standard & Poor—concluded that per capita GDP, external debt, level of economic development, default history, real growth rate and inflation rate are the major determinants of credit rating of a country. Eichengreen and Luengnaruemitchai (2004) examined the determinants of domestic bond market of 41 countries for the period 1990–2001. Using the panel regression method, they concluded that country size, institutional quality, exchange rate volatility and capital control positively affect the domestic bond market.

Further, the empirical study done by World Bank (2005) examined the key determinants of public debt in case of 15 countries and found the primary fiscal deficit, real GDP growth rate, real interest rate, and change of exchange rate regime are the major determinants of public debt to GDP ratio. Burger and Warnock (2006) examined the public and private sector bond markets of 49 countries, out of which 27 were emerging and 22 were developed countries. They concluded that low inflation rate, rule of law and country size positively affect the government bond market, while GDP growth rate and fiscal balance negatively determine the size of public and private sector bond markets. Claessens *et al*. (2007) examined the determinants of local currency government bond market by studying 36 countries, out of which 12 were emerging and 24 were advanced economies. They used panel data obtained from BIS data series for the period 1993—2000. The results indicate that fiscal burden, flexible exchange rate, and GDP share on total deposits are positively determining the local currency in government bond market. Gurbuz *et al*. (2007)

analysed the past and future sustainability of total public debt in Turkey for the period 1980–2002, and concluded that banking system, populist policies and political instability are the major factors responsible for non-sustainability of public debt. Borensztein *et al*. (2008) studied the determinants of bond market by segregating the bond market into three categories, which are government, corporate and financial sector. By using the regression analysis, they found that country size affects bond market nonlinearly, while trade openness, total public debt, lack of capital control, institutional quality and the privatization of the pension system positively affect the bond market. On the other hand, they also found that the domestic interest rates negatively affect the bond market, and there is no significant relation between the banking spread and the size of the government bond market.

Similarly, Forslund *et al*. (2011) examined the determinants of public debt in emerging market economies. The study considered a large set of control variables in estimating total public debt. The control variables were divided into five categories: (i) macroeconomic imbalances, (ii) country size and level of development, (iii) crisis and external shock, (iv) openness, and (v) exchange rate regime. It was observed that inflation weakly determines public debt because of the presence of capital control. Sinha *et al.* (2011) examined the determinants of public debt for middle and high income countries. Using panel regression model, they concluded that GDP growth rate, central government expenditure, education expenditure, and current account balance are the most important factors affecting the public debt in middle and high income countries. While FDI and inflation do not show any significant impact on the public debt in high income countries, but they have found a significant effect in context of middle income countries.

2.4.3. Optimum Level of Public Debt

Aiyagari and McGrattan (1998) calculated theoretically, the optimum quantity of debt for US economy concluded that debt is equal to average debt-to-GDP ratio in the post-Second World War period. They theoretically explained the optimum quantity of debt. They derived the optimum debt through neoclassical aggregate production function which is represented as

$$Y_t = F(K_t, z_t N_t) \tag{2.16}$$

Where, Y_t is per capita output, K_t, is per capita capital, N_t, is per capita labor input, and z_t, is a measure of labor-augmenting, exogenous, technical progress for period t. They assume that

$$z_t = z(1+g)^t \tag{2.17}$$

Where, g is the rate of technical progress. It also assumed that capital is depreciated at the geometric rate δ. Further, they assumed the wage rate w_t and interest rate r_t are given by

$$w_t = z_t F_2(K_t, z_t) \tag{2.18}$$

$$r_t = F_1(K_t, z_t) - \delta \tag{2.19}$$

With some of more assumptions of the behavior of consumer Aiyagari and McGrattan (1998) pointed out the quantity of debt on welfare as

$$\Omega = \iint V(a,e)dH(a,e) \tag{2.20}$$

Where, *V (a, e)* is the optimal value of function and *H* is the steady-state joint distribution of assets and productivity.

The empirical studies on optimal debt such as Smyth and Yu (1995) estimated the optimal debt ratio for economic growth for the period 1960–1991. They found that the optimal debt ratio for debt held by the public is 38.4 percent and the total debt is 48.9 percent. Cohen (1997) shows that debt performs negatively to the growth beyond 50 percent of debt to GDP ratio. Hence, he concluded that 50 percent of debt-to-GDP ratio is the optimum debt for the Latin America countries. Elbadawi, Ndulu, and Ndung'u (1997) studied the relation between debt and growth and finally, estimated the threshold level of debt for the 99 developing countries. The results inferred a threshold level of debt around 100 percent of GDP, beyond which the marginal impact of debt on per capita growth turns negative. Further, Prskawetz *et al*. (1998) calculated the optimum level of public debt for European Union is to be 60 percent of GDP. Pattillo, Poirson, and Ricci (2002) studied the non-linear impact of debt on economic growth in a sample of 100 developing countries. They controlled the endogeneity problem present in the model and concluded that 20 percent of debt-to-GDP ratio is the optimum debt for developing counties (Clements, Bhatacharya, and Nguyen, 2003 find the same results). Manasse, Roubini, and Schimmelpfennig (2003) estimated that 50 percent of debt-to-GDP ratio is optimum for developing counties. Smyth et al. (1995) estimated that the debt ratio that maximizes US growth is about 40 percent of GDP. Further, Pattillo, Poirson, and Ricci (2003a) suggested that debt has negative impact on economic growth in highly indebted countries. More specifically, they concluded that debt has significantly stronger negative impact on total factor productivity in the developing countries. Pattillo and Poirson (2004) showed that external debt negatively affects the economic growth. They found that debt-to-GDP ratio of 35-40 percent is optimum for 93 developing countries for the period 1969–1998. Imbs and Ranciere (2005) said that 30 to 35 percent debt-to-GDP ratio is optimum for developing countries.

Abiad and Ostry (2005) suggested the existence of an irrelevance threshold for public debt—a level beyond which fiscal policy no longer seeks to satisfy the government's inter-temporal budget constraint. Again, Mati (2005) estimated that a debt-to-GDP ratio of 38% is the optimum level for Indonesia, while Ostry *et al*. (2010) estimating the optimum level of public debt for 23 advanced countries finds that the threshold of point debt ratio is 63 percent of GDP in long-run.

Reinhart and Rogoff (2010) showed that when gross external debt reaches 60 percent of GDP, annual growth declines by about 2 percent, and for levels of external debt in excess of 90 percent of GDP, growth rates decrease to half. Kumar and Woo (2010) investigating the relationship between the initial debt-to-GDP ratio and growth and found the threshold level at which debt has a negative impact on growth is 90 percent of GDP. Caner *et al*. (2010) examining the threshold point for 99 developing economies during the period 1980–2008, concluded that a public debt-to-GDP ratio of 77 percent is optimum for these economies. Topalova and Nyberg (2010) discussed the public debt targets of India suggested that a debt ratio 60 to 65 percent of GDP is good for India in 2015–2016. Bannister and Barrot (2011) calculated the debt target through credit rating for Central America, Panama and the Dominican Republic for more than 21 years and concluded that these countries fall in debt intolerance region. Again, Abutaleb and Hamad (2012) assessed the optimum foreign debt of Egypt for the period 1985–2005 using stochastic control approach found that Egypt's foreign debt was higher than the optimal debt level before 1997, but it converged after 1997 towards the optimal value. Further, they have shown that for each additional percent of debt, the annual real growth decreases by 0.017 percent. Checherita and Rother (2012) studied the effect of gross public debt on per capita GDP growth and they have shown a debt-to-GDP ratio of 90 to 100 percent has negative impact on growth. Again, Greenidge *et al*. (2012) examined the effects of threshold public debt on economic growth and

finds that as the debt level reaches 55 to 56 percent of GDP, it exerts a negative impact on the growth of Caribbean countries.

Table 2.1: Optimum Level of Debt-to-GDP ratio of Different Countries

Regional Integration Agreements	**Debt / GDP**
Economic and Monetary Community of Central Africa (CEMAC)	70
West African Economic and Monetary Union (WAEMU)	70
Economic and Monetary Union of the EU (EMU)	60
Andean Community	50
Central American Countries	50
Mercosur	40
Individual Countries	**Debt / GDP**
Estonia	60
Indonesia	60
Pakistan	60
Poland	40
United Kingdom	40
Denmark	40
Slovenia	40
Ecuador	40
Panama	40
Kenya	40
Namibia	30

Source: IMF staff Discussion paper.

Recently, Bohn (2005), De Haan *et al*. (2008), Feld and Kirchgässner (2008), Galli and Padovano (2008), Haugh (2011), Collignon (2012), Fincke and Greiner (2012), and Neck and Haber (2012) have tested the sustainability of public debt. Cordella et al. (2005), employed spline functions and the threshold estimation techniques of Hansen (1996, 2000) concluded that 15 to 20 percent is optimum for non-Heavily Indebted Poor Countries (HIPC) and 0 to 20 percent is optimum for HIPCs.

2.4.4. Burden of Public Debt

The classical economist such as Hume (1752), Simth (1977), and Say (1964) have showed that public debt is unproductive and harmful to the economy. Subsequently, Malthus, Mill, Sidgwick, and Cairnes found that the consequence of the public debt is evil for the nation[6]. The modern theory on public debt such as Lerner (1948) showed that the national debt is neither benefits nor burden for the country. Further, the Keynesian economics supported the views of no burden of public debt. According to them, the creation of debt can be able to bring the unutilized resources, and hence raise the national income. Therefore, the interest payment created by imposing the tax rate may not have any burden on the economy.

After the Keynesian era, economist like Domar (1944), explained the concept of public debt and examined that if the growth rate of national income is constant and the growth rate of public debt is increasing then public debt is a burden for the country, and the rising level of national income growth will respond simultaneously to the growth rate of public debt than to the fall of public debt. It is because of rising the level of national income will lead to increase in the tax collection, and hence, does not create burden for the country. Subsequently, Musgrave (1959) purposed the burden of public debt for future generation through reduction in private investment. Bowen–Davis–Kopf (1960) defined the burden of debt in terms of life time consumption expenditure of different generation of tax payer. They concluded that debt burden will be shifted to future generation. Similarly, Modigliani (1961) defines the burden of public debt in the contest of loss of capital formation and reduction of potential future income. Hence, it is a burden for the future generation.

The study discussed the Domar (1944) theoretical framework on the impact of debt burden on society. It is because Domar discussed the intelligible of the

[6] Principles of Political Economy (London, 1836), p.409, cited in Burkhead,

concept of debt burden. Domar explained that the burden of debt is based on four cases, which are the following: Case 1: National income remains constant; Case 2: National income increases at a constant absolute rate; Case 3: National income increases at a constant percentage rate; and Case 4: The war model. The Domar framework of burden of debt in every case is explained in a mathematical framework as follows:

Let Y = national income; D = public debt; $U = D_i$ = interest charges on the debt; $T = Y+U$ = taxable income; U/T = tax rate; $Y' = Y(1-U/T)$ = net income of the non-bondholders after the payment of taxes; a = national income at the beginning of the experiment; α = percentage of national income borrowed by the government; i = interest rate paid on the debt; b = absolute annual rate of growth of national income (in case 2); r = percentage annual rate of growth of national income (in case of 3 and 4); t = time (in years).

Case 1: National income remains constant

$$Y = a$$
$$D = D_0 + \alpha a t \tag{2.21}$$

$$\frac{D}{Y} = \frac{D_0}{a} + \alpha t \tag{2.22}$$

$$\lim_{t\to\infty} \frac{D}{Y} = \infty \tag{2.23}$$

$$\frac{U}{T} = \frac{D_i}{Y + D_i} = \frac{1}{\frac{Y}{D_i} + 1}$$

$$\lim_{t\to\infty} \frac{U}{T} = 1 = 100\,percent \tag{2.24}$$

$$\lim_{t\to\infty} Y' = Y(1 - \lim_{t\to\infty} \frac{U}{T}) = 0 \tag{2.25}$$

Case 2: National income increases at a constant absolute rate

$$Y = a + bt$$

$$D = D_0 + \alpha \int_0^t (a + bt)$$

$$= D_0 + \alpha t(a + \frac{b}{2} t)$$

$$\frac{D}{Y} = \frac{D_0 + \alpha t(a + \frac{b}{2} t)}{a + bt} \tag{2.26}$$

$$\lim_{t\to\infty} \frac{D}{Y} = \infty \tag{2.27}$$

$$\lim_{t\to\infty} \frac{U}{T} = 1 = 100\, percent \tag{2.28}$$

$$Y' = Y(1 - \frac{U}{T}) = \frac{Y^2}{Y + U}$$

$$\lim_{t\to\infty} Y' = \frac{2b}{ai}$$

Case 3: National income increases at a constant percentage rate

$$Y = ae^{rt}$$

$$D = D_0 + \alpha a \int_0^t e^{rt} dt = D_0 + \frac{\alpha a}{r}(e^{rt} - 1)$$

$$\frac{D}{Y} = \frac{D_0}{ae^{rt}} + \frac{\alpha}{r}(1 - e^{-rt}) \tag{2.29}$$

$$\lim_{t\to\infty} \frac{D}{Y} = \frac{\alpha}{r}$$

$$\lim_{t\to\infty}\frac{U}{T}=\frac{i}{\frac{r}{\alpha}+i} \tag{2.30}$$

Case 4: The war model

Some of the additional symbols are used in this case. They are p = length of the "peace" period; α = percentage of national income borrowed during the "peace" period; w = length of the "war" period; β = percentage of national income borrowed during the "war" period; $\sigma=\frac{\alpha p+\beta w}{p+w}$ = the average percentage of national income borrowed. So, this model is as follows:

Maximum $\lim_{t\to\infty}\frac{D}{Y}=\frac{\alpha+Ke^{rp}}{r}$ (2.31)

Minimum $\lim_{t\to\infty}\frac{D}{Y}=\frac{\alpha+K}{r}$ (2.32)

Where $K=\frac{(\beta-\alpha)(e^{rw}-1)}{e^{(p+w)r}-1}$ (2.33)

Average $\lim_{t\to\infty}\frac{D}{Y}=\frac{\sigma}{r}$ (2.34)

Maximum $\lim_{t\to\infty}\frac{U}{T}=\frac{(\alpha+Ke^{rp})i}{r+(\alpha+Ke^{rp})i}$ (2.35)

Minimum $\lim_{t\to\infty}\frac{U}{T}=\frac{(\alpha+K)i}{r+(\alpha+K)i}$ (2.36)

Average $\lim_{t\to\infty}\frac{U}{T}=\frac{i}{\frac{r}{\sigma}+i}$ (2.37)

Erbil and Salman (2006) developed a transparent approach in order to measure the burden of public debt. They characterized each bond issue with several

parameters which are as follows: B = the size of the issue; b = the date of the issue, and s = the payment date of the principle with accrued interest; t =the time dimension. And t could be before, during or after this particular bond issue. Therefore, the value of a bond I at time t ($VB_{i,t}$) can be represented by the following formula:

$$VB_{i,b,t} = B_{i,b}(1+r_i)^{t-b} \qquad (2.38)$$

Where, $t = 1,\ldots..T$, $VB_{i,t}$ is the magnitude of the payment. This equation (2.38) stated the renegotiation of both principle and interest payments. Hence, the total accumulated debt is determined as:

$$DB_{i,t} = \sum_{i=1}^{I} VB_{i,b,t} \qquad (2.39)$$

Therefore, the burden of debt includes both principle amount and interest payment on this principle amount.

Bohn (1998) examined the dynamic relationship between government debt and primary surplus. He stated government finance as $D_{t+1} = (D_t - S_t)\ (1 + R_{t+1})$. This defined as this one period debt minus the primary surplus times the gross interest factors is the next period debt. As the economy is growing, it increases the taxation as well as government spending. Hence, the budget equation in a ratio is formed as:

$$d_{t+1} = x_{t+1}[d_t - s_t] \qquad (2.40)$$

Where, $d_t = \frac{D_t}{Y_t}$ which is the ratio of debt to aggregate income, $s_t = \frac{S_t}{Y_t}$ is the ratio of primary surplus to income, and $x_{t+1} = (1+R_t)(\frac{Y_t}{Y_{t+1}}) \approx 1 + r_{t+1} - y_{t+1}$ is the ratio of the gross return on government debt to the gross rate of income in either real or nominal terms. The variables r_{t+1} and y_{t+1} denote the real interest rate and the real growth rate, respectively. So, Bohn (1998) showed that the debt-income ratio and the primary surplus are stated as:

$$s_t = \rho.d_t + \alpha.Z_t + \varepsilon_t = \rho.d_t + \mu_t \qquad (2.41)$$

Where, Z_t is a set of other determinants of the primary surplus, ε_t is an error term, and $\mu_t = \alpha.Z_t + \varepsilon_t$. Finally, Bohn (1998) defined the model for the surplus-GNP ratio as:

$$s_t = \rho.d_t + \alpha_0 + \alpha_G.GVAR_t + \alpha_Y.YVAR_t + \varepsilon_t \qquad (2.42)$$

Where, *GVAR* is the level of temporary government spending and *YVAR* is the business cycle indicators.

Similarly, the empirical studies by Erbil and Salman (2006) revealed the Turkey's public debt burden by using the monthly data from 1998 to 2003. The study revealed that the transparent payment approach is superior policy making tool for measuring the debt burden for the fiscal authority. Ogawa and Ono (2010) examined the public debt burden using diamond type overlapping generation model. They found that debt is not burden for future as well as unborn generation maintain better living standard. The other studies such as Steigum (2001), Kaas and Von Thadden (2004), Josten (2006), Ganelli (2005), Cunningham (1993) and Cecchetti et al.

(2011) have found that public debt is burden for the economy. On the other hand, Gulley (1994), Seater (1993), Deravi, Hegji and Moberly (1990), Barro (1987), and Evans (1985, 1987) have concluded that public debt has neutral effect on economic growth. They supported the Ricardian equivalence theory.

2.5. Review of Literature on Public Debt in the case of India

The earliest studies in case of Indian public debt by Venkataraman (1968) analyzed that the volume of debt of the State Government of India had increased during the first three five years plan. Therefore, he concluded that this rising level of debt can be the matter of concern for the country. Patnaik (1970) warned the increasing level of state public debt and raised the level of interest payment for poor state like Odisha. Sreekantaradhya (1972) examined the reason of raising the level of public debt for India. Subsequently, Rao (1972) examined the pattern of public borrowing in India. Ghuge (1977) showed that national debt displays the rising trend since 1956 and plays the role of a significant factor that influences the monetary and fiscal policy. For the first time, Seshan (1987) pointed out that the rising level of public debt of India is unacceptable and harmful for the country. Similarly, the report of the Comptroller Auditor General (CUG) of India (1988) also warned the harmful nature of high level of public debt for India. Ghosh (1988) empirically has shown that public debt involves the interest payment, and it creates the burden for the country like India. Rakshit (1989) analyzed the structure and trend of public debt.

Rangarajan, et al. (1989) showed the dynamic nexus of government deficit and different mode of finance to this deficit. They found that debt financing is more dangerous than other mode of financing to the deficit financing. Lakdawal (1990) analyzed the large size of public debt in India. He suggested that the rising level of public debt is going to create the burden for the future. Chelliah (1993) showed the advantages and disadvantages of public debt in case of India. He has projected the

growth of public debt happens to be up to 2003. Rao (1992) said that state level revenue expenditure occurs more than its revenue collection, and hence, the level of state debt follows the increasing trend. Thus, with these problems that different state governments are facing particularly for the debt servicing payment, central government formed a finance commission for having smooth function of debt management in states. So, the report of second finance commission in 1956 focused on the problem of State Government debt. The commission attempted to rationalize the interest rate structure of central loans as it was opposed to the policy of giving loans interest free.

Singh (1999) investigated the relationship between domestic debt and economic growth during the period 1959–1995. He concluded that there is no effect of domestic debt on economic growth in India. Rangarajan and Srivastava (2005) argued that large fiscal deficit and interest payment to GDP adversely affect growth from 1980 to 2011 for India. They also pointed out that public debt negatively affect the economic growth. Kannan and Singh (2007) showed that public debt and high level of fiscal deficit from the period from 1971 to 2006 and concluded that public debt has adversely affect the interest rate, output, inflation and trade balance in the long run in India. In contrast, Gulati (1993) studied the growing burden of internal public debt during the period 1980–1992. He suggested that employing the productive government expenditure can be able to tackle the fiscal deficit, and hence reduce the debt burden in India. Jha and Shrama (2004) used the structural break test and cointegration methods from the period between 1871 and 1921 and the post-independence period from 1950 to 1997. They concluded that public debt may not be unsustainable for India.

2.6. Conclusions

On the basis of the theoretical as well as empirical literature, the finding on public debt clearly showed that the level of debt-to-GDP ratio plays an important role for macroeconomic performance of any economy like India. Further, from the literature, this study concluded that the relationship between public debt and growth is inclusive. This ambiguity further motivates us to reassess the linkage between debt and growth by addressing three major research questions in the context of India. First, we re-examine the relationship between debt and growth by introducing key macroeconomic channels. Second, this study makes an attempt to identify the key factors that drive public debt and then calculate the threshold level of debt. This study further examined whether public debt causes burden for India or not. Before examining the three core objectives, in the next chapter, this study presents the trends, composition, patterns and structure of Indian debt scenarios. Therefore, Chapter 3 is very crucial to understand the overall debt dynamics of Indian economy.

Chapter III
Trends, Composition and Structure of India's Public Debt

3.1. Introduction

The floating debt increased because of the budget deficit during the period of 1918–1929 (Barman, 1978). In order to repay the debt including the interest, India adopted a sinking fund in the year 1924. This method of debt repayment clearly indicates that Indian government maintains its expenditure from taxation and wants to avoid public borrowing. Further, some changes in the structure of debt are seen during the period of Second World War. The marketable debt follows the decline trend from 32 percent to 19 percent during the period between end of March 1938 and end of March 1945. However, the share of securities which were above ten years follows the increasing trend from 26 to 44 percent (Barman, 1978).

The level of the public debt has considerably increased after the end of War. It is because of the curve in the inflationary situation that aroused in the economy created owing to the war. Therefore, the policy maker suggested increasing in the level of savings and reduction in the consumption expenditures. Hence, various small saving schemes such as the interest free bonds, prize bonds, and defense savings were implemented. After independence, India faced many economic problems such as lack of funds, deficits of budget, heavy inflationary pressure, unstable monetary mechanisms, and high speculations in commodity market (Barman, 1978). Further, the commercial banks sold out the government securities the prices of which were guaranteed by the Reserve Bank thereby causing high inflation. All these problems marked the India economy to be stagnant. Therefore, in order to solve these

problems government adopted a fiscal policy which can bring stability in the economy. Even after the adoption of the new fiscal policy, the borrowing programs failed. On 15th October, 1948 India introduced a treasury deposit scheme to increase the short term finance and to assist an increment in the liquidity of the banks. Even this instrument could not run properly and failed to provide much to the government loans.

Therefore, the growth of public debt has been a debatable issue over the responsible fiscal policy. Critics not only have faulted the deficit financing policy, but have also warned about the burden of debt accumulation for the future generation.[7] In order to apprehend the role of public debt in financing for economic development in India, it is necessary to evaluate the trends and structure of public debt over the period of time.

The rest of the study is structured as follows: Section 2 provides the trend of public debt in India. The composition of public debt is delineated in Section 3. The classification of central public debt is explained in Section 4. The trend of interest payment on public debt is discussed in Section 5. The last section contains the summary and concluding remarks.

3.2. Trends of Public Debt in India

India's stock of total public debt (both internal and external debt) which includes both centre and state has increased from Rs.7, 269 crores in 1960 to Rs.74,99,192 crores in the year 2013 at current price (Handbook of Statistics, RBI). The state government of India can also raise the fund and should follow the constitution of India which is mentioned in the Article 246. There are certain restrictions on state government in terms of borrowing. They can't raise funds from the external sources.

[7] Musgrave and Musgrave, Public Finance in the Theory and Practice, Fifth Edition, Chapter 32, p.544

Though the constitution of India says that either centre or state can borrow independently and/or collectively, however, it is mentioned in the Article 292 of the Indian constitution that the state government can only borrow funds from central Govt. after getting permission from the Legislature of the security of the consolidated fund. The trends of total debt by centre and states are shown in the following Figure 3.1.

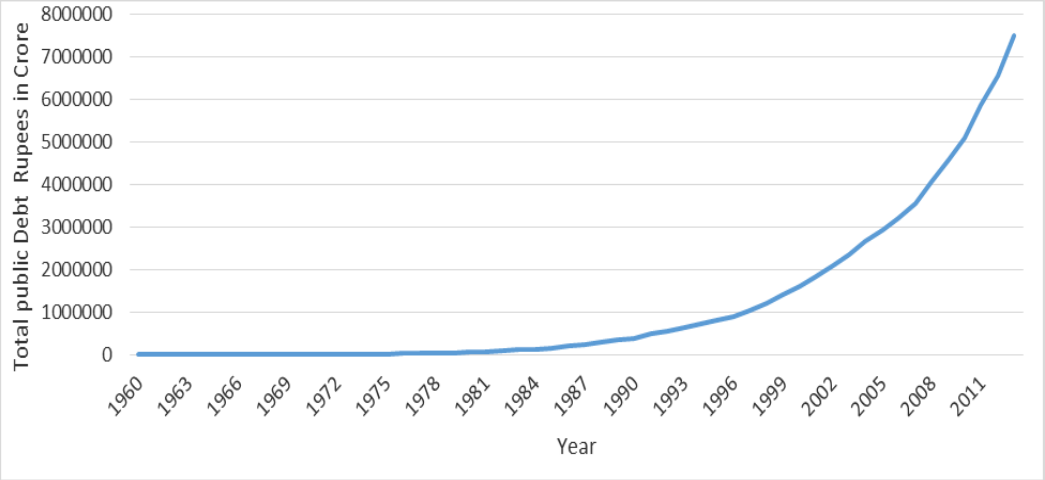


Figure 3.1: Combined Total Debt of the Central and State Governments of India

Sources: Ministry of Finance, Government of India and Database on Indian Economy, RBI

The figure 3.1 clearly shows that the trend of total debt in absolute figure for both central and state government has been increasing from 1960–1961 to 2013–2014. These figures also tell about the India's public debt continuously increased greatly after the period of 1990 onwards. Although the volume of total public debt shows the increasing trend, the total public debt as a percentage of GDP shows both increasing and decreasing trend from end of March 1970 to end of March 2013. It is presented in Figure 3.2. This Figure illustrates that the total public debt as a percentage of GDP has increased from 44.5 percent at the end of March 1970 to

66.24 percent of GDP at the end of March 2013. The figure 3.2 shows the increasing trend of public debt as a percentage of GDP between 1983 and 1989. It is because of the large current account deficit and high level of fiscal deficit that India was facing. It was financed by multilateral and bilateral assistance commercial borrowing, non-resident deposits, and domestic borrowings. This high level of fiscal deficit was financed through the domestic borrowing by issues of Treasury Bill caused by the double digit of inflation. Thus, the government was forced to raise the statutory liquidity ratio of the commercial bank for overcoming the inflation, but it hampered the profitability of commercial bank and negatively affected the monetary as well as financial sector of the economy. Therefore, India greatly depended on external assistance with high interest payment. Further, the second oil price shock was also another reason which forced the government to go for high external borrowings. The decline trends of public debt as a percentage of GDP was observed from 1993 to 1996. There was no indication of economic development of India. India faced balance of payment crisis, high level of fiscal and revenue deficit and high level of inflation. Therefore, in this period government implemented the structural adjustment through adopting new economic policy. Thus, government was forced to reduce the public expenditure on social welfare and capital investment. Government also reduced the expenditure of defense which was seven times higher than the central and state expenditure on education.

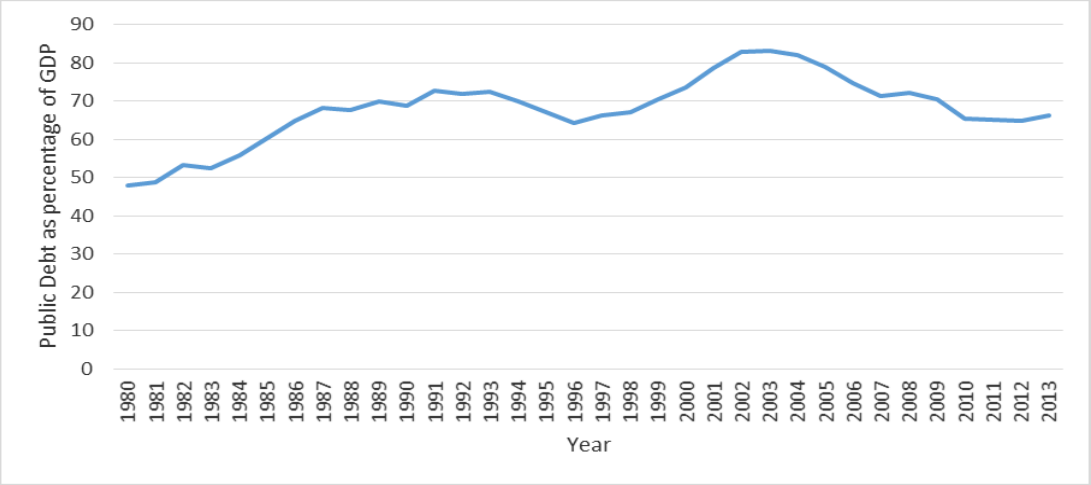


Figure 3.2: Combined Central and State Government of India Total Debt as a Percentage of GDP

Source: Database on Indian Economy, RBI

Further, the Figure 3.2 clearly indicates the public debt as a percentage of GDP has increased sharply from 1997 to 2003. It is because of the implementation of fifth pay commission which added to the government expenditure and the sluggish revenue growth of poor performance of public sector undertakings. The trend of accumulation of debt as a percentage of GDP shows steady decline from 2004 to 2007. This is attributed to fiscal consolidation which was achieved through gradual reduction in the fiscal deficit. However, this trend shows reversed situation from 2008 to 2009 owing to protection from the adverse impact of global economic crisis of the Indian economy. The government has undertaken concerted efforts in reducing the fiscal deficit gradually so as to decline the public debt as a percent of GDP from 2010 to 2012. But, the present Euro zone crisis showed the rising trend of public debt to GDP ratio from 64.91 percent at the end of March 2012 to 66.29 percent at the end of March 2013.

3.3. Composition of Public Debt

The total public debt represents the combination of central and state government debt. Figure 3.3 shows the composition of central and state government debt as a percentage of total debt. The state government cannot meet all its expenditures from the tax revenue. It is therefore, the state governments depend on central government fund in order to avoid the tax burden on the people. Though there are no such disparities on the issue of loan between centre and states, the central government can borrow more in favorable terms than the states government. The Figure 3.3 clearly shows that the percentage of central debt is much higher than the state government debt between the end of March 1970 and the end of March of 2013. The share of states debt has increased particularly from 1980-81 onwards. The main reason for this jump was because of state debt classification. Earlier the state debt was classified into public debt and unfunded debt, which later on changes to internal debt, loan and advances from central government. Second, the developmental expenditure of all the state government has increased rapidly, which causes for increase in debt. The third reason for expansion of state public debt was the need for raising the funds for rapid economic development. The advantage of the centralized borrowing is that the central government can allocate the funds in proper way. The central government can borrow funds from richer states and can assign the funds in the underdeveloped states. So, the equality can be achieved among them.

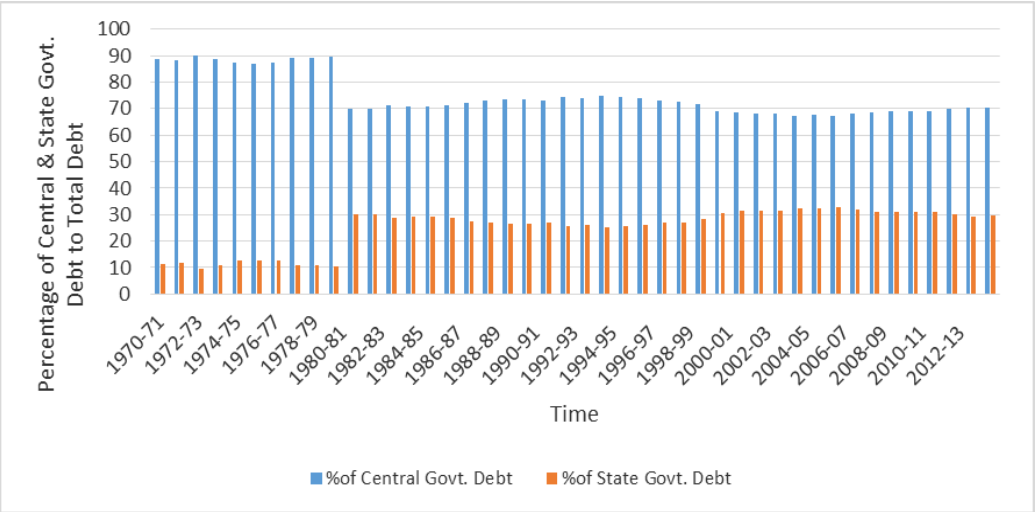


Figure 3.3: Composition of Central and State Debt as a Percentage of Total Debt

Source: Database on Indian Economy, RBI

According to the Article 293(1) of the constitution of India, the state government can borrow only from domestic sources. Further, the Article 293(3) says, as long as a state government has outstanding borrowings from the central government, it is required to obtain central government prior approval before incurring debt[8]. The major sources for financing the state government's deficit are market borrowings, borrowing from national small saving fund (NSSF), loans from financial institution and loans from centre. Further, the state government debt is classified as permanent debt, floating debt, unfunded debt, loans from the central government, and other debt. The permanent debt generally covers loans raised in open market. It includes cash and conversion loans as well as bonds issued in compensation for the abolition of intermediary rights in land such as Zamindari Abolition Compensation Bonds and Encumbered Estate act Bonds. The floated debts are short term debt, and the maturity period is less than 12 months. It includes treasury bills, overdrafts from the Reserve Bank of India, and cash credits from the State Bank of India and other

[8] Government Status paper, Ministry of Finance, Dept. of Economic Affairs-2013.

commercial banks. Loans from the central government are one of the major forms of debt of the state government. These loans are given by the central government for developmental projects, expenditure on natural calamities, purchase of fertilizers and rehabilitation scheme etc. And finally, the other debts are unfunded debt and market borrowing. The funded debt consists of state provident funds, saving banks deposits, and employees insurance etc.

3.4. Classification of Central Public Debt

The public debt of the centre is broadly classified into internal and external debt of the centre. The internal debt largely consists of dated securities and treasury bills which are issued through auction. These types of debt are generally called as the short term debt and the maturity period ranges from one year to seven years and more. On the other hand, the external debt is a small proportion of total debt of the government of India. But after independence, India launched economic planning and at that time the accumulated foreign exchange reserve was very low and India faced low investment and balance payment crisis. Therefore, in order to fill these gaps, India government borrows heavily from the external sources. The external debt is generally used to finance specific projects at the central and state level. The share of internal and external debt to total debt is presented in Figure 3.4. This figure shows that the percentage of internal and external debt to total debt of the central government. It shows that the share of internal debt is large than its share of external debt to total debt from the period 1980 to 2013.

It is also observed that the share of external debt to total public debt of the centre follows the declining trend from the end of March 1980 to the end of March 2013, while the increasing trend follows the percent of internal debt to the total public debt of the centre. In the end of March 1980, the total internal debt as a

percent of total public debt is 78.23 percent while it reaches to 93.51 percent in the end of March 2013.

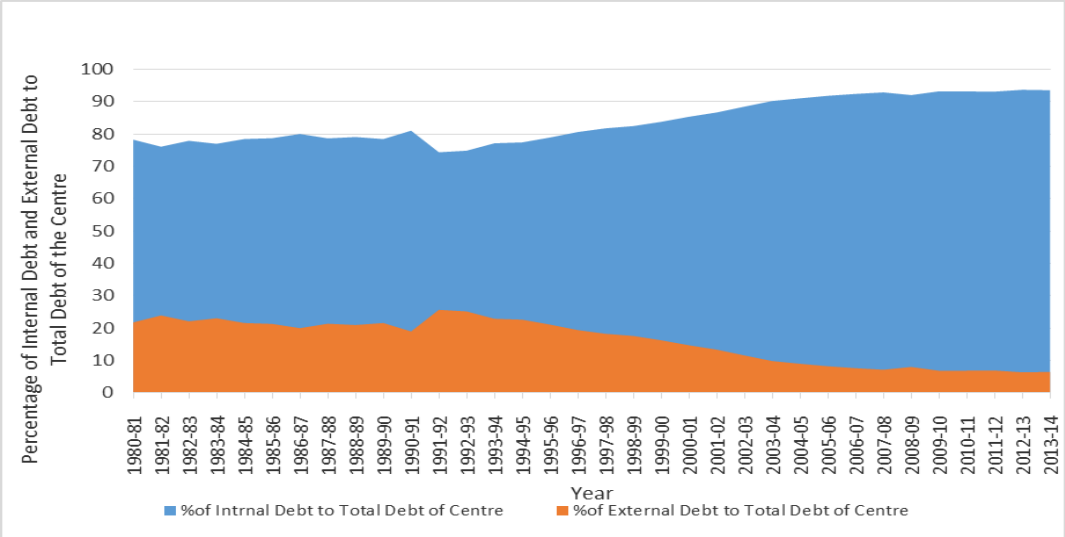


Figure 3.4: Components of Central Public Debt

Source: Database on Indian Economy, RBI

In contrast to that, the external debt of the central government as percentage of total debt decreased from 21.76 percent in the end of March 1980 to 6.78 percent in the end of March 2013. The share of total internal debt contributes highly to the total public debt of India's central government debt accounts. The total internal debt can be classified as marketable loan, non-marketable loan and other loan. The marketable loan, generally known as dated securities, is a significant instrument which is used to finance the fiscal deficit of the central government. "It is the endeavour of the Government to elongate the maturity profile of debt to reduce redemption pressure in short to medium term to aid the process of fiscal consolidation" (Government Debt, Status Paper, 2012). The weighted average of maturity of issued securities increased from 11.16 in 2009–2010 to 11.62 in 2010–11, but it increased to 12.56 in the year 2011–2012. However, the average maturity of outstanding stock of dated securities decreased marginally from 9.67 in 2009–

2010 to 9.94 in 2010–2011, but it increased to 9.66 in 2011–2012. The components of total internal debt of the centre are presented in Figure 3.5.

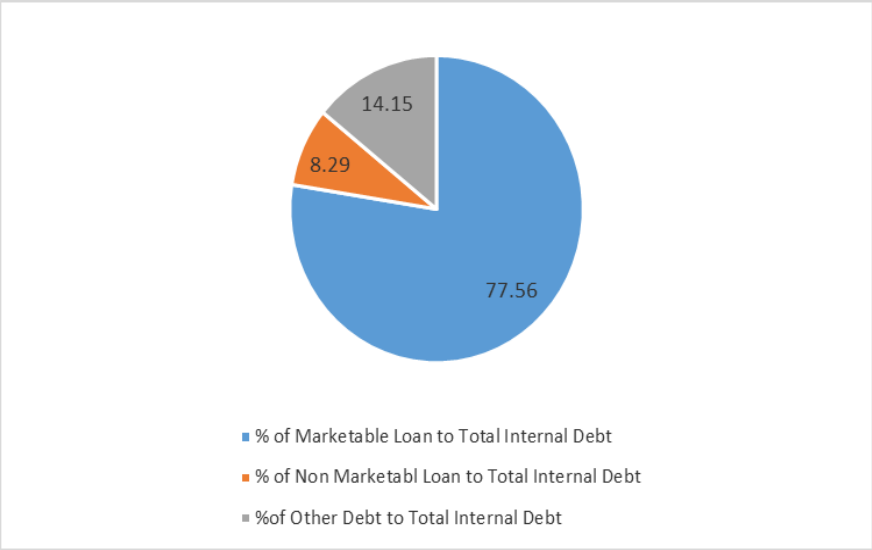


Figure 3.5: Components of Total Internal Debt in 2012

Source: Ministry of Finance, Govt. of India

The Figure 3.5 shows that among the total internal debt of the central government of India, the share of marketable loan is 77.56 percent, the share of non-marketable securities is 8.29 percent, and the share of other securities is 14.15 percent. The marketable loan contributes more in the total internal debt of the central government. So, the components of marketable loans are presented in Figure 3.6. The market loan consists of dated securities and treasury bills. Dated securities are commonly known as market loans, and it constitutes the most significant component of instruments that are used for financing the fiscal deficit of the central government. At the end of March 2013, central government of India borrowed 91.42 percent of total marketable loans from the dated securities and the rest amount was borrowed from treasury bills. The 91-days, 182-days and 364-days treasury bills are short term cash flow issued under the regular auction programme of the government. This short term cash flow also provides opportunity for short term investment in financial

institutions. The 91-days treasury bills are generally auctioned every week, and 182-days and 364-days treasury bills are auctioned every fortnight.

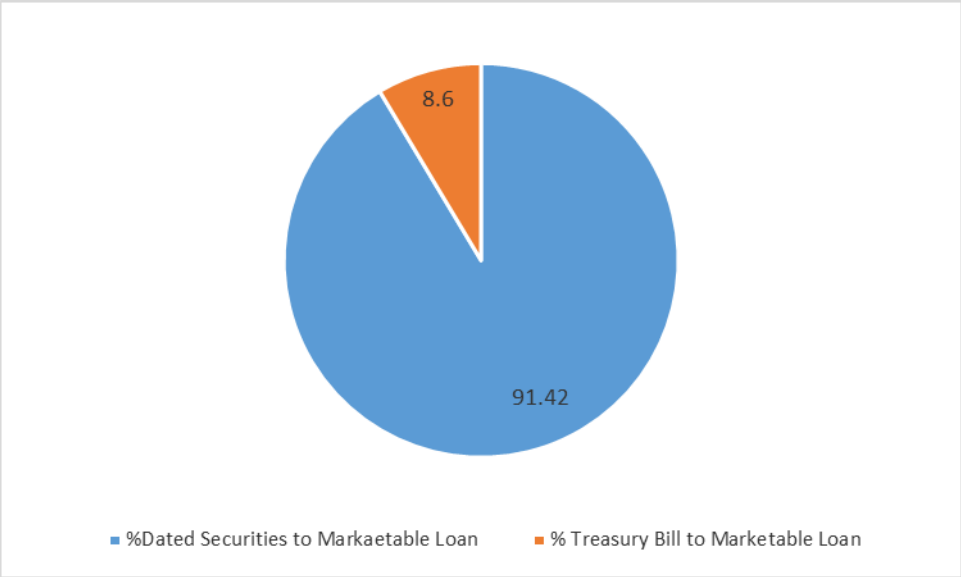


Figure 3.6: Components of Market Loans in 2013-14

Source: Ministry of Finance, Govt. of India

The tenor of dated securities goes up to 30 years. While it has generally been the endeavor to elongate the maturity profile, the tenor of new issuances is function of acceptable roll over risk as well as market appetite across various maturity segments. While the weighted average maturity of securities issued during 2012–2013 increased to 13.5 years from 12.7 years in 2011–2012, the weighted average maturity of outstanding stock of dated securities at the end of 2012–2013 increased to 9.7 years from 9.6 years as at the end of March 2012.

Central government also borrows funds from non-marketable securities which consist of 14 days intermediate treasury bills, compensation and other bonds, securities issued to international financial institutions and securities against small savings. But the percentage of non-marketable securities of total internal debt is small, and it is shown in the Figure 3.5. The Figure 3.6 shows that dated securities

contributed more fund to the government for financing the short term fiscal deficit of the government. Therefore, the ownership patterns of government's dated securities of the centre are presented in Figure 3.7. The Figure 3.7 shows that the share of commercial banks in the total outstanding Government of India securities is 34.5 percent in the end of March 2013. Similarly, the shares of insurance companies, RBI, bank–primary dealers and provident funds in the total outstanding Government of India securities are 18.56, 16.99, 9.36 and 7.37 percent, respectively. This ownership pattern of commercial banks, insurance companies, RBI, bank–primary dealers, others, and provident funds contribute major shares to the ownership such as non-bank PDs, mutual funds, co-operative banks, financial institutions, corporates, and FIIs. These dated securities carry fixed interest rate.

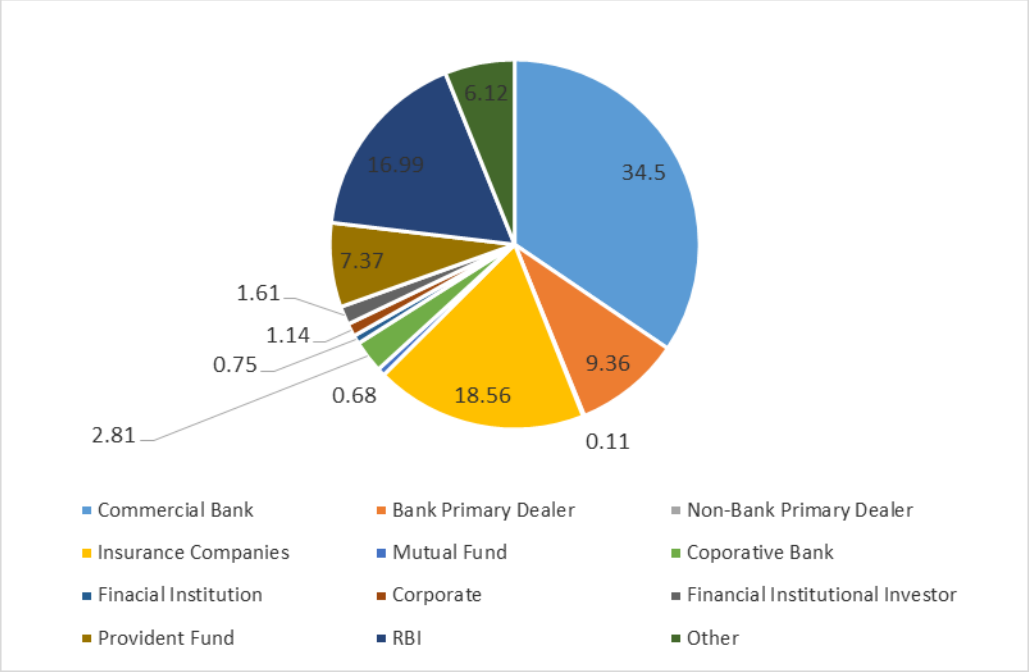


Figure 3.7: Ownership Pattern of Government of India Dated Securities in 2013-14

Source: Monthly Bulletin, RBI, Issue of Various Quarters

External debt is another source of debt for India. The gross external debt, at a point in time, is defined as "the outstanding amount of those actual current, and not contingent, liabilities that require payment(s) of principal and/or interest by the debtor at some point(s) in the future and that are owed to non-residents by residents of an economy" (External Debt Statistics–Guide for Compilers and Users, International Monetary Fund, 2003). Every kind of debt has certain original and residual maturity date. The original maturity is defined as the period encompassing the precise time of creation of the financial liability to its date of final maturity, and the debt by residual maturity (or remaining maturity) includes short term debt by original maturity up to one year, combined with medium to long term debt repayment by original maturity falling due within the twelve month period following a reference date. The external debt is commonly expressed in terms of original maturity. India's external debt increased from US$ 305.9 billion at the end of March 2011 to US$ 409.4 billion at the end of March 2013 and further it rises to US$ 440.6 billion at the end of March 2014. Although the trend of India's external debt in volume shows the increasing trend, the policy maker saying that India's external debt to GDP ratio is within the manageable limits. Figure 3.8 shows the trends of India's external debt to GDP ratio.

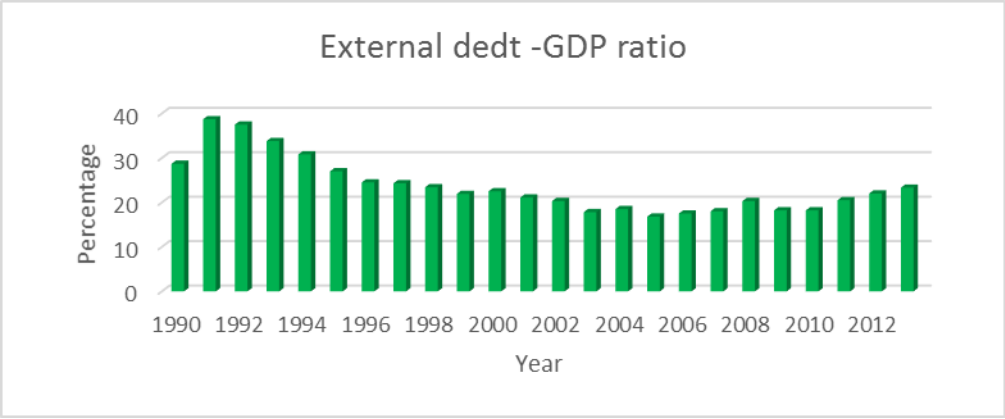


Figure 3.8: External Debt to GDP Ratio

Source: Ministry of Finance, Govt. of India, India's External Debt, Annual Status Report

The Figure 3.8 clearly illustrates that end of March 1991 external debt to GDP ratio is highest from 1990 to 2013. The reason behind this is the balance of payment crisis, high fiscal deficit, and second oil price shock. These are the major reasons in which the external debt-to-GDP ratio was 38.7, 37.5, 33.8 and 30.8 percent in 1991, 1992, 1993, and 1994, respectively. This Figure 3.8 shows declining trend from 1991 to 2007, and it shows little increase from 18 percent in 2007 to 20.3 percent in 2008 and then falls to 18.2 percent in 2009. This trend further shows increase from 18.2 percent in 2010 to 23.3 percent in 2013. The external debt of the country continues to dominate the commercial borrowings and the short term trade flows. The components of external debt of 2013 are presented in Figure 3.9. The Figure 3.9 shows that the share of commercial borrowings in total external debt increased from 19.29 percent in the year of 2004 to 34.26 percent at the end of March 2013. Apart from the commercial borrowings, the short term debt in total external debt also witnessed sharp rise from 3.88 percent in the year 2004 to 23.63 percent at the end of March 2013. The long term external debt consists of multilateral debt, bilateral debt, IMF, export credit, commercial borrowing, NRI deposits and rupee debt. These long terms debt accounted for 76.36 percent of the total external debt at the end of March 2013. The remaining 23.63 percent contains the short-term debt from the total external debt at the end of March 2013.

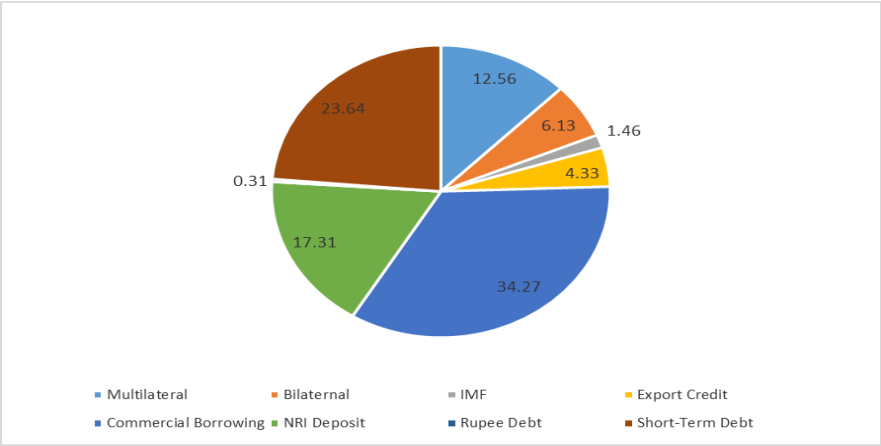


Figure 3.9: Components of External Debt in 2013

Source: Ministry of Finance, Govt. of India, India's External Debt, Annual Status Report

The currency composition of India's external debt reveals that the US dollar denominated debt, which is pointed out in Figure 3.10. At the end of March 2013, the share of the US dollar in the total external debt stood at 59.1 percent, followed by the Indian rupee (22.9 per cent), SDR (7.2 per cent) and Japanese yen (6.1 per cent).

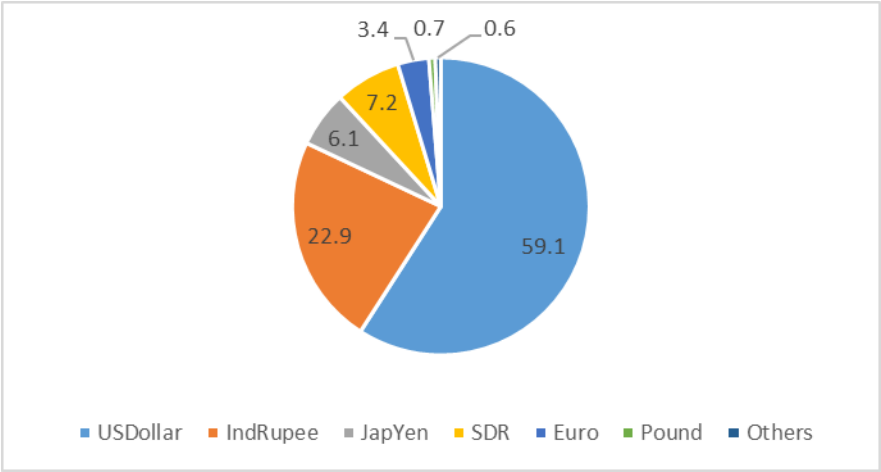


Figure 3.10: Currency Composition of India's External Debt

Source: Ministry of Finance, Govt. of India, India's External Debt, Annual Status Report

The cross–country comparison of external debt provides an assessment of the position of India's external debt from the international perspective. This is presented in Figure 3.11. International comparison based on World Bank's International Debt Statistics 2014 indicate that India continues to be among the less vulnerable countries and India's key debt indicators are comparable with other indebted developing countries. India falls under third categories followed by China and Brazil among the top ten debtor countries.

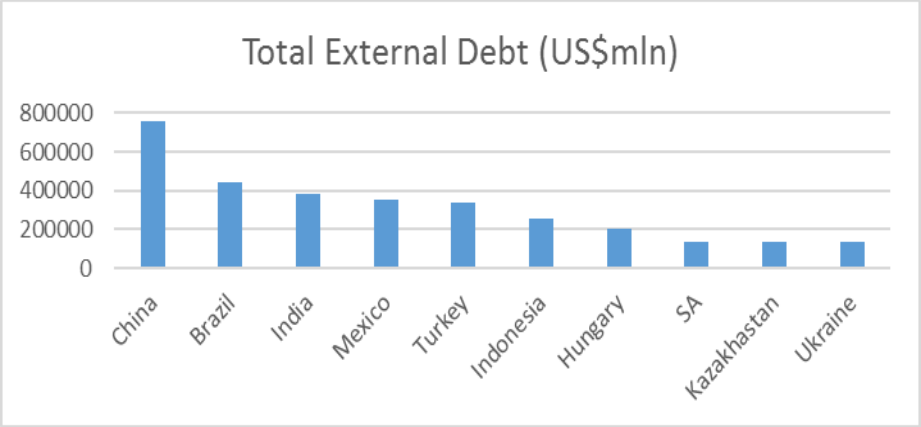


Figure 3.11: International Comparison of Top Ten Debtor Countries, 2012

Source: Ministry of Finance, Govt. of India, India's External Debt, Annual Status Report

India's key debt indicators, especially debt to GNI ratio, debt service ratio and short term to total external debt ratio continue to be comfortable. As per Article 292 of the Indian Constitution, the Government of India has been borrowing only from the multilateral and bilateral sources, while the Article 293 mentions that the state governments can borrow only from internal sources. Therefore, the multilateral creditors are primarily multilateral institutions such as the International Development Association (IDA), International Bank for Reconstruction and Development (IBRD), Asian Development bank (ADB) etc. Bilateral creditors are sovereign countries with

whom sovereign and non-sovereign entities enter into one-to-one loan arrangements. Some of India's bilateral creditors, who extend loans to both sovereign and non-sovereign debtors, include Japan, Germany, United States, France, Netherlands, and Russian Federation etc.

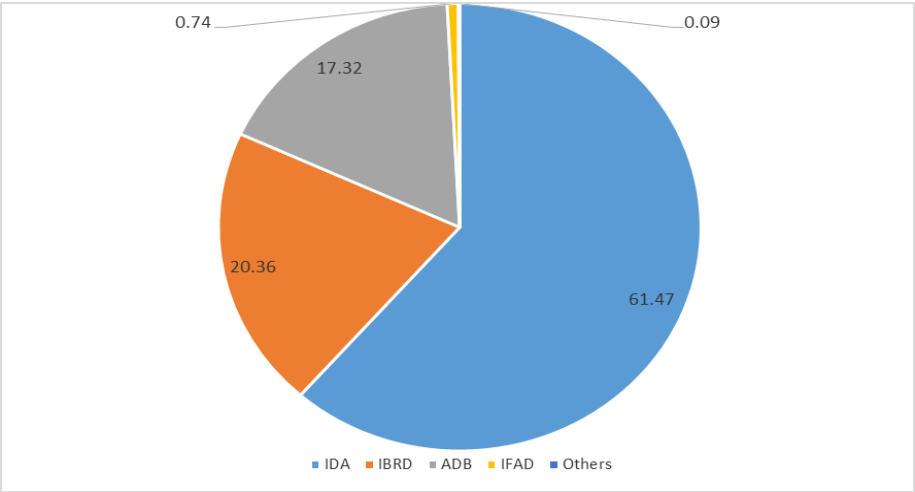


Figure 3.12: Components of Multilateral External Debt of 2012

Source: Ministry of Finance, Govt. of India, India's External Debt, Annual Status Report

The composition of the country's multilateral sovereign debt is undergoing changes over the years. This is presented in the Figure 3.12. The share of IDA in total multilateral sovereign debt decreased from approximately 73.3 percent in 2008 to 61.46 percent at the end of March 2012, while that of IBRD increased from 16.5 percent to 20.36 percent over the same period. The share of ADB increased to 17.32 percent at the end of March 2012 from 10.1 per cent at the end of March 2008. In case of bilateral sovereign debt presented in Figure 3.13 indicates that a substantial portion is accounted by Japan (76.16 percent), followed by Germany (13.72 percent), Russia (6.93 percent) United States (1.65 percent) and France (1.51 percent).

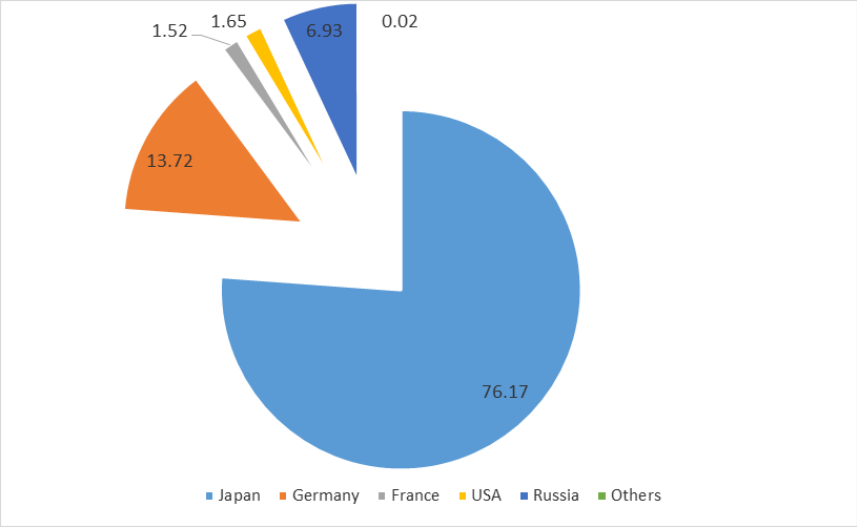


Figure 3.13: Components of Bilateral External Debt of 2012

Source: Ministry of Finance, Govt. of India, India's External Debt, Annual Status Report

3.5. Interest Payment

Government has to repay the public debt within the predetermined time period. It is always better for the government to clear the debt as early as possible. It is mainly because of the demoralizing effects on people. If the government fails to honor its promise that is not paying the interest, its credit worthiness will be lost, and hence it would be difficult for a government to raise a new loan when circumstances warranted. The interest payment is calculated as the difference between gross fiscal deficit and gross primary deficit. Figure 3.14 shows the interest payment of India's public debt is continuously increasing from the end of March 1970 to the end of March 2014.

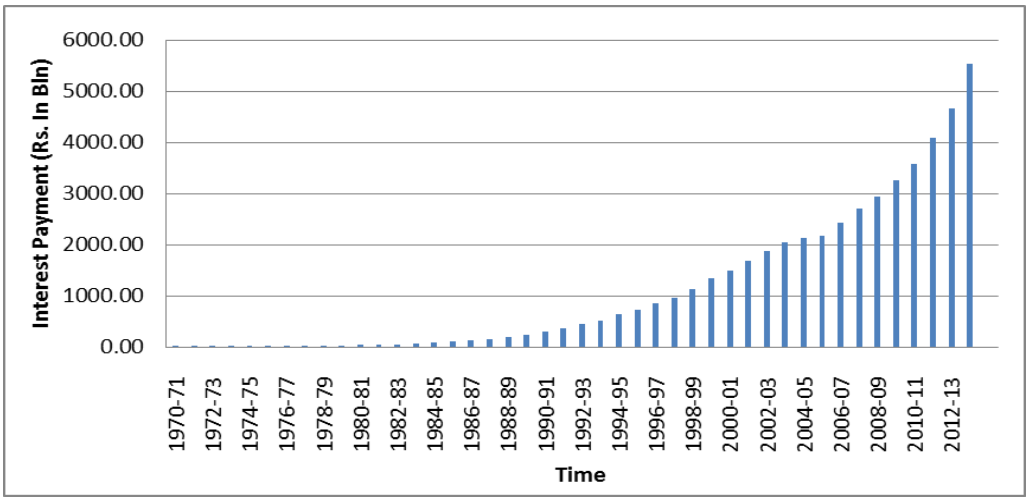


Figure 3.14: Interest Payment of the Public Debt

Source: Database on Indian Economy, RBI

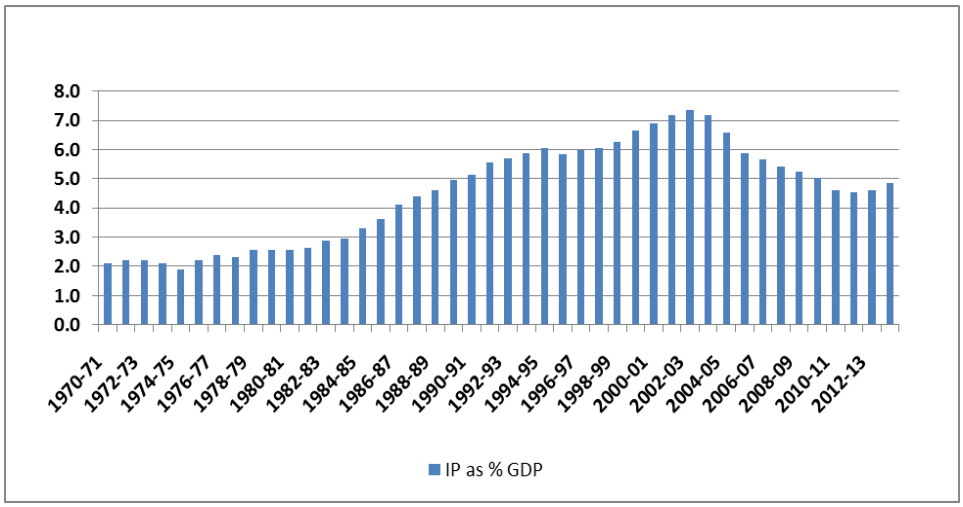


Figure 3.15: Interest Payment of the Public Debt as a Percentage of GDP

Source: Database on Indian Economy, RBI

Figure 3.15 shows the interest payment as a percentage to GDP in India. The figure clearly indicates three types of regime. First, from 1970-71 to 1982-83 period shows a lower interest payment regime, then the interest payment has increased consistently from 1982-83 to 2003-04. The interest payment as a percentage to GDP

was around 7.4% in 2002-03. The interest payment was started falling from 2004-05 to 2010-11 and then started increasing in recent years.

Table 3.1: Summary of Key Indicators

Period	Public Debt	Economic Growth	Fiscal Deficit	Primary Deficit	Interest Payment
1970s	41.7	2.9	5.6	3.4	2.3
1980s	59.0	5.6	9.3	5.7	3.6
1990s	69.2	5.5	8.7	2.8	5.9
2000s	76.9	7.2	7.8	1.6	6.2
2010-2014	65.4	6.2	7.1	2.4	4.7
Pre-reform	52.2	4.2	7.6	4.5	3.2
Post-reform	71.8	6.8	7.9	2.1	5.9
Post-global crisis	67.4	6.7	7.7	2.9	4.8

Source: Author's calculation based on Database on Indian Economy, RBI

Table 3.1 shows key variables used in this study. Fist column demonstrates the public debt as a percentage to GDP. The decadal average share of combined central and state public debt to GDP was highest in 2000s with 76.9%. The public debt as a percentage to GDP also has increased over the decades. The debt to GDP ratio was more in post-reform periods as compared to pre-reform periods. The increase in public debt in post reform periods is alarming because the central government is forced to borrow even to meet its current revenue expenditure. While correlating the Public debt with growth, the results show a positive relationship except 1990s. That means there is a direct relationship between debt and growth. Moving to fiscal deficit as a percentage to GDP, the figures show high numbers irrespective of decade. The fiscal deficit is also high during post-reform periods as compared to pre-reform periods. Though we find a positive relationship between economic growth and public debt, but it is worthwhile to notice that the fiscal deficit as a percentage to GDP is higher than economic growth in all the years. The primary deficit has declined in post-reform periods as compared to pre-reform periods. However, primary deficit as

percentage to GDP has further increased during post-global financial crisis. We also notice positive relationship between interest payments as a percentage to GDP with debt to GDP. The interest payment has almost increased by two-folds in post-reform periods as compared to post-reform periods.

Now, let's point out the position of India in the context of debt among the world. India is among the top 41 debtor country among the world in the recent years. Figure 3.16 shows the debt as a percentage of GDP of the debtor country of the world. This figure shows that Japan is the highest debtor countries. The Japanese public debt is more than twice the annual gross domestic product. The large budget deficit followed by global recession, earthquake and tsunami raised the debt as a percentage of GDP to more than 200 percent. Countries, such as Japan, Greece, Jamaica, Lebanon, Italy, Eritrea, Portugal, Ireland, Grenada, Singapore, United States and Cape Verde, have debt more than 100 percentage of GDP and lie in the most dangerous zone. Further, debt as a percentage of GDP varies from 100 to 99 percent of GDP for countries like Belgium, Iceland, Sudan, and United Kingdom.

The debt varies from 89 to 80 percent of GDP for the countries Antigua and Barbuda, Cyprus, Canada, Saint Lucia, Spain, Saint Kitts and Nevis, Seychelles, Germany, and Egypt. The debt varies from 79 to 71 percent of GDP for the countries Mauritania, Jordan, Hungary, Belize, Maldives, Gambia, Sao Tome and Principle, Austria, Dominicia, Bhutan, Barbados, and Netherland. For the countries Israel, Brazil, Saint Vincent and India, the debt varies from 60 to 66 percent of GDP.

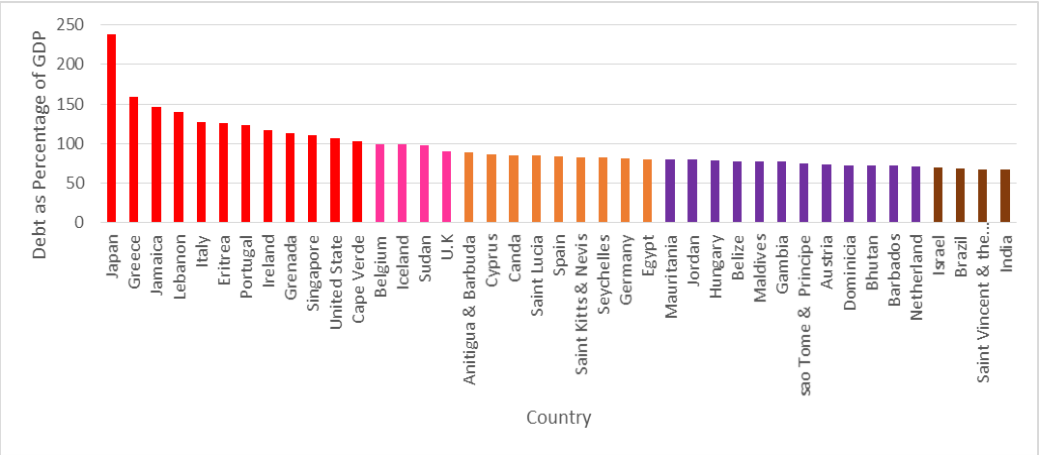


Figure 3.16: Debt Position of the Country as a Percentage of GDP in 2012

Source: International Monetary Fund, April 2013 World Economic Outlook Database

Further, the International Monetary Fund listed in the most emerging economics among the world on 2012 and the debt position of them are illustrated in the following Table 3.2. This is presented in Figure 3.16 which represents the government debt as a percentage of GDP. It is clearly observed that amongst the most emerging economics of the world, India is the third largest debtor country after Hungary and Brazil. China is listed as a less debt country with only 22.84 percent of GDP in the year 2012 and Estonia is listed as the least (only 8 percent) borrowed country amongst the all emerging economies in the world in 2012.

Table 3.2: Debt Position of India on 2012 among the most Emerging Countries

Emerging Country	Debt as Percentage of GDP
Argentina	44.88
Brazil	**68.469**
Bulgaria	18.497
Chile	11.222
China	22.849
Colombia	32.838
Estonia	8.498
Hungary	**79.003**
India	**66.842**
Indonesia	24.004
Latvia	36.417
Lithuania	39.586
Malaysia	55.474
Mexico	43.519
Pakistan	62.079
Peru	19.759
Philippines	41.919
Poland	55.166
Romania	37.038
Russia	10.877
South Africa	42.282
Thailand	44.252
Turkey	36.383
Ukraine	37.422
Venezuela	57.287

Source: International Monetary Fund, April 2013 World Economic Outlook Database

3.6. Conclusions

This chapter presents the preliminary analysis of India's public debt scenario starting from the First World War period. The recent trends from the last four decades indicate that the combined central and state debt has significantly increased from 44.5 percent at the end of March 1970 to 66.24 percent of GDP at the end of March 2013. Although the share of external debt declined during the period 1980–2013, while the share of internal debt substantially increased from 78.23 percent to 93.51 percent of the total debt from the end of March 1980 to 2013. The share of internal

debt to total public debt is a sizeable portion of the central government. This chapter further highlighted the composition of internal debt, viz., marketable debt, non-marketable debt and other debt and showed that the share of marketable securities to total internal debt is approximately 78 percent and the remaining constitutes of non-marketable and other debt in 2012. This chapter also analyzed the components of marketable securities which consisted of dated securities and treasury bills. It shows that approximately 91 percent of the total marketable loans are borrowed from dated securities and the rest are from treasury bills.

The sovereign external debt shows decline trend, but the contribution to total public debt of India cannot be ignored. So, the study shows that the share of commercial borrowings in the total external debt increased from 19.29 percent in 2004 to 34.26 percent at the end of March 2013. The share of multilateral debt is also a major source of external debt in India. It shows that the share of IDA is the major components of total multilateral sovereign debt. In case of bilateral debt for India, this study shows that Japan is the major creditor countries followed by Germany, Russia, USA and France. Although India's external debt declared by International debt statistics as less vulnerable in 2014, among the most emerging countries India stands as the third largest debtor countries after China and Brazil. The analysis on trend and structure of the public debt shows that the debt accumulation is driven by different economic and political factors. The proper management and inequality between allocation and distribution of debt by the government is always a serious concern and has significant political consequences.

In a nutshell, this study reveal that there is need to analyze the impact of public debt on economic growth and it is essential to gauge the channels through which public debt impacts on other key macroeconomic variables in India. It is also very important to estimate the threshold level of public debt in the case of India. Further, this study examines the burden of public debt in India. Although India's

debt position is not declared as danger zone, but the rise in interest payment, high fiscal deficits, and some of the credit rating agencies indicated about the debt repayment worthiness of the nation. The core objectives of this thesis are written in successive chapters.

Chapter IV
The Effects of Public Debt on Economic Growth and its Channels

4.1. Introduction

There is no doubt that the deterioration of revenue deficit in every country is the root cause of fiscal deficit. India is no exception from the aforementioned fact. In the recent years, the government of India tries to mobilise her financial resource through tax and deficit financing. However, resource mobilization through tax and non-tax has failed to match the expenditures of the government. Hence, the government started to borrow more for its funding to foster economic growth. As a consequence, the public (combined Centre and State governments) debt as a percentage to GDP has increased in India particularly from 2011 (Handbook of Statistics on Indian Economy, 2014). The central government debt amounted to 44.3 percent of GDP during 1980–81, and increased to 69.7 percent during the fiscal year 1991–92. Similarly, the combined debt of central and state governments was 52.4 percent of GDP in 1980–81, but it increased to 80.1 percent in 1991–92. The public debt scenario of the Indian government in the post-reform period was worse than in the pre-reform period. In the post-reform period, the central government debt was 68.3 percent of GDP in 1992–93, which further increased to 72.3 percent in 2002–03, and then slightly declined in the consecutive years till 2010–11 (Handbook of Statistics on Indian Economy, 2012). However, it remained an alarming fact that the average public debt of the central government during the post-reform period was 65 percent, which is higher than the debt of the pre-reform period. "Further, the combined central and state governments' average debt (public debt plus other liabilities) during

the post reform period was 79 percent" (Handbook of Statistics on Indian Economy, 2012).

On the one hand, increase in fiscal deficits lead to upward trends in public debt, and on the other hand, the slowdown of India's economic growth raises the question about the relationship between public debt and economic growth. In this context, most of the policy makers pointed out that high level of public debt is negatively affects the long run economic growth[9]. This negative impact of public debt on long run economic growth is also consistent from both neoclassical and endogenous growth model (Diamond, 1965; Saint–Paul, 1992).

Number of economic literature has examined the impact of public debt on economic growth. The debate of the relation between public debt and economic growth has been ambiguous. The classical economists such as Smith (1977) and Mill (1845) pointed out that the public debt negatively affects the economic growth. However, the Ricardian Equivalence theory points out that public debt are neutral with respect to consumption and, as a result, with respect to economic growth (Ricardo, 1951). The Keynesian theory supports that the government should go for higher public debt to achieve higher economic growth in the short run. Further, the debt overhang theory suggested that if future debt will be larger than the country's repayment ability, the expected debt–service costs will discourage further domestic and foreign investment, and thus is harmful for growth (Reinhart et al. (2010). A few empirical studies on the impact of public debt on economic growth in India are examined by Rangarajan and Srivastava (2005), Singh (1999), Kannan and Singh (2007), and Goyal (2013). The main finding of these studies is mixed in nature. Although the findings based on examining the impact of public debt on economic

[9] For instance, the former Director of the IMF Fiscal Affairs Department argued that: ''in addition to problems for growth arising from a debt crisis, one should also be worried about problems for growth arising from high, even if stable, debt.'' (Cottarelli, 2011).

growth differ among these studies, all the studies assume a linear relationship between public debt and economic growth.

But there are many studies which investigate the presence of non-linear relationship between public debt and economic growth by using cross–countries data. Few prominent studies, those have focused on developed as well as developing countries such as Reinhart and Rogoff (2009); Reinhart and Rogoff (2010); Kumar and Woo (2010); Cecchetti et al. (2011); Checherita-Westphal and Rother, (2012); Furceri and Zdienicka (2012); Herndon et al. (2013); and Kourtellos et al. (2013) have found non-linear relationship between public debt and economic growth.

The existence of non-linear relationship between public debt and economic growth in most of the advanced countries motivated us to re-examine the impact of public debt on economic growth in India, which is one of the leading emerging countries in the world. In this chapter, we not only tried to investigate the non-linear relationship between the two key variables, but also tried to identify the channels through which public debt affects the economic growth. We investigated the non-linear impact of public debt on economic growth through the following four channels: (1) private saving, (2) public investment, (3) household saving, and (4) total factor productivity.

The novelty of this chapter can be explained in three ways. First, although there are several papers that examine both the causal as well as the long run relationship between public debt and economic growth in India, hardly any studies focus on the channels through which the public debt affect the economic growth of India. In this chapter, we tried to capture the non-linear relation between public debt and economic growth. Examining this link is very important because it helps policymakers to gauge the channels where public debt is affecting the economic

growth. The identification of key channels would be helpful for the government to take preventive measures for controlling debt and enhancing economic growth.

Second, it is important to re-examine the impact of public debt on economic growth when India is experiencing sluggish growth because of the financial crisis as well as domestic factors like lower saving and investment, high inflation, and higher lending rates particularly after 2010. It is worthwhile to examine whether the borrowed amount of public debt has any role in enhancing economic growth or not. Finally, our study is innovative for making methodological contribution to earlier Indian studies by applying 2SLS technique for controlling the endogeneity problem between debt and economic growth.

The remainder of the chapter is organized as follows: The empirical framework of public debt and economic growth is explained in Section 2. The data sources and methodology are presented in Section 3. The results are delineated in Section 4 and the Section 5 concludes.

4.2. Empirical Framework

4.2.1. Direct Impact of Public Debt on Economic Growth

As discussed in the literature, theoretically public debt can affect the economic growth both positively and negatively. Two of the prominent classical economists, Smith (1977) and Mill (1845) pointed out that the public debt is negatively affected by economic growth. They explained that an increase in the public debt will make the consumer wealthier in the short run and motivate her to opt for higher spending. The higher spending resulted in increasing level of demand of goods and services with sticky prices in the short run and will reduce the total saving of the economy, which in turn will negatively affects the economic growth and increase the public

debt. However, the Keynesian theory supports that the government should go for higher public debt to achieve higher economic growth in the short run.

The increasing aggregate demand for goods and services with sticky prices in the short run will increase the output and employment. As the proportion of marginal propensity to consume is higher than the proportion of marginal propensity to save, it leads to reduction in the total savings of the economy. As a result, the real interest rate tends to increase, which encourages more capital inflow from abroad. The higher level of real interest rate will discourage the investment and is likely to crowd out the private investment in the long run. Thus, reduction in investment over a period of time will decline the domestic capital stock, which in turn implies lower output and income. On the other hand, a higher level of capital inflow increases the aggregate demand of the foreign currency, and it negatively affects the exchange rate, and thereby affects the trade of the home country. In a nut cell, the increasing levels of public debt in the long run are likely to reduce the aggregate output, and thereby reduce the consumption and welfare of the nation.

On the basis of *a priori* relationship among key macroeconomic variables, the following empirical model is developed in this chapter. We considered four key sectors (viz. real sector, fiscal sector, monetary sector and external sector) through which public debt can impact on economic growth. We choose the important variables that have strong direct relationship between debt and economic growth. The key variables such as total investment, real interest rate, debt service payment, total factor productivity, export, and real exchange rates have been used in the model. To examine the non-linear relationship between debt and economic growth, the square of public debt into a growth equation is taken in this study (following the seminal paper by Checherita and Rother, 2012). The basic equation is as follows:

$$y_t = \alpha + \beta_1 debt_t + \beta_2 debt\_sq_t + \beta_3 ds_t + \beta_4 rir_t + \beta_5 tfp_t + \beta_6 ti_t + \beta_7 op_t + \beta_8 er_t + \mu_t \quad (4.1)$$

where y_t is economic growth, $debt_t$ is public debt, $debt_t\_sq_t$ square of public debt, ds_t is debt service payment, tfp_t is total factor productivity, rir_t is real interest rate, ti_t is total investment, op_t is trade openness, and er_t is exchange rate.

4.2.2. Public Debt and its Channels

The channels through which public debt can affect the economic growth are clearly mentioned by Elmendorf and Mankiw (1998) through the national accounting identities as:

$$S + (T - G) = I + NFI \quad (4.2)$$

Where, S is private saving; T is taxes less government transfer payment; G is government purchases of goods and services; I is domestic investment and NFI is net foreign investment. The left side of the equation (4.2) shows the national saving to be the sum of private saving and public saving, and the right side shows the uses of these saved funds for investment at home and abroad. This equation (4.2) describes the two sides of the market for loanable funds. Let's, assume that G increases and T remains constant, which is a general case of developing countries where the marginal propensity to consume is high. In that case, the equation (4.2) may continue to be satisfied in several complementary ways: (i) private saving may rise; (ii) domestic investment may decline; and (iii) net foreign investment may decline. On the basis of the first possibility and according to the conventional view, private saving increases but the increment is less than the decline of public saving. So, the total national saving declines, and thereby, affects negatively the total investment at home as well as in abroad. Therefore, in all possibility, the national output and economic growth of the country fall. The decrease in economic growth motivates the government to

borrow funds from either internal, external or both sources in order to equalize the equation (4.2). High level of borrowings leads to increase in the public debt of the home country. Thus, in this chapter, we investigated the channels through which public debt is likely to affect the economic growth and those channels are (1) private saving; (2) public investment; (3) household saving; and (4) total factor productivity. Public debts are likely to have an adverse effect on capital accumulation as well as productivity, which in turn reduces the growth. We further investigated whether public debt can non-linearly affect the economic growth through these channels or not. Thus, we take square of public debt in all the channels equations.

This chapter started with mentioning the private savings channel using the following regression equation:

$$ps_t = \alpha_0 + \alpha_1 debt_t + \alpha_2 debt\_sq_t + \alpha_3 y_t + \alpha_4 m2_t + \alpha_5 dcp_t + \alpha_6 rir_t + \alpha_7 txr_t + \alpha_8 op_t + \varepsilon_{1t} \quad (4.3)$$

where ps_t is private saving, y_t is economic growth, $debt_t$ is public debt, $debt_t\_sq_t$ square of public debt, $m2_t$ is financial depth, dcp_t is domestic credit to private sector, rir_t is real interest rate, txr_t is government revenue, and op_t is trade openness.

We employed a simple ordinary least square method for tracing the channels in which public debt affects the private saving, and thereby, economic growth. The square of the debt is added in the equation (4.3) to know the non-linear relation between public debt and private saving. The other control variables, such as economic growth (y_t), financial depth ($m2_t$), domestic credit to private sector (dcp_t), real interest rate (rir_t), government revenue (txr_t), and trade openness (op_t), are usually employed in the literature literature (Masson *et al*., 1998; Schclarek, 2004; and Checherita and Rother, 2012) for showing the impact of public debt ($debt_t$) on private savings (ps_t).

The second channel on the household saving can be written using the following equation:

$$hs_t = \gamma_0 + \gamma_1 debt_t + \gamma_2 debt\_sq_t + \gamma_3 y_t + \gamma_4 m2_t + \gamma_5 rir_t + \gamma_6 dcp_t + \gamma_7 pg_t + \gamma_8 txr_t + \varepsilon_{2t} \quad (4.4)$$

Where hs_t is household saving, y_t is economic growth, $debt_t$ is public debt, $debt_t\_sq_t$ square of public debt, $M2_t$ is financial depth, rir_t is real interest rate, dcp_t is domestic credit to private sector, pg_t is population growth, and txr_t is government revenue.

The economic growth, financial depth, real interest rate, domestic credit to private sector, population growth and tax rate are the control variables that are employed for analyzing the impact of public debt on household saving. Turning to the channel of public investment, this chapter built the relation between public investment and public debt in the following equation:

$$pu_t = \delta_0 + \delta_1 debt_t + \delta_2 debt\_sq_t + \delta_3 y_t + \delta_4 m2_t + \delta_5 rir_t + \delta_6 gds_t + \delta_7 op_t + \varepsilon_{3t} \quad (4.5)$$

where pu_t is public investment, y_t is economic growth, $debt_t$ is public debt, $debt_t\_sq_t$ square of public debt, $m2_t$ is financial depth, rir_t is real interest rate, gds_t is gross domestic savings, and op_t is trade openness.

The control variables, such as economic growth, financial depth, real interest rate, gross total saving and trade openness, are illustrating the channels through which public debt affects the public investment. In this contest, Schumpeter (1932) showed that the financial depth (m2) is one of the important factors for promoting the technological progress. Domestic saving is the major determinants of investment and is the level of savings that determine the interest rate. Further, growth rate is

positively determined by the investment (Wai and Wong, 1982; Greene and Villanueva, 1991; and Fielding 1993, 1997), and the neoclassical economist pointed out that high level of interest rate raises the cost of capital and this leads to decline in investment. Similarly, the studies by Harrison, 1996; Levine and Renelt, 1992; and Ndikumana, 2000 show that trade openness can affect the investment significantly.

Finally, this chapter used total factor productivity as one of the key channel through which debt can affect the growth. There are few studies (Pattillo et al. 2004; Schclarek, 2004; and Checherita–Westphal and Rother, 2012), which have applied the productivity channel as follows:

$$tfp_t = \lambda_0 + \lambda_1 debt_t + \lambda_2 debt\_sq_t + \lambda_3 y_t + \lambda_4 rir_t + \lambda_5 pg_t + \lambda_6 dcp_t + \lambda_7 rir_t + \lambda_8 op_t + \varepsilon_{4t} \quad (4.6)$$

Where tfp_t is total factor productivity, y_t is economic growth, $debt_t$ is public debt, $debt_t\_sq_t$ square of public debt, rir_t is real interest rate, dcp_t is domestic credit to private sector, and op_t is trade openness.

4.3. Data Sources and Methodology

4.3.1. Methodology

Before implementing any time series model, it is mandatory to analyze the time series property. So, a time series where mean, variance and covariance are time invariant is said to be (covariance or weakly) stationary. The data, which do not possess this property, is called non-stationary, for e.g. a random walk process. A non-stationary process is also called a unit root process. Most of the macroeconomic time series data in general are sensitive to shocks and known to be non-stationary. Since econometric models using non-stationary data are likely to violate the desirable statistical properties of the estimators and or give misleading inferences, it

has become necessary to test the stationary of the series before attempting any econometric exercise. A simple first order autoregressive process can be expressed by the following general equation:

$$Y_t = \mu_0+\mu_1 t+\alpha Y_{t-1} + \varepsilon_t \qquad (4.7)$$

Where $\{Y_t\}$ is the stochastic process, μ_0, μ_1 and α are parameters and ε_t is a random disturbance term with white noise properties. μ_0 is called drift or constant or intercept. The nature of the time series described by the equation (4.7) depends on the parameter values. If $\mu_1 \neq 0$ and $|\alpha| \prec 1$, then Y_t follows a deterministic trend. The presence of autoregressive component, αY_{t-1}, means there may be short-run deviations, but the series will return to trend eventually. A series of this sort is known as a trend stationary (TS) process, as the residuals from the regression of Y_t on a constant and a trend will be stationary. If $\mu_0 = 0$, $\mu_1 = 0$ and $\alpha = 1$, the series is said to follow a simple random walk, a unit root process. If $\mu_0 \neq 0$, $\mu_1 = 0$ and $\alpha_1=1$, the series is said to follow a random walk with drift. Any stochastic process, which becomes stationary after differencing once, is called a difference stationary (DS) process, for e.g. a simple random walk process is a DS process. Likewise, any time series, which becomes stationary after de-trending is called a TS process.

There are several tests for testing the non-stationarity, more popularly known as testing for unit root, in a time series. These include the Dicky-Fuller, Augmented Dicky-Fuller and Phillips-Perron tests to check the presence of unit root in the data. These tests are necessitated because the usual Student's t-test is inappropriate to tests the null hypothesis, $\alpha = 1$ in equation (4.7).

Dicky-Fuller and Augmented Dicky-Fuller Tests

The basic Dicky-Fuller (DF) test examines whether the value of the parameter $\alpha = 1$ in equation (4.7), in other words, the underlying first order difference equation has a unit root. Specifically, assuming the absence of trend term in equation (4.7) and rewriting it in a modified form as below:

$$\Delta Y_t=\mu_0+\delta_0 Y_{t-1} + \varepsilon_t \qquad (4.8)$$

Where, $\Delta Y_t = Y_t - Y_{t-1}$. The null hypothesis is that the $\{Y_t\}$ process has a unit root, i.e. H_0: $\delta = \alpha - 1 = 0$. Since $-1 \leq \alpha \leq 1$, it follows that $-2 \leq \delta \leq 0$.
More generally, if the given time series follows a p^{th} order autoregressive process [AR(p)] or even autoregressive moving average process [ARMA(p,q)], an extended Dicky-Fuller test called augmented Dicky-Fuller (ADF) test is suggested. Specifically, if the original time series follows AR (p), it can be represented as,

$$Y_t=\mu_0+\sum\alpha_i Y_{t-1} + \varepsilon_t \qquad (4.9)$$

After suitable mathematical manipulation, equation (4.9) can be written as,

$$\Delta Y_t = \mu_0 + \delta Y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta Y_{t-i+1} + \varepsilon_t \qquad (4.10)$$

Where, $\delta = -(1 - \sum_{i=1}^{p} \alpha_i), \beta_i = p\sum_{j=1}^{p} \alpha_j$

Equation (4.10) is also recommended if the residuals sequence, $\{\varepsilon\}$ in equation (4.8), is not a white noise, for e.g. when ε_t are auto correlated. There are different forms of DF and ADF tests, which are possible by including trend terms in

equation (4.8) and (4.10), and also excluding drift (intercept or constant) term, μ_0, from these equations.

The DF test is a special case of the ADF test when p = 1. To test the significance of δ in equation (4.8) and (4.10), the usual Student's t-statistics critical values cannot be used. Initially, Dicky-Fuller and later MacKinnon have developed the appropriate test statistic, known as ι-statistic, and its critical values using Monte Carlo simulations. The critical values of ι-statistic are made available under alternative assumptions of drift, trend, sample size and level of significance. They are abbreviated as ι (no drift and no trend), ι_μ (only drift) and ι_t (with both drift and trend). Dicky-Fuller have also provided the critical F-test values, known as ϕ_1, ϕ_2, and ϕ_3 for pair-wise joint tests of significance for μ_0 and μ_1. Thus, the null hypothesis that δ = 0 can be rejected if the computed t-value for the coefficient δ is greater than the critical ι-value in absolute magnitude. It has been shown that the same DF test critical values are valid for the ADF test as well. To check for unit root of a $\{Y_t\}$ process, estimate the following equation:

$$\Delta Y_t = \mu_0 + \delta Y_{t-1} + \gamma t + \sum_{t=1}^{I} \Delta Y_{t-1} + \varepsilon_t \qquad (4.11)$$

Two Stage Least Square (2SLS) Method

In the next step this chapter uses the Ordinary Least Square (OLS) method to show the channels for the impact of public debt on economic growth separately. In order to show the direct impact of public debt on economic growth, this chapter uses the 2SLS method as the OLS method cannot give robust results to examine the impact of public debt on economic growth. It is because, many highlight that public debt and economic growth is endogenously determined in the model (Checherita and Rother, 2012; Panizza and Presbitero, 2014). Hence, in order to avoid such kind of endogeneity

and simultaneous bias, this study uses the instrumental variables and estimated the model using Two Stage Least Square (2SLS). In order to point out the endogeneity bias let us consider a linear equation as:

$$y = \alpha_1 + \alpha_2 x + \varepsilon \tag{4.12}$$

Since, $E(y) = \alpha_1 + \alpha_2 E(x),$ we have:

$$y_t - E(y) = \alpha_2 (x - E(x)) + \varepsilon \tag{4.13}$$

Multiply both side of equation (4.13) $(x - E(x))$ which yields:

$$\text{cov}(x, y) = \alpha_2 \text{ var}(x) + \text{cov}(\varepsilon, x) \tag{4.14}$$

Which means that:

$$\alpha_2 = \frac{\text{cov}(x, y)}{\text{var}(x)} - \frac{\text{cov}(\varepsilon, x)}{\text{var}(x)} \tag{4.15}$$

We know that for a linear regression with one explanatory variable the OLS estimator is:

$$\hat{\alpha} = \frac{\hat{\text{cov}}(x, y)}{\hat{\text{var}}(x)} \tag{4.16}$$

This means that α_2 converges to:

$$\hat{\alpha}_2 \rightarrow \alpha_2 + \frac{\text{cov}(\varepsilon, x)}{\text{var}(x)} \tag{4.17}$$

If $\text{cov}(\varepsilon, x) \neq 0$, the OLS estimators are inconsistent, i.e. its value does not converge to the true value of the parameter with the sample size. Moreover, the OLS estimator is biased. The value of this bias, which is called the endogeneity bias, is equal to $\frac{\text{cov}(\varepsilon, x)}{\text{var}(x)}$. Let us notice that if $\text{cov}(\varepsilon, x) \succ 0$ the OLS estimates tend to be too high, whereas for $\text{cov}(\varepsilon, x) \prec 0$ OLS estimates tend to be too low.

Therefore, this chapter implemented 2SLS to show the direct impact of public debt on economic growth. So, we briefly explains 2SLS model here which as follows: Let the multiple regression model as:

$$Y = X'\beta + \mu \qquad (4.18)$$

With k explanatory variables, X and β are K×1 vectors. Assume the existence of r×1 vector of instruments Z, with r ≥ k, satisfy:

i. Z is uncorrelated with the error μ,
ii. Z is correlated with the regression vector X, and
iii. Z is strongly correlated with regressor X

When the model is just identified, so r = k, the instrument variables estimator in the matrix notation as:

$$\hat{\beta}_{IV} = (Z'X)^{-1} Z'Y \qquad (4.19)$$

When Z is an N×K matrix, by substituting (4.18) in the regression model (4.19) yield:

$$\hat{\beta}_{IV} = (Z'X)^{-1} Z[X\beta + \mu]$$

$$= \beta + (Z'X)^{-1} Z'\mu$$

$$= \beta + (N^{-1}Z'X)^{-1} N^{-1}Z'\mu$$

The Instrumental Variable (IV) estimator of (4.19) requires that the number of instruments equal the number of regressors. For over-identified model the IV estimator can be used, by discarding some of the instruments so that the model is just identified. Thus a common procedure is to use those instruments with the 2SLS estimator.

$$\hat{\beta}_{2SLS} = [X'Z(Z'Z)^{-1}Z'X]^{-1}[X'Z(Z'Z)^{-1}Z'Y] \qquad (4.20)$$

4.3.2. Data Sources

The empirical relationship between the impacts of public debt on economic growth through key macroeconomic channels is examined using two stage least square (2SLS) method. This study used annual data covering the period from 1970 to 2013. The variables used in this analysis are in real terms. The appropriate deflators have been used for converting nominal data into real variable. The annual growth rate of gross domestic product at factor cost at constant price is defined as economic growth. The total liabilities-to-GDP ratio, which includes both domestic and external liabilities, is treated as public debt-to-GDP ratio. The real effective exchange rate of thirty six based trade weighted average is treated as the exchange rate. The sum of export and import as a percentage to GDP is defined as the trade openness, and similarly, the real interest rate is calculated from the formula of Fisher index, according to which it is the difference between nominal interest rate and the expected inflation rate. The average of 15 years bond yield is treated as the long term nominal interest rate and all these data are collected from the Handbook of Statistics on Indian Economy published by Reserve bank of India (RBI). The data of M2/GDP is represented as the India's financial development, the annual percentage of population growth, the domestic credit to private sector as a percentage of GDP, and the debt

service payment as a percentage of export which is the proxy for the debt service payment, and all these data are collected from World Development Indicators (WDI) published by World Bank. The data of debt service payment as a percentage of export is available from 1978, as we needed the data from 1970, so we extracted the previous year data from backward trend interpolation method in excel 2007. The data of tax-GDP ratio is the proxy for the government revenue, and this data is collected from the Indian Public Finance Statistics of 2013–2014, published by Ministry of Finance, Government of India. The private corporate saving is taken as a proxy for private saving. The data of private saving as percentage of GDP, household saving as percentage of GDP, the gross total saving as a percentage of GDP, the public sector gross fixed capital formation as a percentage of GDP are taken as a proxy for public investment, and the total gross fixed capital formation as a percentage of GDP, which includes both public sector and private sector, is taken as a proxy for total investment. So, the data of public investment and total investment are collected from the economic survey of 2013–2014 published by the Government of India.

We measured the total factor productivity for aggregate economy of India using non-parametric method of Data Envelopment Analysis (DEA). The countries total factor productivity can be calculated using different techniques. Though bulk of the literature used Growth Accounting framework to measure the productivity growth. However, the Growth Accounting method assumes perfect competition, constant returns to scale and Hick's neutrality. First, advantages of using DEA method is that it does not follow any production function. Second, since this thesis focused on the performance of overall macroeconomic, hence DEA approach is more suitable. DEA was originally designed to study the relative efficiencies of different firms or managerial units assumed to have a common best practice production technology available. However, there are studies, where DEA technique has been used to measure the overall productivity of a nation as whole (See, Fare et al., 1994; Maudos et al., 1999; and Tian and Xiaohua, 2012). The detailed methodology for

estimation of TFP is discussed in (Farrell, 1957; Charnes et al., 1978). In this study, while measuring the TFP, the real GDP of the country is treated as the single output and both labour force and capital stocks are taken as two inputs. The measurement of capital stock is elucidated in Appendix-1.

4.4. Results

This chapter implemented both two stage least square (2SLS) method for examining the relation between public debt and economic growth and the ordinary least square (OLS) to look at the impact of public debt on different channels though which it affects the economic growth. The chapter first presented the summary statistics which are delineated in Table 4.1. After presenting the summary statistics, the unit roots results are reported in Table 4.2. The results of ADF (Dicky and Fuller, 1979) test shows that $debt_t$, $debt\_sq_t$, ds_t, ti_t, op_t, er_t, ps_t, $m2_t$, gds_t, pu_t, hs_t, tfp_t, are integrated of I(1); and y_t, rir_t, dcp_t, txr_t, and pg_t are integrated of I(0).

After examining the stationary property of the time series, the 2SLS regression is performed to examine the impact of debt on economic growth in table 4.3. The main intention behind introducing the squared term of public debt is to find out the nonlinear effects on economic growth, the association of public debt with growth as well as to trace the long-run effect of public debt on economic growth. The authors include a quadratic term to test for non-linearities, following common practice in the early literature on debt and growth (Cecchetti et al. 2011; Checherita and Rother, 2012 and Kaur and Mukherjee, 2012).

Table 4.1: Descriptive Statistics

variable	Mean	Median	Max.	Min.	S.D.	Sk.	Ku.	JB
$debt_t$	62.01	66.16	83.22	33.69	13.73	-0.49	2.11	3.23
$debt\_sq_t$	4030.04	4377.89	6927.01	1135.64	1620.97	-0.18	2.03	1.95
y_t	5.46	5.56	10.15	-5.20	3.01	-1.08	4.99	15.83
ds_t	17.75	16.49	31.73	1.74	9.38	-0.23	1.86	2.77
rir_t	1.80	2.14	8.66	-12.45	4.92	-1.09	4.20	11.40
ti_t	24.67	24.80	35.82	14.61	5.88	0.20	2.16	1.58
op_t	19.86	16.15	43.50	7.0	10.61	0.91	2.68	6.34
er_t	134.90	109.94	229.55	93.78	40.68	0.68	2.13	4.83
ps_t	14.25	12.40	24.90	7.40	5.92	0.52	1.81	4.57
$m2_t$	46.59	42.73	77.71	21.00	17.25	0.43	2.08	2.89
dcp_t	27.31	24.00	51.82	11.04	11.54	0.86	2.72	5.62
txr_t	1.47	2.32	12.95	-7.91	4.85	-0.14	2.55	0.50
pg_t	1.89	1.96	2.33	1.24	0.37	-0.40	1.71	4.23
gds_t	23.16	21.50	36.80	14.10	6.17	0.62	2.28	3.78
pu_t	8.45	8.15	12.30	5.80	1.67	0.50	2.16	3.14
hs_t	16.90	16.35	25.20	9.50	4.89	0.11	1.57	3.82
tfp_t	145.38	138.31	269.80	95.58	39.23	0.20	1.49	4.43

Note: $debt_t$ = Public debt; $debt\_sq_t$ = Square of public debt; y_t = Economic growth; ds_t = Debt service payment; rir_t = Real interest rate; ti_t = Total investment; op_t = Trade openness; er_t = Exchange rate; ps_t = Private saving; $m2_t$ = Financial depth; dcp_t = Domestic credit to private sector; txr_t = Government revenue; pg_t = Population growth; gds_t = Gross total saving; pu_t = Public investment; hs_t = Household saving; tfp_t = Total factor productivity.

However, this has been criticized as being inappropriate for variables with a unit root by (Eberhardt, 2013). The general problem is that integration is a linear concept, and that using first differences for a quadratic variable results in violating the finite variance characteristic because the variance is a function of time. To overcome this problem, we first begin with testing the linear property. One of the common properties of a linear relation is that every linear map f: IR → IR is of the form $f(x) = \alpha x$, where α is a constant.

$y(x) = \alpha x$, $dy/dx = \alpha$

This implies that the rate of change is constant. If it does not follow this property, it can be concluded that the relation between the two variables is nonlinear (Bal and Rath, 2015). Fig. 4.1 illustrates the relationship between square of public debt and economic growth.

Table 4.2: Result of Unit Root Test

Variable	Level	1st Order Difference	Inference on Integration
$debt_t$	-1.89 (0.64)	-4.00 (0.01)	I (1)
$debt\_sq_t$	-2.34 (0.40)	-3.73 (0.03)	I (1)
y_t	-7.62 (0.00)	------	I (0)
ds_t	-1.31 (0.87)	-6.92 (0.00)	I (1)
rir_t	-3.38 (0.06)	------	I (0)
ti_t	-2.40 (0.37)	-6.92 (0.00)	I (1)
op_t	-1.36 (0.85)	-7.59 (0.00)	I (1)
er_t	-1.81 (0.68)	-6.06 (0.00)	I (1)
ps_t	-2.65 (0.26)	-8.22 (0.00)	I (1)
$m2_t$	-2.11 (0.52)	-4.28 (0.00)	I (1)
dcp_t	-4.53 (0.00)	------	I (0)
txr_t	-6.30 (0.00)	------	I (0)
pg_t	-2.82 (0.00)	------	I (0)
gds_t	-1.95 (0.60)	-6.96 (0.00)	I (1)
pu_t	-2.10 (0.53)	-6.28 (0.00)	I (1)
hs_t	-2.10 (0.52)	-7.20 (0.00)	I (1)
tfp_t	-2.82 (0.17)	-6.77 (0.00)	I (1)

Note: Figure in parentheses are p-values; $debt_t$ = Public Debt; $debt\_sq_t$ = Square of Public Debt; y_t = Economic growth; ds_t = Debt service payment; rir_t = Real interest Rate; ti_t = Total investment; op_t = Trade openness; er_t = Exchange rate; ps_t = Private saving; $m2_t$ = Financial depth; dcp_t = Domestic credit to private sector; txr_t = Government revenue; pg_t = Population growth; gds_t = Gross total saving; pu_t = Public investment; hs_t = Household saving; tfp_t = Total factor productivity.

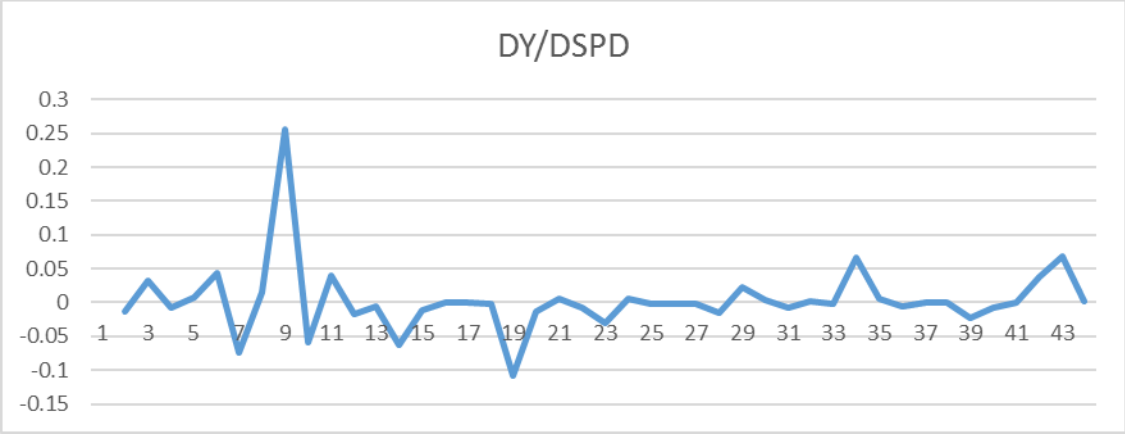


Fig. 4.1: Changes in Economic Growth with respect to Changes in Difference of Square of Public Debt.

Note: dy = difference of the economic growth and dspd = difference of the square of public debt.

The preliminary result from Fig.4.1 clearly shows a non-linear relation between square of public debt and economic growth. Thus, we can say that the difference of the variables is nonlinear concept, and we are considering the difference variables in the regression equation in order to satisfy the stationary property of the regression model.

After identifying the non-linear relationship between economic growth and public debt, the next issue related to our estimation is the problem of endogenity in the regression model. We apply 2SLS method using one-period lagged value of public debt and economic growth as instrumental variables for overcoming the endogenity problem to avoid the simultaneous bias in the model. The problem of endogeneity is well documented in the literature (for e.g. Panizza and Presbitero, 2014; Dube, 2013). Before we interpret the results of 2SLS, first and most basic, we present results from a simple OLS regression of growth on debt and controls, so that we can assess what the effects of instrumenting with lags of debt and growth have on the OLS coefficients. If instrumenting does not significantly change the OLS

coefficients, we should be concerned that it does not adequately account for endogeneity. Then in the second stage, we present simple and transparent visual tests for reverse causality following Dube (2013).

Table 4.3: OLS Regression Results

(**Dependent Variable:** y_t)

Variable	**Coefficient**
Constant	4.10^{***} (0.000)
d($debt_t$)	1.02^{***} (0.000)
d($debt\_sq_t$)	-0.011^{***} (0.002)
d(ds_t)	-0.08 (0.333)
rir_t	0.22^{***} (0.001)
d(tfp_t)	0.39^{**} (0.000)
d(ti_t)	0.11 (0.752)
d(op_t)	0.02 (0.94)
d(er_t)	0.010 (0.78)
Adj. R^2	0.58
DW-Stat.	2.14
F-statistics	6.80^{***} (0.000)

Note: Figures in parentheses are *p*-values; and explanation of the variables is same as in Table 1.

While comparing the results of OLS in Table 4.3 with the results obtained from 2SLS in Table 4.4 it is clearly noticed that the coefficient of debt and square or the debt is significantly change and hence can be concluded that the instruments taken in the equation in the 2SLS are valid. The results in Table 4.4 suggest that the growth rate of public debt has positive effect and growth rate of square of public debt has negative impact on economic growth. This implies that one percentage increase of the difference of the public debt leads to raise the economic growth with 1.33 percent and one percent increase of difference of square of public debt leads to decline 0.012 percentages to economic growth. The result infers that increase in the growth rate public debt-to-GDP ratio is positively affects the economic growth of India in the short run, and negatively affects it in the long run. The plausible reason could be that in India the government had committed to implement prudent debt

management strategies to ensure that public debt creates fiscal space for developmental expenditures (Government Debt Status Report, 2012). In the short run, higher the public debt, higher is the capital formation. Therefore, other things being equal, high capital formation would increase the economic growth. However, in the long run, the gradual increase in public debt-to-GDP ratio would possibly increase the borrowing cost, which in turn enhances the debt servicing risk and hampers the economic growth.

The results in Table 4.4 also indicate that apart from public debt, other key indicators like real interest rate and total factor productivity growth rate significantly affect economic growth. It is observed that TFP growth has a positive impact on economic growth, which corroborates with the findings of earlier studies. Similarly, increase in real interest rates also boosts economic growth. In India, higher interest rate enhances gross domestic savings, other things being equal. Again, higher interest rate also attracts more foreign investment, which leads to augmentation in the economic growth of most emerging countries like India. Further, the Wald *F*-test results show that the overall results of the model are statistically significant at 1% significance level. It shows the existence of long-run relationship between debt and growth. The insignificant value of *Q*-statistics for the various lags shows that there is no autocorrelation in the model and the insignificant value ARCH-LM test clearly indicates the acceptance of the null hypothesis of no heteroscedasticity present in the fitted model.

Table 4.4: 2SLS Regression Results

(**Dependent Variable:** y_t; **Instruments Used:** y_{t-1} and $debt_{t-1}$)

Variable	**Coefficient**
Constant	3.09^{***} (0.00)
d($debt_t$)	1.33^{***} (0.02)
d($debt\_sq_t$)	-0.012^{***} (0.00)
d(ds_t)	0.06 (0.65)
rir_t	0.18^{*} (0.10)
d(tfp_t)	0.53^{**} (0.04)
d(ti_t)	0.86 (0.11)
d(op_t)	0.55 (0.23)
d(er_t)	0.011 (0.83)
R^2	0.36
Adj. R^2	0.18
DW-Stat.	1.76
Wald Test	7.71^{***} (0.00)
Q(5)	2.29 (0.68)
Q(10)	8.31 (0.50)
Q(15)	13.29 (0.50)
Q(20)	13.70 (0.80)
ARCH-LM Test	0.002 (0.96)

Note: Figures in parentheses are *p*-values; and explanation of the variables are same as in Table 4.1.

To further show the non-linear relationship between economic growth and public debt in India, we present visual confirmation of the non-linearity using a non-parametric kernel regression. Fig. 4.2 indicates a non-linear relationship between real GDP growth and public debt as a percentage to GDP.

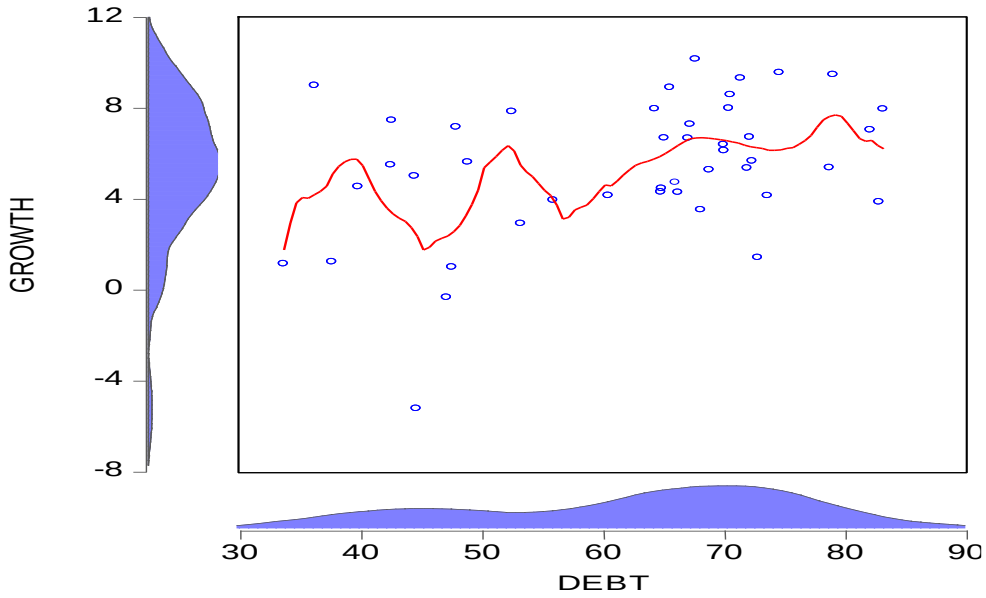


Fig.4.2: Visual Representation between Public Debt and Economics Growth

Before we rely on the results derived from 2SLS regression, this study presents simple and transparent visual tests for reverse causality to assess the degree of endogeneity by following Dube (2013). The method of calculation is followed by the paper Dube (2013) and the method is as follows:

3 year past average growth is:

$$\bar{g}_{i,t-3,t-1} = \frac{1}{3}\sum_{r=1}^{3}(g_{i,t-r}) = \frac{1}{3}\sum_{r=1}^{3}(\frac{y_{t-r} - y_{t-r}}{y_{t-r}}) \qquad (4.21)$$

3 year forward average growth is:

$$\bar{g}_{i,t+1,t+3} = \frac{1}{3}\sum_{r=1}^{3}(g_{i,t+r}) = \frac{1}{3}\sum_{r=1}^{3}(\frac{y_{t+r+1} - y_{t+r}}{y_{t+r}}) \qquad (4.22)$$

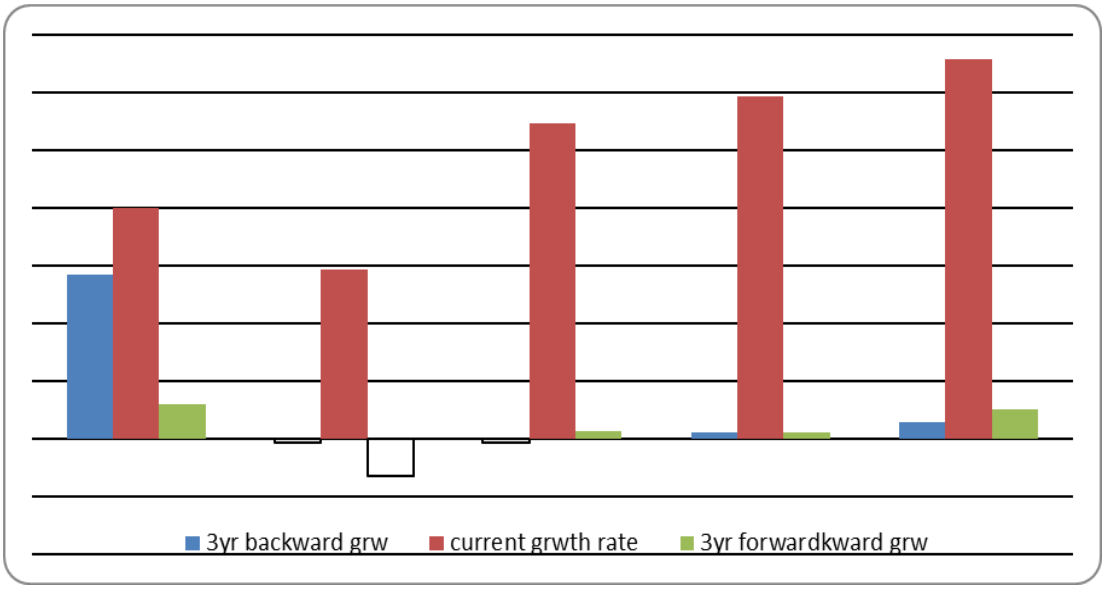


Fig.4.3: Visual Representation of Reverse Causality between Public Debt and Economic Growth

* Reverse causality is calculated based on three years average growth from 1970 to 2013.

Figure 4.3 presents the averages for the three year past growth, present growth, and the three year future growth, for different levels of public debt. This figure shows that the average past growth is higher than the future growth in the lower rate of growth (30-40 and 40-50 ranges) and it became higher in the higher rate of public debt to GDP ratio.

Thus, based on the findings of 2SLS regression and kernel regression, it can be inferred that nonlinear relation exists between public debt and economic growth. After identification of the nonlinear relationship between public debt and economic growth, in the second stage, the study tries to explore the channels through which public debt could affect economic growth non-linearly. As mentioned earlier, it is observed from the literature that there exist four channels, viz., private saving, public investment, household saving and total factor productivity through which public debt

can affect economic growth. The study uses OLS method to examine the impact of public debt on different channels through which it affects the economic growth. The results of each key channel are delineated in Table 4.5.

Table 4.5: OLS Estimation for Private Saving (ps_t), Public Investment (pu_t), Household Saving (hs_t) and TFP

Explanatory/Dependent Variable	Private Saving	Public Investment	Household Saving	TFP
Constant	-0.24 (0.59)	0.02 (0.90)	-0.28 (0.57)	-1.03 (0.51)
$d(debt_t)$	0.015 (0.90)	0.32^{***} (0.01)	-0.39^{**} (0.05)	-1.16^{**} (0.06)
$d(debt\_sq_t)$	0.0004 (0.72)	-0.002^{***} (0.02)	0.003^{***} (0.02)	0.01^{***} (0.03)
y_t	0.20^{**} (0.03)	-0.03 (0.37)	0.24^{***} (0.01)	0.82^{***} (0.00)
$d(m2_t)$	-0.08 (0.27)	0.19^{***} (0.00)	0.22^{***} (0.01)	-----
dcp_t	-0.03^{***} (0.00)	------	-0.03^{***} (0.00)	-0.03 (0.43)
$d(op_t)$	0.30^{***} (0.05)	0.013 (0.80)	------	-0.12 (0.60)
rir_t	0.02 (0.49)	-0.04^{**} (0.06)	-0.03 (0.47)	0.007 (0.95)
txr_t	0.04 (0.26)	------	-0.06^{*} (0.09)	-----
gds_t	------	4.78 (0.51)	------	-----
pg_t	------	------	4.78 (0.51)	-4.82 (0.86)
R^2	0.62	0.40	0.53	0.43
Adj. R^2	0.51	0.24	0.35	0.31
D.W.	1.95	1.98	1.97	2.24
Wald-test	17.26^{***} (0.00)	3.58^{***} (0.00)	4.33^{***} (0.00)	3.70^{***} (0.00)
Q(5)	6.48 (0.16)	0.93 (0.81)	2.18 (0.33)	3.20 (0.66)
Q(10)	8.54 (0.48)	2.36 (0.96)	4.93 (0.66)	5.44 (0.85)
Q(15)	12.18 (0.59)	5.24 (0.96)	9.99 (0.61)	9.44 (0.85)
Q(20)	19.41 (0.43)	10.32 (0.92)	13.78 (0.68)	11.55 (0.93)
ARCH-LM test	1.24 (0.26)	0.013 (0.90)	0.038 (0.84)	0.0009 (0.97)

Note: Author's calculation; Figure in parentheses are p-values.

Considering the results of the first channel, i.e., private saving, it is observed from Table 4.5 that the coefficients of public debt and square of public debt are not

statistically significant and hence public debt has no impact on private saving. However, other control variables like economic growth, domestic credit to private sector and trade openness affect private saving. On the other hand, the results of the other three channels show a nonlinear impact of public debt on economic growth. Further, it is observed that public debt has a positive impact on public investment, household saving and total factor productivity up to a certain threshold level, beyond which it follows a negative path. Thus, an inverted U-shaped curve is obtained between public debt and the channels, public investment, household saving and total factor productivity. A perusal of the results related to the channel of public investment reveals that financial depth affects public investment positively, while real interest rate affects public investment negatively. Similarly, in the case of household saving channel, apart from public debt, other variables like economic growth and financial depth show a statistically significant positive impact, while domestic credit to private sector and the tax rate show a statistically significant negative impact on household saving. Finally, the results of TFP channel reveal that apart from public debt and square of public debt, the economic growth has a statistically significant positive impact on productivity.

4.4.1. Stability Test

This chapter conducted the stability test to show the robustness of the results presented in Table 4.4 and Table 4.5 using 2SLS and OLS techniques, respectively. The idea of applying the stability test is to check whether the residuals obtained from Table 4.4 and Table 4.5 are normally distributed or not. Theoretical quantile–quantile plots (QQ) plots are used to assess whether the data in a single series follow a specified theoretical distribution; for example, whether the data are normally distributed (Cleveland, 1994; Chambers, *et al.* 1983). If the two distributions are the same, the QQ–plot should lie on a straight line. If the QQ–plot does not lie on a straight line, the two distributions differ along some dimensions. The pattern of

deviation from linearity provides an indication of the nature of the mismatch. Hence, the plots of Quantile–Quantile graphs are presented in Figure 4.4, 4.5, 4.6, and 4.7 respectively.

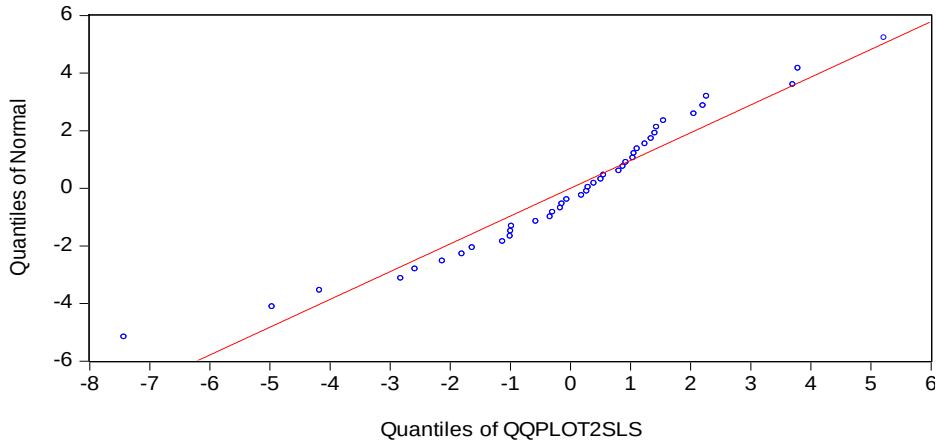


Figure 4.4: Estimated Residual of 2SLS Model

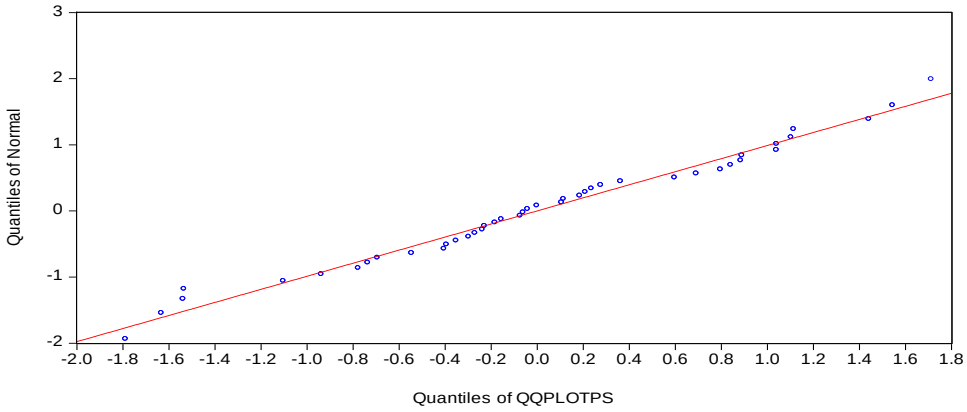


Figure 4.5: Estimated Residual of OLS of Private Saving Channel

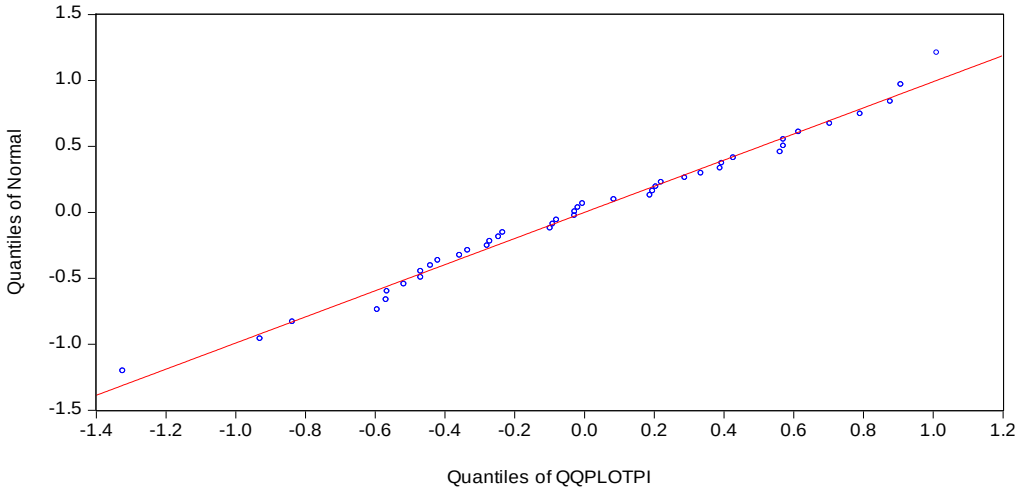


Figure 4.6: Estimated Residual of OLS of Public Investment Channel

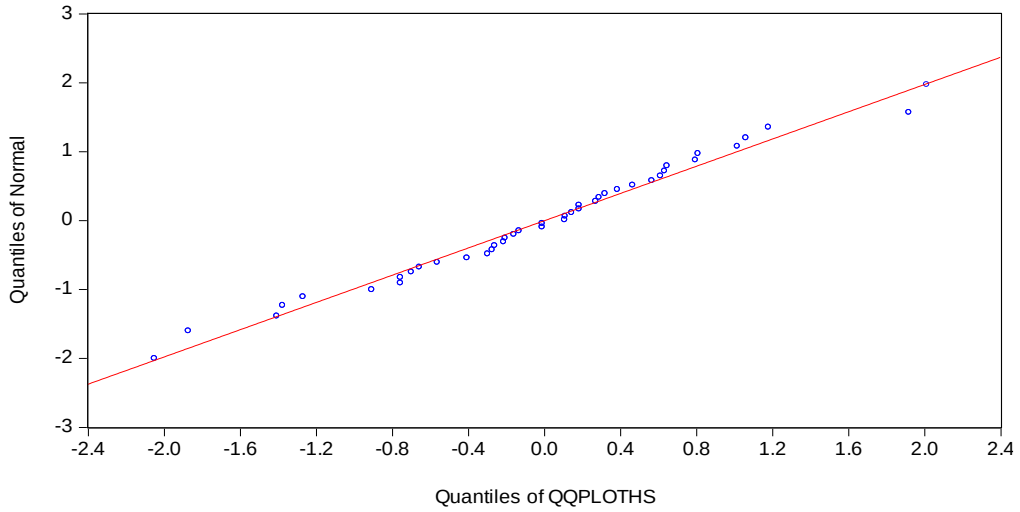


Figure 4.7: Estimated Residual of OLS of Household Saving Channel

From all the graphs, it clearly shows that all plots are reverting towards median and normally distributed. It is because these entire circles are close to the line. Since the residuals follow a normal distribution, hence, we can conclude that both 2SLS and OLS are stable and produce robust results.

4.5. Conclusions

There is ample number of studies in literature which examines the impact of public debt on economic growth. The findings from those studies produce ambiguous results; where one group finds an existence of positive impact of debt on growth, the other group shows a negative relationship between both the variables. Again no proper inferences have been drawn while examining this relationship in the context of India. This motivates us to investigate the impact of public debt on economic growth using key macroeconomic channels for India from the period 1970 to 2013. First, we examined whether public debt has any non-linear impact on economic growth or not. Second, this chapter explores the key channels through which public debt non-linearly associated with economic growth. To examine both the objectives, the present chapter uses both 2SLS and OLS techniques by using annual data spreading from 1970 to 2013.

The results derived from 2SLS model trace that the public debt positively affects the economic growth in the short run, but shows a negative relation in the long run. Further, this chapter finds the existence of a non-linear impact of public debt on economic growth. The channels through which public debt significantly affect the economic growth are household savings, public investment, and total factor productivity. From the policy perspective, this chapter suggests that government should target the public investment and productivity channels to see whether the increase in public debt enhances the capital formation and productivity of India. The government should opt for borrowings as long as it creates the capital formation and output of a nation. As this chapter finds a non-linear impact of public debt on economic growth, further this thesis estimate the optimum level of public debt in the Chapter 5.

Chapter V
Estimation of Optimum level of Public Debt: Evidence from Genetic Algorithm Approach

5.1. Introduction

Optimum debt plays a very crucial role in achieving higher economic growth particularly for countries with high fiscal deficit. The absence of well-developed theoretical models for estimating optimum level of public debt coupled with the high level of public borrowings has been a concern for both developed and developing economies. Moreover, it is observed that the non-linear impact of public debt on economic growth is a debatable issue from the beginning (Kumar and Woo, 2010; Cecchetti *et al*., 2011; Checherita and Rother, 2012; and Kaur and Mukherjee, 2012). It started with the work of Reinhart and Rogoff (2010), who argued that government debt has negative impact on Gross Domestic Product (GDP) beyond the threshold level of 90 percent of debt-to-GDP ratio. Later, Herndon *et al*. (2013) criticized Reinhart and Rogoff (2010) and concluded that debt does not have negative impact on GDP even after the threshold level of 90 percent of debt-to-GDP ratio is attained. Therefore, in line with the literature related to calculation of the optimum debt, this chapter makes an attempt to estimate the optimum level of debt in case of India.

The novelty of the study can be explained broadly in three ways. First, the study identifies the key factors that influence the public debt in India which is hardly attempted in the literature. Secondly, this study solves the endogeneity problem between public debt and economic growth by using the Auto Regressive Distributive Lag (ARDL) model. Finally, the study used a novel approach by using non-traditional optimizing technique called genetic algorithm (GA) for maximizing the

objective function of public debt to GDP ratio which is established through the factors that are responsible for determining the public debt.

Over the recent years, the absolute size of the public debt with high interest payment not only increase the financial burden of the central government but also downgrade the credit worthiness of India from BBB- to BB+ in 2011 and continued to remain negative till 2014 (Standard and Poor Credit Rating Agency, 2015). Therefore, this current fiscal scenario of India motivates one to calculate the optimum level of public debt which would be ideal for the government to achieve higher economic growth. The research question is based on the amount of the optimum level of public debt that India has for targeting high level of economic growth. This chapter seeks to answer the question by first estimating the determinants of public debt in India by using ARDL method and then applying a non-traditional optimizing technique, GA, for obtaining the optimum level of public debt.

The empirical studies by Reinhart and Rogoff (2010) showed that when gross external debt reaches 60 percent of GDP, annual growth declines by about 2 percent, and when the levels of external debt exceed 90 percent of GDP, the growth rates decrease to half. Kumar and Woo (2010) investigated the relationship between the initial debt-to-GDP ratio and growth showed that the threshold level at which debt has a negative impact on growth is 90 percent of GDP. Caner *et al*. (2010) examined the threshold point for 99 developing economies during the period 1980–2008 concluded that a public debt-to-GDP ratio of 77 percent is optimum for these economies. Further, they showed that for each additional percent of debt, the annual real growth decreases by 0.017 percent. Checherita and Rother (2012) studied the effect of gross public debt on per capita GDP growth showed that a debt-to-GDP ratio of 90 to 100 percent has negative impact on growth. Again, Greenidge *et al*. (2012) examined the effects of threshold public debt on economic growth showed

that as the debt level reaches 55 to 56 percent of GDP, it exerts a negative impact on the growth of Caribbean countries. Although, the optimum level of public debt to GDP ratio is more than 90 percent for most of the developed countries, but the optimum level of debt for developing countries expected to be less than the developed countries.

Theoretically, the literature on optimum debt such as, Aiyagari and McGrattan (1998) calculated the optimum quantity of debt for US economy concluded that debt is equal to average debt-to-GDP ratio in the post-Second World War period. Topalova and Nyberg (2010), discussed the public debt targets of India suggested that a debt ratio of 60 to 65 percent of GDP is good for India in 2015–2016. Smyth and Yu (1995) estimated the optimal debt ratio for economic growth for the period 1960–1991. They found that the optimal debt ratio for debt held by public is 38.4 percent and the optimal debt ratio for total debt is 48.9 percent. Further, Prskawetz *et al*. (1998) calculated the optimum level of public debt for European Union to be 60 percent of GDP. Pattillo and Poirson (2004) showed that external debt negatively affects the economic growth. They found that a debt-to-GDP ratio of 35 to 40 percent is optimum for 93 developing countries for the period 1969–1998. In addition to this, Mati (2005) estimated that a debt-to-GDP ratio of 38 percent is optimum for Indonesia, while Ostry *et al*. (2010) estimating the optimum level of public debt for 23 advanced countries concluded that the threshold point of long run debt ratio is 63 percent of GDP. Bannister and Barrot (2011) calculated the debt target through credit rating for Central America, Panama and the Dominican Republic for more than 21 years and concluded that these countries fall in debt intolerance region. Moreover, Abutaleb and Hamad (2012) assessed the optimum foreign debt of Egypt for the period 1985–2005 using the stochastic control approach, found that Egypt's foreign debt was higher than the optimal debt level before 1997, but it converged after 1997 towards the optimal value. Recently, Bohn (2005), De Haan *et al*. (2008), Feld and Kirchgässner (2008), Galli and Padovano

(2008), Haugh (2011), Collignon (2012), Fincke and Greiner (2012), and Neck and Haber (2012) have tested the sustainability of public debt.

It is clear from the above literatures that the optimum level of public debt to GDP ratio is varies from country to country. The possible reason could be the adoption of different fiscal policy, external factors such as exchange rate and oil price crisis, changes of certain key monetary factors such as interest rate and effects of different macroeconomic channels such as private domestic investment, gross domestic savings and economic growth of the countries.

The remainder of the chapter is organized as follows: Section 5.2 presents the theoretical explanation of determinants of public debt followed by the discussion of the data sources and methodology used in the study which is explained in Section 5.3. Subsequently, the results are delineated in Section 5.4, and finally, the conclusion is offered in Section 5.5.

5.2. Theoretical Explanations of Determinants of Public Debt

In this section, the study explained the factors which determine the public debt of India. The key variables which determine the public debt are as follows: economic growth (y_t), real interest rate (rir_t), exchange rate misalignment (mis_t), financial development ($m2_t$), government size (gs_t), current account deficit as a percentage of GDP (cub_t), and gross fiscal deficit as a percentage of GDP (gfd_t). Before analyzing the factors which determine significantly the public debt of India, the justification for selecting the factors and the possible relations among them following a priori information are provided.

Economic Growth (y_t):

The relation between public debt and economic growth is widely studied in literature, but the studies yield ambiguous results (Friedman, 1983; Evans, 1985, 1987; Barro, 1987; Ludvigson, 1996; Aschauer, 2000; Islam and Hasan, 2007; and Batool and Zulfiquar, 2013). In this chapter, the real GDP at factor cost is taken as a proxy for economic growth. First, theoretically, higher economic growth of a country leads to decrease in the borrowings of government, and hence, it reduces public debt. Second, high economic growth also generates more revenue for the government, which in turn is used to repay the principal amount and interest payment of past debt, which further reduces the public debt (Burger and Warnock, 2006 and World Bank, 2005). Third, sometimes high economic growth encourages the governments particularly of the developing countries to borrow more for increasing the gross capital formation of the country; as a result of which the public debt increases (Panizza, 2008; Forslund et al. 2011 and Rodrik and Velasco, 1999).

Real Interest Rate (rir_t):

Real Interest rate is one of the important factors which determine the public debt of a country (World Bank, 2005, Borensztein, Cowan, Eichegreen and Panizza, 2008). In this contest, Keynesian and neoclassical models explain that an increase in government debt makes households wealthier and stimulates both output and employment, finally causing interest rate to increase. The spurt in interest rate would finally crowd out private investment, thus, negatively affecting long term growth. Engen and Hubbard (2005) theoretically pointed out that the level of interest rate is determined by the level of capital stock as a consequence to which it is affected by the level of government debt. The change in the interest rate is affected by the government budget deficit, which is essentially because of the change in government debt. Kinoshita (2006) theoretically argued that when government postpones taxation

it leads to imposition of future tax on the next generations. This implies that the tax cut today is worth more than the present discounted value of all future taxes. In this way, the current generation perceives a part of the debt as net wealth and increases consumption by running down physical capital. Hence, rising of debt level and shifting of wealth across generation lead to decline in capital accumulation, thereby, raising the interest rate. De Leeuw and Holloway (1983) showed by using a theoretical model that when the stock of government securities is substituted for capital stock in the public's asset portfolio, government debt in the long run has a crowding-out effect by reducing capital stock, which may further curtail growth. Bahmani–Oskooee and Payesteh (1994) concluded that public debt increases long term interest rate in support of the Keynesian hypothesis.

Government Size (gs_t):

It is argued that developing countries need more funds in order to spend for its basic needs and the revenue is not sufficient. Therefore, government depends heavily on debt as big firms are expected to be more diversified and depends on debt. So, there are positive correlation between debt and size (Harris and Raviv, 1991; Serrasquero and Rogao, 2009; Morri and Cristanziani, 2009; and Ahmed Sheikh and Wang, 2011).

Exchange Rate Misalignment (mis_t):

Exchange rate is one of the factors determining the public debt of India (Feldstein, 1986, Evans, 1986 and Lin, 1994). In this contest, Feldstein (1986) supporting the conventional view of the relation between public debt and exchange rate stated that debt financing fiscal policy leads to appreciation of the currency. On the contrary, Evans (1986) argued that Ricardian equivalence could explain his findings that government deficit leads to depreciation of the dollar relative to many other

currencies. Further, Lin (1994) explained theoretically through overlapping generation model that an increase in government debt depreciates the real exchange rate of the country with relatively higher capital elasticity of output; whereas decrease in government debt appreciates the real exchange rate of the country with relatively lower capital elasticity of output. And if two countries have the same capital elasticity in production, there is no effect on the real exchange rate. However, this chapter considers exchange rate misalignment which is a short-run disequilibrium of exchange rate as one of the key factors for determining the level of public debt (Forslund et al. 2011; Caballero and Cowan, 2006 and Panizza, 2008). The reason is that India's short-run disequilibrium exchange rate is very much inconsistent. Further, exchange rate misalignment has both demand and supply side effects. On the demand side, at a given interest rate, a depreciation of exchange rate vis-à-vis its equilibrium level is likely to foster the demand for domestic currency bonds as investors may foresee an *ex post* deterioration of the foreign currency rate. On the supply side, government might be less likely to issue domestic currency in the presence of a depreciated exchange rate (Forslund *et al*., 2011).

This chapter calculates the exchange rate misalignment of India using Hodrick–Prescott (HP) filter. The HP filter is widely used to obtain the long term trend of Real Effective Exchange Rate (REER) from the actual REER. Technically, the HP filter is a two-sided linear filter that computes the smoothed series *s* of *y* by minimizing the variance of *y* around *s*, which is subjected to a penalty that constrains the second difference of *s*. Thus, the HP filter chooses to minimize *s*:

$$\sum_{t=1}^{T} (y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1} \left((s_{t-1} - s_t) - (s_t - s_{t-1}) \right)^2 \qquad (5.1)$$

Where, the penalty parameter λ controls the smoothness of the series, as $\lambda = \infty$, and s tends to a linear trend.

Financial Development ($m2_t$):

A sophisticated financial development of a country such as well-developed bond and equity markets reduces the costs of liquidation of long-term debt, thereby, increasing the incentives to lend long term debt. Therefore, the financial development plays an important role to determine the public debt of a developing country like India (Rodrik and Velasco, 1999 and Forslund et al., 2011).

Current Account Deficit (cub_t):

The relation between current account deficit and public debt is straight forward as a country with high current account surplus depends less on external sources and vice versa, whereas countries with high fiscal deficit will always face a problem to raise fund in the international market. Hence, the level of current account deficit of a developing country like India is one of the important factors for determining the public debt (Buch and Lusinyan, 2000; Sargent and Wallace, 1981 and Forslund et al., 2011).

Gross Fiscal Deficit (gfd_t):

The level of fiscal deficit also plays a vital role in determining the level of public debt of a country. It is, therefore, expected that there is a positive correlation between country's fiscal deficit and public debt because a country with high level of fiscal deficit depends to a large extent on both internal and external borrowings (Burger and Warnock, 2006; Boskin, 2004; and Schreft and Smith, 2003).

5.3. Data Sources and Methodology

5.3.1. Methodology

This chapter implements both ARDL model (bounds testing approach, Pesaran *et al*., 2001) and GA approach for estimating the factors that determine public debt and calculate the optimum level of public debt in case of India.

5.3.1.1. ARDL Model Specification

ARDL method has been chosen because of three reasons: First, among the variables selected, some are I(0) while few are I(1). Second, the ARDL model solves the endogeneity problem in the model. Finally, the approach is more suitable for small and finite sample data period (Pesaran *et al*., 2001).

Before presenting the Pesaran *et al*. (2001) ARDL test, we focus on Vector Autoregression (VAR) model of order *p* for the growth function:

$$x_t = \eta + \sum_{j=1}^{k} \beta_j x_{t-j} + \varepsilon_t \qquad (5.2)$$

where $x_t = [pd_t , rir_t , mis_t , gs_t , gfd_t, cub_t, m2_t]^{/}$, η is a vector associated with constant term, β_j is a matrix of VAR parameters for lag j and ε_t is the white noise disturbance term. This study used VAR model because, the ARDL model is sensitive to choose the optimal lag length. Therefore, AIC, SC and HQ criteria is chosen to find the optimal lag length, which has been used in the ARDL model.

The Vector Error Correction (VEC) model can be written as:

$$\Delta x_t = \eta + x_{t-1} + \lambda \sum_{j=1}^{k-1} \lambda_j \Delta x_{t-j} + \varepsilon_t \qquad (5.3)$$

where Δ is the first difference and λ is the long-run multiplier matrix that can be written as follows:

$$\lambda = \begin{bmatrix} \lambda yy & \lambda yx \\ \lambda xy & \lambda xx \end{bmatrix}$$

The Wald test (*F*-statistic) is also important for ARDL test. This test confirms existence of long-run relationship among the variables. The null and alternative hypotheses are as follows:

$H_0 = \beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$
$H_a \neq \beta_1 \neq \beta_2 \neq \beta_3 \neq \beta_4 \neq 0$

The computed *F*-statistic is compared to the critical tabulated values (given in Narayan, 2005). According to Pesaran *et al*. (2001) and Narayan (2005), the lower bound critical values imply that the explanatory variables are integrated of order zero, while the upper bound critical values imply that the explanatory variables are integrated of order one. Therefore, if the computed *F*-statistic is smaller than the lower bound value, then the null hypothesis is not rejected and it is concluded that there is no long-run relationship between the variables. Contrarily, if the computed *F*-statistic is greater than the upper bound value, there is existence of long-run relationship among the variables, and if the computed *F*-statistic is in between the lower bound and upper bound then the result is inconclusive.

Once the long-run relationship is identified, the next step in the ARDL model is to estimate the long-run coefficient from the following equation:

$$y_t = \beta_0 + \beta_1 \sum_{i=1}^{p1} y_{t-i} + \beta_2 \sum_{i=0}^{q1} pd_{t-i} + \beta_3 \sum_{i=0}^{q2} rir_t + \beta_4 \sum_{i=0}^{q3} mis_t + \beta_5 \sum_{i=0}^{q4} gs_t + \beta_6 \sum_{i=0}^{q5} gfd_t + \beta_7 \sum_{i=0}^{q6} cun_t + \beta_8 \sum_{i-0}^{q7} m2_t + \varepsilon_t \quad (5.4)$$

Before estimating Equation (5.4), the lag order has to be determined through VAR.

In final step, the short-run dynamic parameter is obtained by estimating the following error correction model:

$$\Delta y_t = \alpha_0 + \alpha_1 \sum_{i=1}^{p} \Delta y_{t-i} + \alpha_2 \sum_{j=1}^{q} \Delta pd_{t-j} + \alpha_3 \sum_{k=1}^{q} \Delta rir_{t-k} + \alpha_4 \sum_{l=1}^{q} \Delta mis_{t-l} + \alpha_5 \sum_{m=1}^{q} \Delta gs_{t-m} + \alpha_6 \sum_{n=1}^{q} \Delta gfd_{t-n} + \alpha_7 \sum_{o=1}^{q} \Delta cub_{t-o} + \alpha_8 \sum_{s=1}^{q} \Delta m2_{t-s} + \vartheta ECM + \varepsilon_t \quad (5.5)$$

Where $\alpha_1, \alpha_2, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7$ and α_8 are the short-run dynamic coefficients and ϑ is the coefficient of speed of adjustment variable which is expected to have a negative sign.

5.3.1.2. Genetic Algorithm Approach

The Genetic Algorithm (GA) technique is used to obtain the optimum value of public debt-to- GDP ratio for India. GA is a non-traditional optimization algorithm based on the natural genetics and natural selection and has been successfully applied in many areas for the purpose of optimization (Bauer, 1994; Deboeck, 1994; Shin and Lee, 2002; Ceylan and Ozturk, 2004; Haldenbilen and Ceylan, 2004; Ozturk *et al*. 2005; and Toksari, 2009). GA is suitable for solving maximization problems as follows:

Max $f(x)$, $x_i^{(L)} \le x_i \le x_i^{(U)}$, $i = 1, 2, \ldots, N$ (5.6)

For solving Equation (5.6), it is rewritten in a string form and this chapter uses binary code for each string. The length of the string is usually determined according to the desired solution accuracy. For example, if four bits are needed for each variable in a two variable function optimization problem, the strings (0000 0000) and (1111 1111) would represent the points: $(x_1^{(L)}, x_2^{(L)})$ and $(x_1^{(U)}, x_2^{(U)})$ respectively, because the substrings (0000) and (1111) have the minimum and the maximum decoded values. Any other eight-bit string can be found to represent a point in the search space according to a fixed linear mapping rule as follows:

$$x_i = x_i^{(L)} + \frac{x_i^{(U)} - x_i^{(L)}}{2^{l_i} - 1} \text{ decoded value } (s_i) \qquad (5.7)$$

In Equation (5.7), the variable x_i is coded in a substring s_i of length l_i. The decoded value of a binary substring s_i is calculated as $\sum_{i=0}^{l-1} 2^i s_i$, where $s_i \in (0,1)$ and the string *s* is represented by $(s_{l-1}s_{l-2}....s_2s_1s_0)$.

After the coding, it needs to fit the fitness function *F(x)*. This fitness function is derived from the objective function and is used in successive genetic operations. For the maximization problem, the fitness function is same as the objective function. In the next case, the operation of GA begins with a population of random strings representing design or decision variables. Thereafter, each string is evaluated to find the fitness value. The population is then operated by three main operators—reproduction, crossover and mutation to create a new population of points. The new population is further evaluated and tested for termination. If the termination criterion is not met, the population is iteratively operated by the above-stated three operators and is evaluated. This procedure is continued until the termination criterion is met (see Figure 5.1).

The first operator of GA is applied to the population for reproduction. Then the good strings in the population are selected among them and a mating pool is formed. The commonly-used reproduction operator is the proportionate reproduction operator where a string is selected for the mating pool with a probability proportional to its fitness. Thus, the i^{th} string in the population is selected with a probability proportional to F_i. Therefore, the probability for selecting the i^{th} string is:

$$p_i = \frac{F_i}{\sum_{j=1}^{n} F_i} \tag{5.8}$$

Where n is the population size. The way to implement this selection scheme is to imagine a roulette-wheel with its circumference marked for each string proportionate to the string's fitness. The roulette-wheel is spun n times; each time selecting an instance of the string chosen by the roulette-wheel pointer. Since the circumference of the wheel is marked according to a string's fitness, this roulette-wheel mechanism is expected to make (Deb, 2012): $\bar{F} = \sum_{i=1}^{n} \frac{F_i}{n}$.

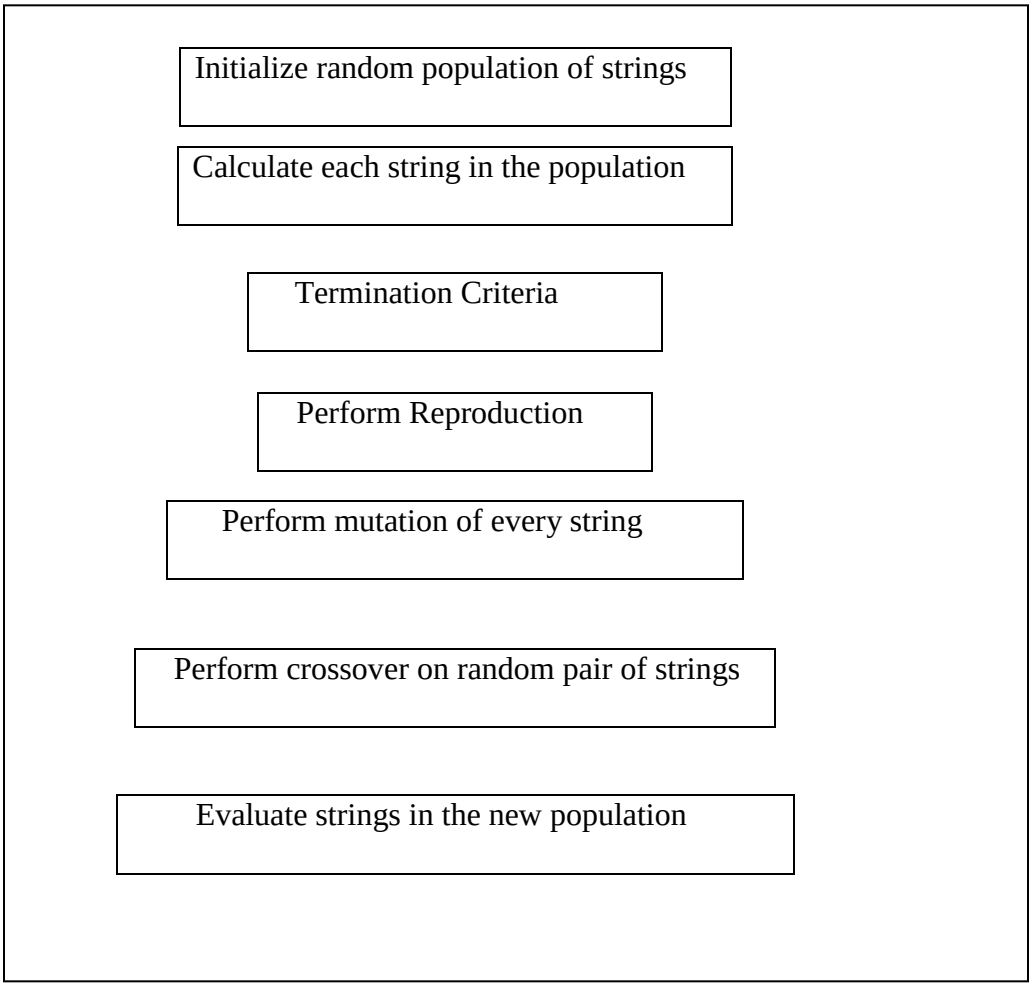


Figure 5.1: GA Procedure

5.3.2. Data

The chapter used annual data covering the period between 1970 and 2013. The nominal values of the relevant variables are deflated by using suitable price indices for getting real values of the variables. The price indices are converted to a single base year, and thus, homogeneity is maintained. The data for the variable real GDP is taken as proxy for the economic growth (y), and the real interest rate is calculated by using the Fisher's index, which is the difference between nominal interest rate and the expected inflation rate. In addition to this, the average of 15-year bond yield is treated as the long term nominal interest rate (rir), and real effective exchange rate is used to calculate the exchange rate misalignment (mis). The total public consumption expenditure as a percentage of GDP of the centre and state government (Labonte, 2010 and Davies, 2009) is taken as a proxy for government size (gs). The data for current account deficit as a share of GDP (cub) and the gross fiscal deficit (gfd) as a percent of GDP are obtained from the *Handbook of Statistics* which is published by Reserve Bank of India (RBI). The data for financial development as a percent of GDP (m2) is obtained from *World Development Indicators* (WDI) published by the World Bank.

5.4. Results and Discussion

The summary statistics of the variables are presented in Table 5.1. This summary statistics highlighted the mean, variance, distribution of variables and minimum as well as maximum value of the parameter used in the model. In the next step, the present study conducts Augmented Dickey-Fuller (ADF) test (Dickey and Fuller, 1979) for analyzing the unit root in the data series, and the results are presented in Table 5.2. The results of ADF test show that y_t, rir_t, mis_t, and gs_t are integrated of order zero, that is, I(0) and pd_t, $gfdt$, cub_t and $m2_t$ are integrated of order one [I(1)]. The ADF test results reveal that the dataset contains a mixture of I(0) and I(1)

variables. This mixed ordering of stationary property of the time series motivates us to employ the ARDL cointegration technique proposed by Pesaran *et al*. (2001). This technique helps to investigate the existence of long run equilibrium relationship among the determinants of public debt even in the presence of non-uniformity in the stationary property of variables. The results of ARDL test are presented in Table 5.3.

Table 5.1: Descriptive Statistics of Variables Used in the Study

Variable	Mean	Median	Max.	Min.	SD	Skewness	Kurtosis	JB
y_t	5.46	5.57	10.15	-5.20	3.005	-1.09	5.04	16.46
pd_t	62.01	66.16	83.22	33.69	13.73	-0.49	2.11	3.23
rir_t	1.80	2.14	8.66	-12.45	4.92	-1.09	4.20	11.40
mis_t	-9.79E-13	0.65	19.01	-20.68	7.78	-0.31	3.74	1.74
gs_t	11.46	10.12	56.82	-31.82	14.59	0.20	5.43	11.17
gfd_t	7.79	7.91	10.99	4.05	1.91	-0.22	2.08	1.90
cub_t	-1.14	-1.20	2.30	-4.70	1.39	0.09	3.73	1.06
$M2_t$	46.59	42.73	77.71	21.00	17.25	0.43	2.08	2.89

Note: y_t = Economic growth, pd_t = Public Debt-to-GDP ratio, rir_t = Real interest rate, mis_t = Exchange rate misalignment, gs_t = Government size, gfd_t = Gross fiscal deficit, cub_t = Current account deficit, and $m2_t$ = Financial development

Table 5.2: Results of ADF Unit Root Test

Variable	Level	First Order Difference	Inference on Integration
y_t	-7.64 (0.00)	------	I(0)
pd_t	-1.89 (0.64)	-4.002 (0.01)	I(1)
rir_t	-3.38 (0.06)	------	I(0)
mis_t	-3.72 (0.03)	------	I(0)
gs_t	-6.08 (0.00)	------	I(0)
gfd_t	-2.25 (0.44)	-5.97 (0.00)	I(1)
cub_t	-3.04 (0.13)	-7.44 (0.00)	I(1)
$M2_t$	-2.11 (0.52)	-4.28 (0.00)	I(1)

Note: Figures in parentheses are *p*-values. y_t = Economic growth, pd_t = Public Debt-to-GDP ratio, rir_t = Real interest rate, mis_t = Exchange rate misalignment, gs_t = Government size, gfd_t = Gross fiscal deficit, cub_t = Current account deficit, and $m2_t$ = Financial development

The results in Table 5.3 show that the calculated *F*-statistics is greater than the critical values of Pesaran *et al*. (2001) at 1 percent level and Narayan (2005) at 5 percent level. Hence, the null hypothesis of no long run relationship between the variables is rejected, which implies that there exist long run relationships between the determinants of public debt. An optimum lag order of 2 is chosen through VAR model by following AIC, SC, and HQ criteria. Having found evidence for long run relation among the determinants of public debt, the chapter estimates the ARDL regression for the factors determining the public debt. The regression results are presented in Table 5.4.

Table 5.3: Bound Test Results

Country	***F*-Statistic**	**Lag Length**	**Significance Level**	**Bound Critical Values by Narayan (2005)**		**Bound Critical Values by Pesaran *et al*. (2001)**	
				I (0)	I (1)	I (0)	I (1)
India	5.74	2	1 %	4.483	6.320	3.74	5.05
			5 %	3.120	4.560	2.45	3.61
			10 %	2.560	3.828	2.12	3.23

Source: Author's Own Calculation and Critical Values are borrowed from Narayan (2005).

The results in Table 5.4 show that economic growth and one-period lagged value of economic growth have a significant negative effect on the public debt of India. This implies that higher is the growth of India's economy lower is its dependence on public debt and vice versa. Therefore, we can say that public debt and economic growth does have bidirectional causality between them. It is because, from the Table 4.3 in this study we find a significant effect of public debt on economic growth as well as in Table 5.4 our result also finds a significant impact of economic

growth on public debt. As our results concludes from the chapter 4 that public debt is positively affects the economic growth in the short run and negative effect in long run. However, while estimating the determinants of public debt, we found that economic growth has negatively determine the public debt. The results are not contrary to each other, because ARDL model shows the long run effects among the variables. Hence, the findings of this chapter support the monetarist view. Further, it is observed that one-period lagged value of real interest rate, one-period lagged value of public debt-to-GDP ratio and gross fiscal deficit have a significant positive effect on public debt. This clearly indicates that higher fiscal deficit, higher one-period lagged value of real interest rate, and higher one-period lagged value of public debt-to-GDP ratio lead to greater borrowing of funds from both internal as well as external sources. Although government size is a key determinants of public debt but this variable did not significantly affect the public debt in India. Though the public expenditure of the central government has increased from Rs.530 crores in 1950-51 to Rs.17, 94,892 crores in 2013-14, but that does not necessarily mean for raising the public debt in India. In order to meet the high public expenditure, the Government of India raises its fund through deficit financing and by acquiring foreign capital flows. Further, this study did not find current account deficit and exchange rate misalignment are the significant factors to determine the public debt. It is because, India's external debt does not contribute much to the total public debt and hence the external factors are not significantly determining the public debt in the case of India. Subsequently, the chapter estimates the long run relation between public debt and its determinants and the results are presented in Table 5.5.

Table 5.4: ARDL Regression Results

Dependent Variable: pd_t

Variable	Coefficient	Standard Error	*t*-Statistics
$pd_t(-1)$	0.54^{***}	0.40	21.35 (0.00)
yt	-0.51^{***}	0.14	-3.65 (0.01)
$y_t(-1)$	-0.32^{***}	0.127	-2.52 (0.01)
rir_t	0.13	0.08	1.47 (0.15)
$rir_t(-1)$	0.37^{**}	0.120	3.08 (0.04)
mis_t	0.01	0.04	0.30 (0.76)
gs_t	0.03	0.02	1.47 (0.14)
gfd_t	0.78^{***}	0.20	3.78 (0.00)
cub_t	0.21	0.28	0.77 (0.44)
$M2_t$	0.02	0.03	0.80 (0.42)
Constant	5.13^{**}	2.38	2.15 (0.03)
R^2	0.986		
Adjusted R^2	0.981		
Prob. F (10, 32)	227.88 (0.000)		
$\chi^2_{(Auto)}$ (2)	0.0006 (0.97)		
$\chi^2_{(Norm)}$ (1)	0.82 (0.66)		
$\chi^2_{(Het)}$ (1)	1.78 (0.18)		

Note: The figures in the parentheses show the *p*-values; *** and ** indicate significance at 1 percent and 5 percent levels respectively. y_t = Economic growth, pd_t = Public Debt-to-GDP ratio, rir_t = Real interest rate, mis_t = Exchange rate misalignment, gs_t = Government size, gfd_t = Gross fiscal deficit, cub_t = Current account deficit, and $m2_t$ = Financial development

The results in Table 5.5 show that economic growth has a significant negative effect on public debt in India. Similarly, the real interest rate and gross fiscal deficit positively determine the public debt of India. The findings of the chapter corroborate with *a priori* information. Finally, the study estimates the error correction representation of the ARDL model which comprises the short run parameters and speed-of-adjustment term. The results of the error correction model are presented in Table 5.6.

Table 5.5: Long-Run Estimation Results of the ARDL Model

Dependent Variable: pd_t

Variable	Coefficient	Std. Error	*t*-Statistic
y_t	-6.03**	2.65	-2.27 (0.03)
rir_t	3.63***	1.32	2.73 (0.01)
mis_t	0.09	0.31	0.30 (0.76)
gs_t	0.25	0.20	1.24 (0.22)
gfd_t	5.69***	1.63	3.49 (0.00)
cub_t	1.56	1.96	0.79 (0.43)
$M2_t$	1.90	0.20	0.91 (0.36)
Constant	37.16**	17.64	2.10 (0.04)

Note: The figures in the parentheses show the *p*-values; *** and ** indicate significance at 1 percent and 5 percent levels respectively.

Table 5.6: Results of Error Correction Representation of the ARDL Model

Dependent Variable: pd_t

Variable	Coefficient	Std. Error	*t*-Statistic
Δy_t	-0.51***	0.14	-3.65 (0.00)
Δrir_t	0.13	0.08	1.476 (0.14)
Δmis_t	0.01	0.04	0.30 (0.76)
Δgs_t	0.03	0.02	1.479 (0.14)
Δgfd_t	0.78***	0.20	3.78 (0.00)
Δcub_t	0.21	0.28	0.77 (0.44)
$\Delta m2_t$	0.02	0.03	0.80 (0.42)
Constant	5.13**	2.38	2.15 (0.03)
ECM (-1)	-0.13***	0.04	-3.42 (0.00)

Note: The figures in the parentheses show the *p*-values; *** and ** indicate significance at 1 percent and 5 percent levels respectively.

The negative sign and significance of the error term confirms that the series is non-explosive and there exists a stable long run relationship among the variables (Bannerjee and Mestre, 1998). The coefficient of the error correction term shows the speed at which the endogenous variables adjust to changes in the equilibrium level, and *ECM* (-1) term suggests adjustment to equilibrium takes place after one year. Further, the results reveal that in the short-run economic growth negatively affects

the public debt, while gross fiscal deficit has positive effect on the public debt of India. To check the robustness of the model, the stability of the regression coefficient is tested through CUSUM and square of CUSUM test, and the plots are presented in Figures 5.2 and 5.3, respectively. These figures show that the stability condition is satisfied as the plots do not exceed the 5 percent level of significance.

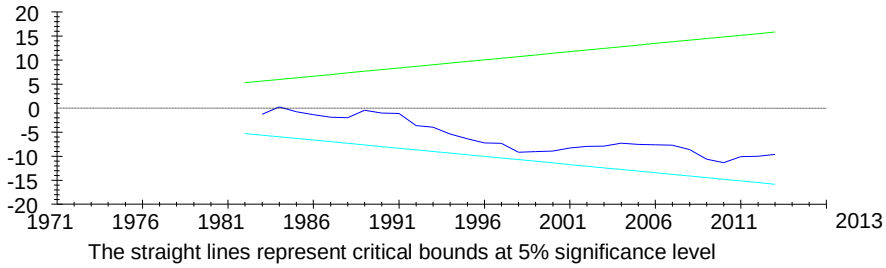


Figure 5.2: Plot of Cumulative Sum of Recursive Residuals Test

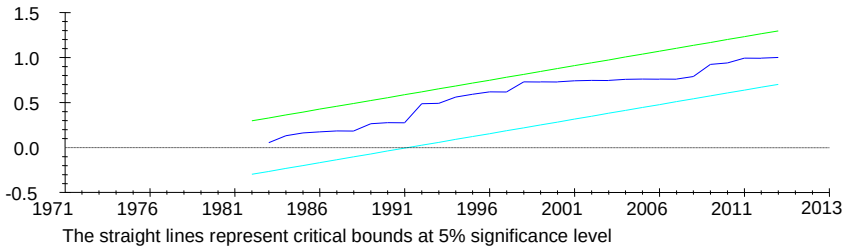


Figure 5.3: Plot of Cumulative Sum of Squares of Recursive Residuals Test

Having estimated the factors which significantly determine the public debt of India and support the existence of long run and short-run relationship among the variables, this chapter calculates the optimum level of public debt using the non-traditional optimization technique. The objective function is as follows:

$$pd_t = f(pd_{t-1}, y_t, y_{t-1}, rir_{t-1}, gfd_t) \quad (5.9)$$

The aim of the study is to maximize this objective function which gives the optimum level of public debt to GDP ratio. The key factors such as one period lag of public debt to GDP ratio (pd_{t-1}), economic growth rate (y_t), one period lag of economic growth rate (y_{t-1}), one period lag of real interest rate (rir_{t-1}), and gross fiscal deficit (gfd_t) are determining the public debt to GDP ratio in the case of India. In order to find out the global maximum point, this study used the non-parametric optimization technique which is call as Genetic Algorithm (GA) approach. The merits over GA approach over other optimization technique are: first, this method can gives global maximum rather local maxima. Second, this method is not based on any assumption as well as any constraints. Third, this algorithm gives the best solution, if the objective function is noisy and stochastic as well as if the number of parameter to estimate is large, and finally GA approach is robust than other traditional technique as this method based probability rather deterministic selection (Bauer, 1994; Deboeck, 1994; Shin and Lee, 2002).

The parameters used in GA for optimizing public debt are the following: population size (n) = 100, number of generations (t) = 100, mutation probability (P_m) = 0.05, number of decision variables (k) = 5 (because this chapter finds that y_t, $y_t(-1)$, $rir_t(-1)$, gfd_t and $pd_t(-1)$ significantly affect the public debt (refer Table 3), bit length of each variable = 10, and the crossover probability (P_c) = 0.7, 0.8, and 0.9 in different simulations. This technique is based on the Darwinian principle of reproduction. According to this principle, the one who will survive is the fittest.

Hence, crossover and mutation are performed randomly and continuously from generation to generation until the termination criteria is satisfied. After reaching the maximum point for all generations, the algorithm converges at a near optimum point for the model. This chapter performs the simulation by taking three different crossover probabilities, which are, P_c = 0.7, 0.8, and 0.9, as it is difficult to choose an exact crossover probability. The results and the corresponding plots are presented in Tables 5.7, 5.8, and 5.9 and Figures 5.4, 5.5, and 5.6, respectively. The detail coding of GA is presented in Appendix 2.

The results in Table 5.7 show that the optimum value of public debt is 62.25 percent of GDP. The optimum value converges at the 98th generation. To check for robustness, the model is re-estimated using GA by taking the crossover probability value of 0.8 and 0.9. The results given in the Tables 5.8 and 5.9 show that the optimum values of public debt is 60.69 percent and 63.56 percent of GDP, respectively. The optimum values are converging at 70th and 32nd generations respectively. Therefore, based on the findings it can be concluded that the optimum value of public debt ranges from 60.69 to 63.56 percent of GDP and beyond this, the public debt might have an adverse impact on India's economic growth.

Table 5.7: Simulation Results of Optimum Point of Public Debt-to-GDP Ratio (P_c=0.7)

Generation	Optimum Value of Public Debt-to-GDP Ratio
1	59.14
5	58.05
10	58.91
15	56.96
20	57.99
25	59.55
30	59.82
35	57.50
40	57.35
45	58.88
50	58.07
55	59.35
60	58.17
65	56.38
70	59.85
75	56.45
80	55.10
85	54.81
90	55.97
98	62.26
100	58.07

Source: Author's Own Calculation

Table 5.8: Simulation Results of Optimum Point of Public Debt-to-GDP Ratio (P_c=0.8)

Generation	Optimum Value of Public Debt-to-GDP Ratio
1	58.44
5	55.90
10	56.19
15	56.38
20	59.21
25	57.93
30	56.66
35	55.67
40	58.49
45	57.95
50	59.92
55	55.98
60	55.89
65	55.01
70	60.70
75	57.52
80	58.08
85	57.55
90	58.62
95	57.92
100	57.95

Source: Author's Own Calculation

Table 5.9: Simulation Results of Optimum Point of Public Debt-to-GDP ratio (P_c=0.9)

Generation	Optimum Value of Public Debt-to-GDP Ratio
1	54.87
5	60.52
10	60.01
15	58.36
20	57.04
25	54.79
30	62.16
32	63.57
40	57.49
45	55.60
50	58.80
55	57.78
60	60.64
65	59.70
70	60.17
75	60.40
80	58.27
85	59.98
90	60.78
95	59.72
100	57.30

Source: Author's Own Calculation

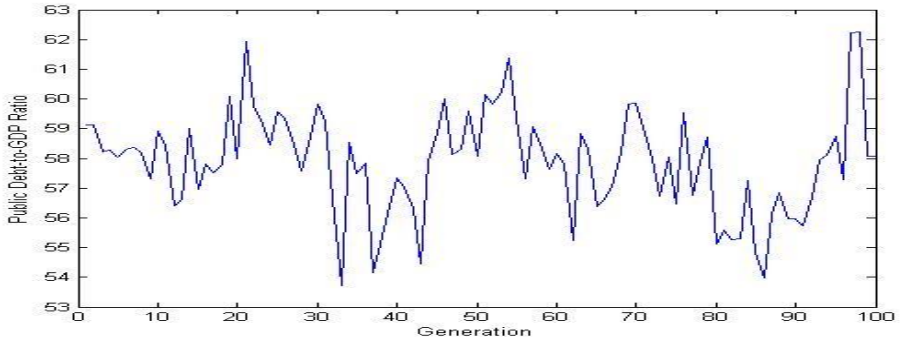


Figure 5.4: Global Maximum Point of Public Debt-to-GDP Ratio (P_c=0.7)

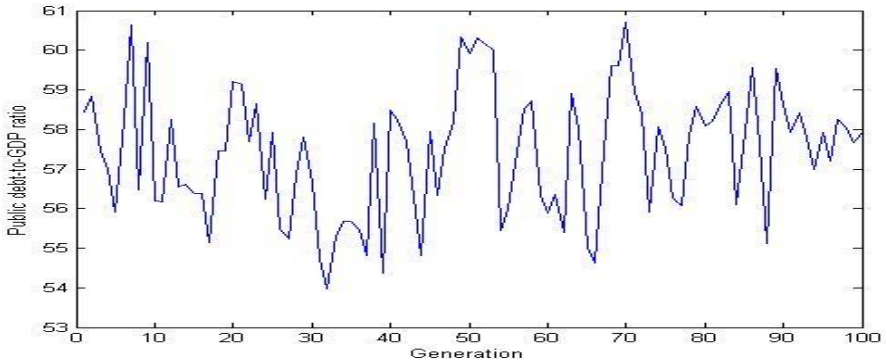


Figure 5.5: Global Maximum Point of Public Debt-to-GDP Ratio (P_c=0.8)

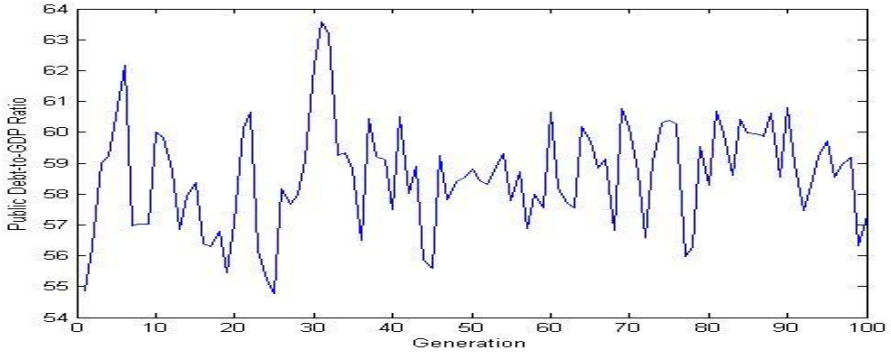


Figure 5.6: Global Maximum Point of Public Debt to GDP Ratio (P_c=0.9)

5.4.1. Robustness

This chapter further calculates the optimum level of public debt by considering the cross over probability of 0.7, 0.8 and 0.9 respectively. This study did not consider less than 0.6 cross over among the variables due to inconstancy of the results which could mislead the inference. Subsequently, the study did the simulation using two alternative simulation, i.e. up to 75 and 125 generation respectively.

Table: 5.10: Results of Optimum Point of Public Debt with Different Generation

Generation	P_c=0.7	P_c=0.8	P_c=0.9
Up to 75th Generation	61.73	60.31	61.81
Up to 100th Generation	62.26	60.70	63.57
Up to 125th Generation	60.83	61.26	61.51

Note: Authors' own Calculation, P_c = cross over probability

The results obtained from the Table 5.10 did not significantly change the ranges of optimum public debt which has simulated using 100 generation as the benchmark. Thus, we conclude that the optimum level of public debt in case of India could varies ranges from 61 to 64 percent of GDP. This optimum level of public debt to GDP ratio is fixed over the period between 1970-71 and 2013-14. This optimum level of public debt to GDP ratio remains prevails with the condition of the parameter used in the study. The inclusion and exclusion of the parameters in the objective function will change the optimum point. Similarly, any changes of these parameters beyond the maximum and minimum values would change the public debt to GDP ratio accordingly.

5.5. Conclusions

The present study attempted to estimate the optimum level of public debt for India by identifying the key factors that affect the public debt in India. The determinants of public debt have been estimated using the ARDL model for the data over the period 1970–2013. On the basis of the findings, it is concluded that economic growth, real interest rate, and gross fiscal deficit significantly determine the public debt of India, whereas other key variables like financial development, current account deficit, exchange rate misalignment, and government size have no significant effect. The possible reason might be that India's major portion of debt is from internal sources, and hence, external factors like exchange rate misalignment and current account deficit do not affect India's public debt-to-GDP ratio. The surprising aspect of the findings is that the size of the government does not show any significant impact on the public debt of India. Once the key determinants are ascertained, the values of those coefficients are used for calculating the optimum debt by using the GA. The use of GA to calculate the optimum debt for India is a novel attempt of this chapter. The study used GA approach to calculate the optimum level of public debt in the case of India and finds that the 61-64 percent of public debt to GDP ratio is optimum for India. The uniqueness of this chapter is basically to identify the major factors that determine the public debt and to apply those factors as input in the genetic algorithm approach for estimating the optimum value of public debt to GDP ratio for India. Finally, this chapter suggested that beyond the 64 percent of debt to GDP ratio might have an adverse impact on the economy. In this context, the thesis additional shows the burden of public debt in Chapter 6.

Chapter VI

An Analysis of Burdens of Public Debt

6.1. Introduction

The rising level of India's public debt as a percentage to GDP particularly after the financial crisis is a debatable issue in the recent period. One of the reasons behind this is the excessive burden of public expenditure that needs to be financed through borrowing.[10] So, the accumulation of public borrowing can create both financial and real burden on the people. In order to meet the repayment of debt and interest charges, the government typically increases the tax level. In this context Panandiker (2010) says that interest payments have swelled and consume 46 percent of the tax revenue of the government. Hence, this will cause the financial burden for the people (David, 1990). It is also observed that the increasing level of taxable income may cause adverse effects on the willingness to work and save. This type of effect is called as the real burden of the public debt (Lerner, 1941). Though India is not a default country, the recent ranking by some of the credit rating agencies' put forward the major question about debt repayment worthiness of the nation. The sharp deterioration in the economic growth, increasing current account deficit, and growing government expenditures are supposed to be the major driving force for decline in the fiscal health as reflected by worsening the fiscal and primary balances. The high fiscal deficits with low economic growth in recent years anticipate higher government borrowings in the coming years. Thereby, the degree of public debt burden on interest payments will be a fascinating research issue which needs to be examined. The findings of the chapter suggested that high level of public debt, widens the gross primary deficit of India's budget, and thus creates burden for the economy. The interest payment has negative impact on the gross primary deficit of

[10] Panandiker, The Burden of Public Debt; Reuters; 2010

the country. This suggests that higher interest payment discounts the present as well future consumption expenditures, and hence is known as the real burden for the country.

It is seen that the growth of public debt has been a political issue over the period of time. Critics have not only find fault with the deficit financing policy, but have also warned the burden of debt accumulation for the future generation.[11] India's stock of total public debt (both internal and external debt) includes both centre and state, and the debt has increased from Rs.0.21 trillion at the end March 1970 to Rs.75 trillion at the end of March 2013. It is also observed that the total public debt as a percentage of GDP has increased from 45 percent at the end of March 1970 to 66 percent of GDP on the end of March 2013 (Handbook of Statistics on Indian Economy, 2013). In opposition to the public debt, government has to pay the interest on the debt and the interest payments were Rs.2.2 trillion while income from investment and loans was only Rs.711 million in the end of March 2009 (Panandiker, 2010). Thus, the increasing level of public debt with respect to high level of interest payments would likely to have a heavy for India. Therefore, the rising level of public debt to GDP ratio is not only creating interest payment burden but is also crowding out the private investment through raising the interest rate, and thereby affecting the economic growth.

This chapter differs from other studies in four ways. First, the public debt as well as the interest payment is continuously increasing, and the economic growth is incessantly deteriorating. So, India is experiencing high level of gross primary deficit, fiscal deficit and current account deficit, but in this contest, hardly any study has measured the burden of public debt in the case of India.

[11] Musgrave & Musgrave, Public Finance in the Theory and Practice, Fifth Edition, McGraw-Hill, Chapter 32, p.544

Second, it is important to measure the burden of public debt, when a country is experiencing slow rate of economic growth, changing of political situation, external crisis like Asian financial crisis, global financial crisis and macroeconomic instability in the domestic economy. Thirdly, this chapter shows the augmented Bohn (1998) test for calculating the burden of public debt in the case of India. Finally, this chapter implements structural VAR approach which is a methodological contribution in the burden of public debt literature.

This chapter is organised as follows. Section 6.2 discusses the empirical methodology; the data sources and measurement of variables are presented in Section 6.3. The results are elucidated in Section 6.4, and the last section provides the concluding remarks.

6.2. Analytical Framework

This chapter analyses the burden of public debt using the seminal work by Bohn (1998) known as the Bohn hypothesis. Bohn (1998) shows that the response of the primary budget surplus occur when there is changes in the public debt ratio. He concludes that a positive response of the primary surplus to public debt is a sufficient condition for solvency. Bohn (1998) defines the government finance budget equation as:

$$D_{t+1} = (D_t - S_t).(1 + R_{t+1}) \qquad (6.1)$$

Where, $D_t = debt, S_t =$ primary surplus (taxes minus noninterest spending S_t), $(1 + R_t)$ = gross interest factor.

But, in a growing economy with a growing tax base and growing spending, the budget equation can be write as:

$$d_{t+1} = x_{t+1}.(d_t - s_t) \qquad (6.2)$$

Where, $d_t = \frac{D_t}{Y_t}$ is the ratio of debt to aggregate income (GDP), $s_t = \frac{S_t}{Y_t}$ is the ratio of the primary surplus to income, and $x_{t+1} = (1 + R_{t+1}).\frac{Y_t}{Y_{t+1}} \approx 1 + r_{t+1} - y_{t+1}$ is the ratio of the gross return on government debt to the gross growth rate of income. The variables r_{t+1} and y_{t+1} denote the real interest rate and the real growth rate, respectively.

Bohn (1998) present the relation between debt-income ratio and the primary surplus in the regression equation as:

$$s_t = \rho.d_t + \alpha.z_t + \varepsilon_t = \rho.d_t + \mu_t \qquad (6.3)$$

Where, z_t is a set of other determinants of the primary surplus, ε_t an error term, and, $\mu_t = \alpha.z_t + \varepsilon_t$. Further, Bohn (1998) argues that the regression equation (6.3) omits other determinants of the primary surplus and it will leads to inconsistent estimates. So, the model for the surplus-GNP ratio is:

$$s_t = \rho.d_t + \alpha_0 + \alpha_G.GVAR_t + \alpha_Y.YVAR_t + \varepsilon_t \qquad (6.4)$$

Where, GVAR= temporary government spending and YVAR= business cycle indicators.

Finally, Bohn (1998) propose an empirical model as:

$$\Delta d_{t+1} = d_{t+1} - d_t = -[1 - x_{t+1}.(1 - \rho)].d_t - x_{t+1}.\mu_t \qquad 6.5)$$

The equation (6.5) simply implies that change in the debt-GDP ratio which depends on the lagged level and on the non-debt components of the primary surplus.

The empirical validity of the Bohn test has been estimated in the literature, such as Gali and Perotti (2003), IMF (2003), Debrun et al. (2008), Mendoza and Ostry (2003) and Debru and Kinda (2013), show the solvency of public debt in fixed effect panel regression method. Similarly, this chapter tested the burden of public debt for India by using the augmented Bohn (1998) test through structural vector auto regressive (SVAR) framework which is explained in equation (6.7). We augment the Bohn (1998) hypothesis by including the additional key variables such as interest payment, development expenditure and output gap. The reason for using the SVAR method over regression analysis as used by Bohn (1998) is to remove the endogeneity problem present in the model. It is because both public debt and primary deficit are interrelated to each other. This chapter takes interest payment, development expenditure and output gap in the Bohn (1998) equation. It is because, if the country is depended on high public debt today, it is also required to pay high interest payment tomorrow. Thus, this interest payment bear by the government can be treated as the burden for the country. The possibility of having the burden of interest payment in the developing country like India causes heavy discount in the future consumption and savings. This is simply because the government of India is heavily dependent on short term debt. The present statistics shows that the central government of India borrows approximately 78 percent of marketable securities as a share of total internal debt in the year 2012, and the average weighted maturity period is less than 10 years. Therefore, the government can either reduce the expenditure or can raise the tax revenue for reducing the pressure of interest payment burden. But, in every possibility this can cause real burden on the economy. Hence, this chapter included the interest payment in the augmented Bohn (1998) test. Further, we included the share of development expenditure as a percentage of GDP in the model, the reason behind this is that if the country is heavily dependent on

public debt and spend on development expenditure, it may not create any debt burden for country. Subsequently, the gross primary deficit of the country can be declined as the development expenditure contributes to the increase in the total revenue of the government. This study also included the output gap into our model. This output gap can be able to trace the proper judgement between output gap, public debt, and primary deficit of the country.

On the basis of this theoretical argument, public debt and primary deficit nexus can be specified as:

$$gpd_t = f(pd_t, ip_t, devt_t, og_t) \quad (6.6)$$

where, the variables gpd_t, pd_t, ip_t, $devt_t$ and og_t denote primary deficit, public debt, interest payment, development expenditure, and output gap, respectively. The theoretical literature predicts that the public debt is positively related to primary deficit, and there is ambiguous relation between interest payment and output gap with primary deficit. It is also predicted that the relation between public debt and interest payment is positive. It is natural that if the government borrows more funds then it bears high interest payment. Similarly, the relation between public debt and development expenditure is ambiguous. It is because whether the borrowed fund is used for productive purposes or unproductive purposes needs to be analyzed. This chapter frames these dynamic relationships among the variables by using SVAR framework.

$$\begin{aligned}
e_t^{gpd} &= b_{gpd}^{pd} e_t^{pd} + b_{gpd}^{ip} e_t^{ip} + a_{gpd}^{og} \mu_t^{gpd} + \mu_t^{gpd} \\
e_t^{pd} &= a_{pd}^{ip} \mu_t^{ip} + \mu_t^{pd} \\
e_t^{ip} &= a_{ip}^{gpd} \mu_t^{gpd} + a_{ip}^{pd} \mu_t^{pd} + \mu_t^{ip} \\
e_t^{devt} &= b_{devt}^{pd} e_t^{pd} + a_{devt}^{ip} \mu_t^{ip} + \mu_t^{devt} \\
e_t^{og} &= a_{og}^{pd} \mu_t^{pd} + \mu_t^{og}
\end{aligned} \quad (6.7)$$

Where, the coefficient b_{gpd}^{pd} stands for the response of gross primary deficit (gpd) because of the structural shock of public debt (pd), b_{gpd}^{ip} stands for the response of gross primary deficit because of the structural shock of interest payment (ip), b_{devt}^{pd} stands for the response of developmental expenditure because of the structural shock of public debt and the coefficient a_{gpd}^{og} stands for the response of gross primary deficit because of the unexpected shock of output gap, a_{ip}^{gpd} stands for the response of interest payment because of the unexpected shock of gross primary deficit, a_{pd}^{ip} stands for the response of public debt because of the unexpected shock of interest payment. Similarly, a_{ip}^{pd}, a_{og}^{pd}, and a_{devt}^{ip} represent the response of interest payment, output gap, and development expenditure resulting from the unexpected shock of public debt and interest payment. $e_t^{gpd}, e_t^{pd}, e_t^{ip}$, e_t^{devt} and e_t^{og} from the corresponding equations are the residuals of the structural disturbance, and $\mu_t^{gpd}, \mu_t^{pd}, \mu_t^{ip}$, μ_t^{devt} and μ_t^{og} are the reduced form of VAR namely gross primary deficit, public debt, interest payment, development expenditure and output gap, respectively.

6.2.1. SVAR Method

The identification of the structural shock in a VAR model is the first question in a SVAR model. As pointed out by Gvay and Pelgrin (2006) that the estimation of SVAR model can proceed even if the variables are non-stationary at level series. Further, Sims, Stock and Watson (1990) shows that the estimated coefficient from VAR is consistent and asymptotic distribution with a case of non-stationary variables. But, a number of issues related to the SVAR method need to be addressed:

i. What type of restriction should be imposed for the model?
ii. Which variables should be included in a model?
iii. What are the optimal lag selection criteria for the model?

Therefore, in order to the explain SVAR model more detail, we assume that the economy is described by a structural form equation i.e.:

$$A(L)Y_t = e_t \qquad (6.8)$$

Where, A (L) is a matrix of polynomial in the lag operator L, $Y_t = (Y_{1t}', Y_{2t}')'$ is an $(n_1 + n_2) \times 1$ data vector (i.e. $n_1 + n_2 = n$) and e_t is $n \times 1$ structural disturbance. It is known that the structural vector e_t is serially uncorrelated and $V(e_t) = \Delta$, where Δ is a diagonal matrix. So that the vector of e_t are mutually uncorrelated. Since, the structural parameter from the structural shock is not estimable, hence we estimate the model through the reduced form of VAR model. Thus, The VAR (p) model in its standard form is expressed as:

$$Y_t = B^* X_t' + e_t' \qquad (6.9)$$

with $B^* = \beta$, Y_t being a (5×1) vector of the three endogenous variables, where X_t is the lagged of the endogenous variables and e_t' is the (5×1) vector. In the reduced VAR model the shock to one variable affect to all other variables and hence it is difficult to assess the particular shock to other variables. Therefore this study uses the structural VAR model to show the structural shock. The main purpose of structural VAR estimation is to obtain non-recursive orthogolization of the error terms for impulse response analysis. Let y_t be a kth element vector of the endogenous variables and $\sum = E [e\ e'_t]$ be the residual covariance matrix; then the class of structural VAR model that is estimated can be written as:

$$A\ e_t = B\ u_t \qquad (6.10)$$

$$e_t = A^{-1}Bu_t \qquad (6.11)$$

Where e_t and u_t are vectors of structural shocks and VAR residuals respectively, A and B are kth matrices that set the linear relationship between structural shocks and the VAR residuals. The structural innovation e_t is assumed to be orthonormal, i.e., its covariance matrix is an identity matrix, $E[e_t e_t^{'}] = I$.

6.3. Data Sources and Measurement of Variables

This chapter uses the annual data covering the period between 1970 and 2013 to analyze the burden of public debt in the case of India. The output gap (og_t) is calculated with the difference between actual output and potential output. The annual percentage of gross domestic product at factor cost at constant price is defined as the actual output. The potential output is calculated with the Hodrick –Prescott (HP) filter. Technically, the Hodrick–Prescott (HP) filter is a two-sided linear filter that computes the smoothed series s of y by minimizing the variance of y around s, and subjecting it to a penalty that constrains the second difference of s. Thus, the HP filter chooses s to minimize:

$$\sum_{t=1}^{T} (y_t - s_t)^2 + \lambda \sum_{t=2}^{T-1} \left((s_{t-1} - s_t) - (s_t - s_{t-1}) \right)^2 \qquad (6.12)$$

The penalty parameter λ controls the smoothness of the series σ. Therefore, the larger λ leads to the smoother σ. As $\lambda = \infty$, s tends to liner trend.

The data on percentage of total liabilities to GDP included both external and internal liabilities that are taken as proxy for percentage of public debt (pd) to GDP ratio. This chapter takes the data of the gross primary deficit (gpd) as percentage of GDP. The data of interest payment (ip) as a percentage of GDP is calculated as the difference between gross fiscal deficit and gross primary deficit as a share of GDP. All these data are collected from the database on Indian economy published by

Reserve Bank of India (RBI), and the development expenditure as a share of GDP is collected from various issue of economic survey.

6.4. Empirical Results

Before conducting any empirical tests to show the burden of public debt, we presented preliminary analysis with the help of Figures 6.1 and 6.2. In a simple sense, public debt which includes both internal and external debt carries burden on the economy. It is because government has to repay both principal amounts as well as interest payment in the future. Therefore, in the beginning of this chapter, the burden of public debt is traced with the help of plotting the behaviour of growth rate of public debt, economic growth, and interest payments for India.

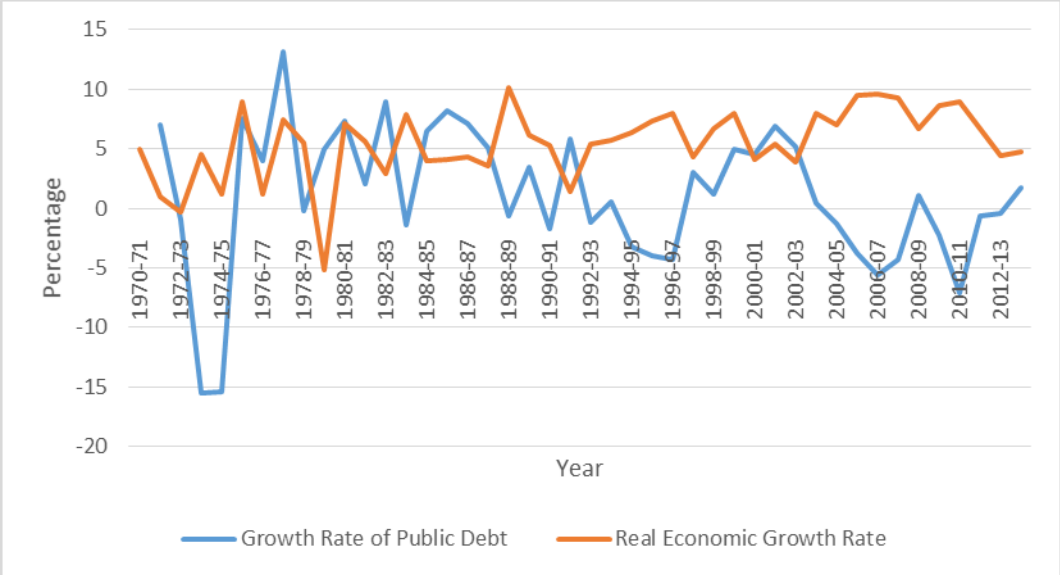


Figure 6.1: Growth Rate of Public Debt and Economic Growth

Source: Handbook of Statistics Published by RBI

The Figure 6.1 clearly shows that as the growth rate of public debt moves upward then real economic growth fall accordingly. These two lines move towards

converging together from 2007-08 to 2013-14. Consequently, the study observes a negative correlation between the growth rate of public debt and economic growth. Hence, this shows that the growth rate of public debt creates burden for the economy as it declines the real economic growth. Similarly, we presented the behaviour of growth rate of interest payment and economic growth in the Figure 6.2. This figure also converges with the growth of interest payment to real economic growth. Further, we also observe a negative correlation between the growth rate of interest payment and economic growth. This implies that both the growth of public debt and interest payment create burden for the Indian economy.

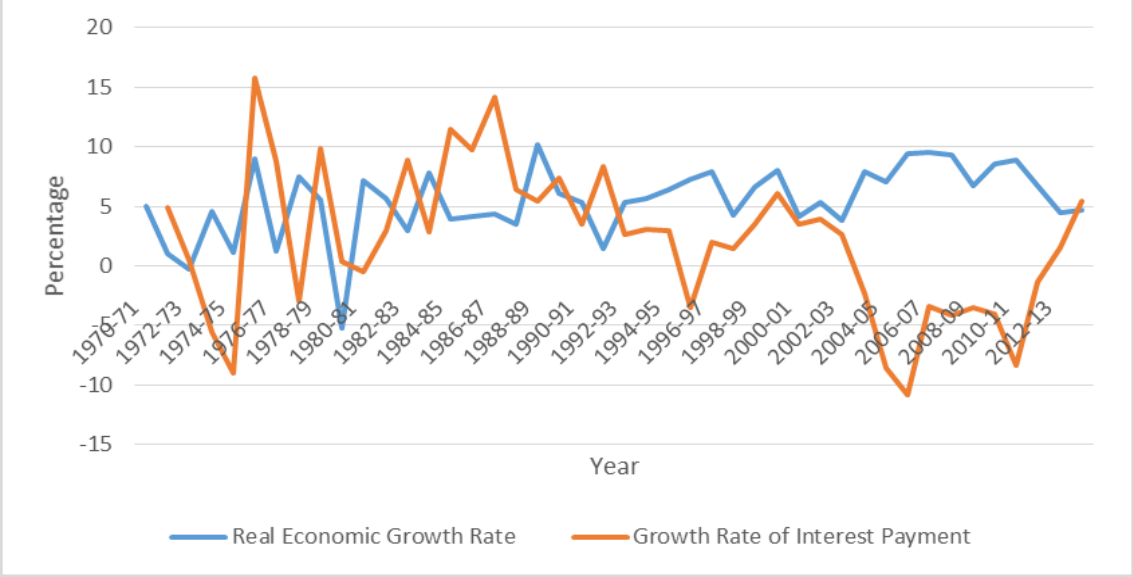


Figure 6.2: Growth Rate of Interest Payment and Economic Growth

Source: Handbook of Statistics Published by RBI

After observing initial indication about the burdens of public debt through preliminary graphs, in the next steps we examined the stationary property of all variables. The standard Augmented Dicky Fuller (ADF) test (Dicky and Fuller, 1979) was used to test the presence of unit root for gross primary deficit as a percentage of GDP (gpd), public debt to GDP ratio (pd), public debt (pd_t) interest payment as a percentage of GDP (ip), development expenditure as a percentage of

GDP ($devt_t$), and output gap (og_t). The result from ADF test shows that the null hypothesis of the presence of unit root is rejected for all the three variables except development expenditure ($devt_t$), output gap (og_t). Thus, gpd_t, pd_t, and ip_t are found to be I (1), and the series are stationary at the first order difference, that is, $devt_t$, and og_t are I (0).

Table 6.1: Result of Unit Root Test

Variable	Level	1st Order Difference	Inference on Integration
gpd_t	-2.61 (0.27)	-5.98 (0.00)	I (1)
pd_t	-1.89 (0.52)	-4.00 (0.01)	I (1)
$devt_t$	-3.28 (0.08)	------	I (0)
ip_t	-1.49 (0.28)	-2.88 (0.05)	I (1)
og_t	-8.43 (0.00)	------	I (0)

Note: Figure in parentheses are p-value; gpd_t = gross primary deficit, pd_t = public debt; ipt = interest payment, $devt_t$ = development expenditure, and og_t = output gap.

In the subsequent step, the optimum lag selection criteria are implemented through VAR model by following AIC, SC and HQ criteria. These criteria suggested that lag 3 is the optimum and VAR follows the stability condition. It indicates that there is no roots of the polynomial are outside of the unit circle and hence can be concluded that VAR satisfy the stability condition in the model. The result of optimum lag selection criteria is presented in Table 6.2.

Table 6.2: Result of Optimum Lag Selection Criteria

Lag	LR	FPE	AIC	SC	HQ
0	NA	19.36	17.15	17.36	17.22
1	92.44	4.29	15.63	16.91*	16.09
2	37.75	4.29	15.56	17.91	16.40
3	46.78*	2.41*	14.81*	18.22	16.03*
4	21.63	3.82	14.89	19.37	16.50

Note: * indicates lag order selected by the criterion of LR, Final Prediction Error (FPE), Akaike Information Criterion (AIC), Schwarz information criterion (SC), and Hannan-Quinn information criterion (HQ) (each test at 5% level).

In the next step, this chapter illustrated the dynamic relation among these variables in a structural VAR framework, and the results are presented in Table 6.3. The results exemplify that the response of interest payment is significantly positive because of the unexpected shock of gross primary deficit. This indicates that higher level of deficit leads to higher pressure of interest payment. Hence, the pressure of gross primary deficit leads to increase in the interest payment. As a result, it creates the monetary burden for the country. Similarly, the study observed a significant positive response to the interest payment because of the unexpected shock of public debt, that is, a one percent increase in public debt leads to 0.29 percent increase in interest payment. Therefore, it is always better to avoid the public debt as it involves the interest payment, and this interest payment is positively significant and is responding to the public debt in case of India. Hence, it shows that the public debt is a burden for India. The response of output gap because of the unexpected shock of public debt is insignificantly affecting each other. The results also show that the response of public debt is negatively significant and is affecting because of the unexpected shock of interest payment. It means higher interest payment leads to lower public debt. Further, the results show significantly negative response to the development expenditure because of the unexpected shock of interest payment. It indicates that higher interest payment leads to decline in the development expenditure. That means government is cutting the revenue from developmental expenditure for repaying the interest payment of public debt. This result clearly indicates that the interest payment of the public debt is a burden for India.

Table 6.3: Structural VAR Parameter Estimates

Parameter	Coefficient	Std. Error	P-Value
$a_{ip_t}^{gpd_t}$	0.40***	0.13	0.00
$a_{ip_t}^{pd_t}$	0.29***	0.06	0.00
$a_{og_t}^{pd_t}$	0.004	0.08	0.96
$a_{pd_t}^{ip_t}$	-7.50***	0.61	0.00
$a_{devt_t}^{ip_t}$	-2.13***	0.61	0.00
$a_{gpd_t}^{og_t}$	0.05	0.17	0.76
$b_{gpd_t}^{pd_t}$	-0.06	0.17	0.69
$b_{devt_t}^{pd_t}$	0.22	0.16	0.17
$b_{gpd_t}^{ip_t}$	0.65***	0.24	0.00

Note: Author's own calculation; gpd_t = gross primary deficit, pd_t = public debt, ip_t = interest payment, og_t = output gap and $devt_t$ = development expenditure; *** indicates 1 percent level of significance.

Further, the results show significantly positive response to gross primary deficit due to structural shock of interest payment. This indicates that the pressure of interest payment is widening the gross primary deficit of India. Hence, the chapter concluded that the pressure of interest payment of the public debt declines the developmental expenditure and increases the gross primary deficit which is really a burden for developing countries like India. The study detected an insignificant result from the response of gross primary deficit because of the structural shock of public debt and the response development expenditure due to structural shock of public debt. Finally, the results show an insignificant response to gross primary deficit because of the unexpected shock of output gap. This insignificant result of the response to gross primary deficit owing to the structural shock of public debt is rejecting the views of Bohn (1998) test for India. Bohn (1998) say's that there is a positive correlation between debt-to-GDP ratio and the primary deficit can be interpreted as solvency of public debt. The findings also can be interpreted as public debt which is a burden for a country as developmental expenditure is responding because of the structural shock of public debt. This means public debt does not play

significant role in raising the developmental expenditure of the country. As the public debt to GDP ratio does not play a significant role in contributing towards the developmental expenditure, therefore, it can be interpreted as the burden for the country. It is because the repayment of both principle and interest payment for the government can be burden, and hence there is possibility of raising new types of borrowing in order to meet this unproductive expenditures. Thus, vicious circles of borrowing for the government can hamper people's willingness to save as well as to invest. The Ministry of Finance, Government of India (2013-14) report stated that the dated securities which are commonly known as market loans. This constitutes most of the significant component of instruments which are used for financing the fiscal deficit of the central government. As at the end March 2013, the central government of India borrows 91.42 percent of total marketable loans from the dated securities and the rest amount is borrowed from treasury bills (Government Debt Status paper, 2013). Thus, the level of public debt to GDP ratio creates a real burden on the society.

Similarly, the impulse response function for the relation between gross primary deficit, public debt, interest payment, developmental expenditure and output gap are plotted in Figures 6.3 to 6.22. This chapter considers the impulse response function prior to 10 years' time period. We began with the results on the impact of a shock in public debt on gross primary deficit. The results demonstrated that the shock of public debt has statistically significant effect on gross primary deficit over the entire 10 years period. This figure shows that the shock of public debt responded positively in the beginning of the period and then moved downward and also responded negatively for three to three and half years' time period and then followed the upward trend. This mix type of movement of the gross primary deficit prior to 10 years period is because of the shock of public debt clearly shows that the prediction of gross primary deficit is difficult because of the shock of public debt in the longer time horizon. In Figure 6.4, it shows that the shock of interest payment has

significant effect on gross primary deficit. The effect is both positive and negative. It is observed from the figure that the response of gross primary deficit is positive in the beginning of the period, and then it became negative in most of the period because of the shock of gross primary deficit. The Figure 6.5 shows that the response of gross primary deficit caused by the shock of development expenditure. This figure says that the response of gross primary deficit is significantly negative in the 10 period horizons because of the shock of development expenditure. The Figure 6.6 shows that the response of gross primary deficit is because of the shock of output gap in the next 10 period horizons, but the findings are statistically insignificant. The response of public debt because of the shock of gross primary deficit is presented in Figure 6.7. This figure shows that the response of public debt is significantly negative in the beginning of the period and then it moves upward and becomes positive because of the shock of gross primary deficit in the next 10^{th} period horizon. The Figure 6.8 observes that the response of public debt is positive in the beginning of the period and then it becomes insignificant because of the shock of interest payment. The Figure 6.9 shows the response of public debt to be significant and positive in the beginning of the period and then it becomes negative after the fourth period and finally it converges in the ninth period of the horizon because of the shock of development expenditure. The response of public debt is statistically significant because of the shock of output gap which is presented in Figure 6.10. This figure shows that the response of public debt is negative in the beginning period, and then it moves towards the positive side and further moves to the negative after the sixth period, and finally it converges in the last part of ninth period. Similarly, in Figure 6.11, it shows that the response of interest payment is significantly positive for most of the period because of the shock of gross primary deficit. This predicts that higher gross primary deficit implies higher interest payment in the next 10^{th} year horizon. The Figure 6.12 shows that the response of interest payment is significantly negative in the beginning of the period, and it then

moves towards the upward direction from the fourth period, and finally it becomes positive in the last part of ninth period caused by the shock of public debt.

Fig. 6.3: Response of GPD due to shock of PD

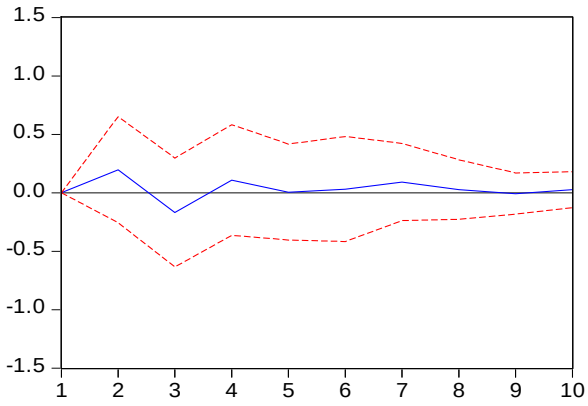


Fig.6.4: Response of GPD due to shock of IP

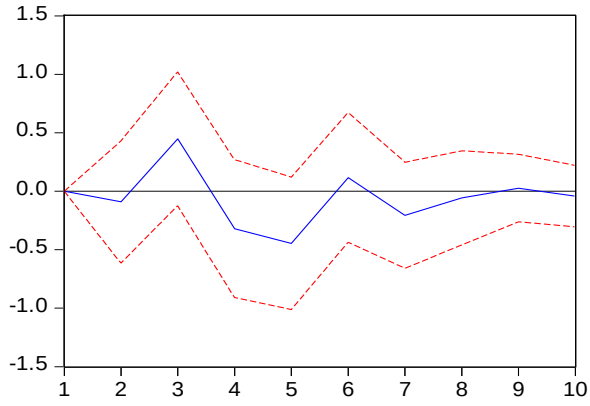


Fig.6.5: Response of GPD due to shock of DEVEXP

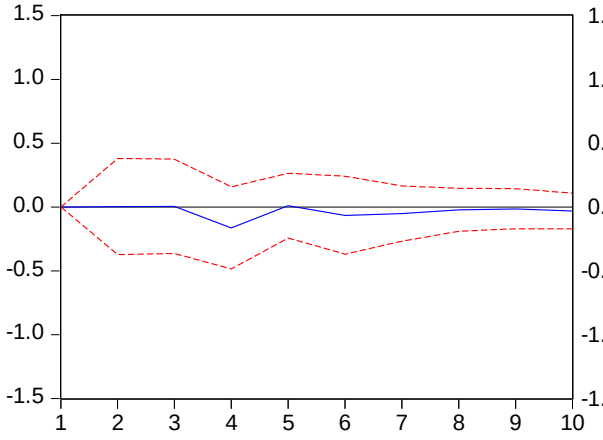


Fig.6.6: Response of GPD due to shock of OG

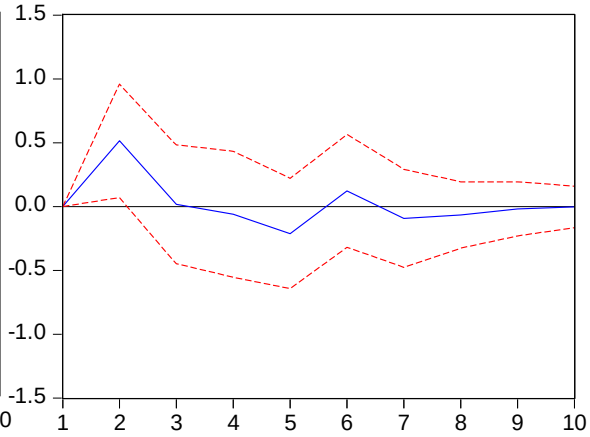


Fig.6.7: Response of PD due to shock of GPD

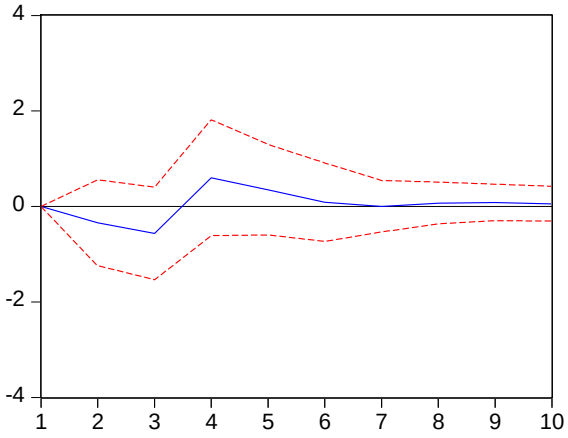


Fig.6.8: Response of PD due to shock of IP

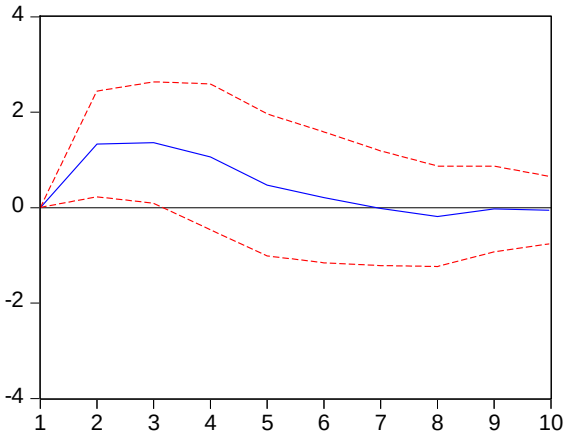


Fig.:6.9: Response of PD due to shock of DEVEXP

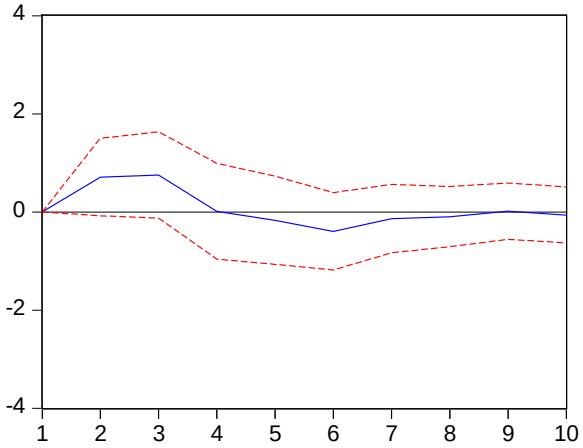


Fig.6.10: Response of PD due to shock of OG

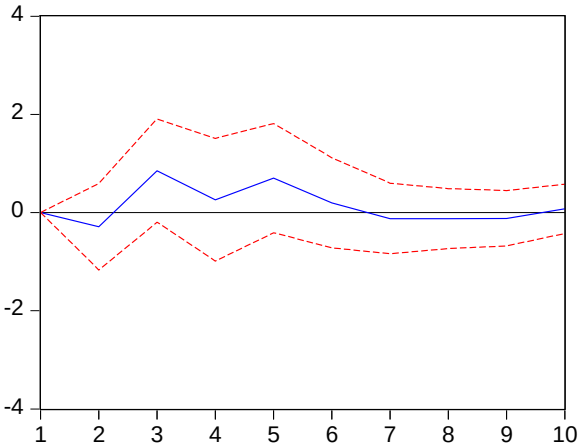


Fig.6.11: Response of IP due to shock of GPD

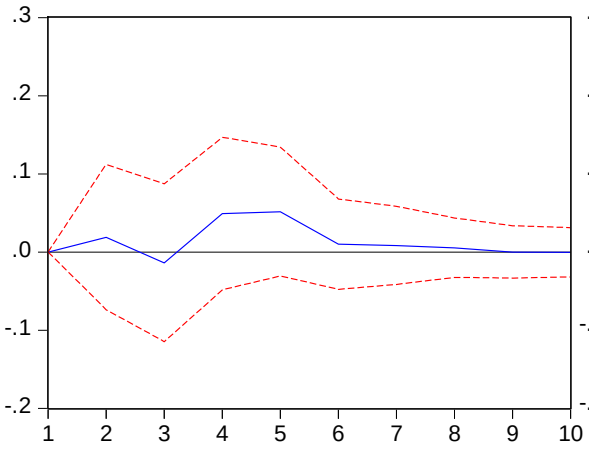


Fig. 6.12: Response of IP due to shock of PD

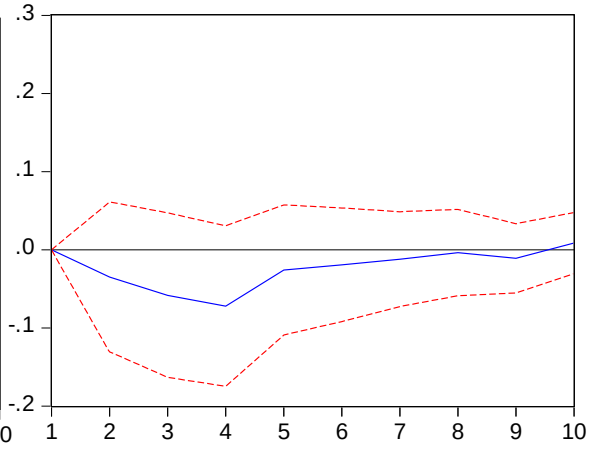


Fig. 6.13: Response of IP due to shock of DEVEXP

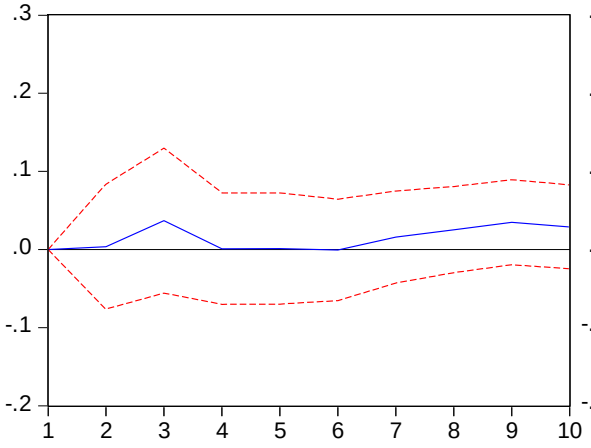


Fig. 6.14: Response of IP due to shock of OG

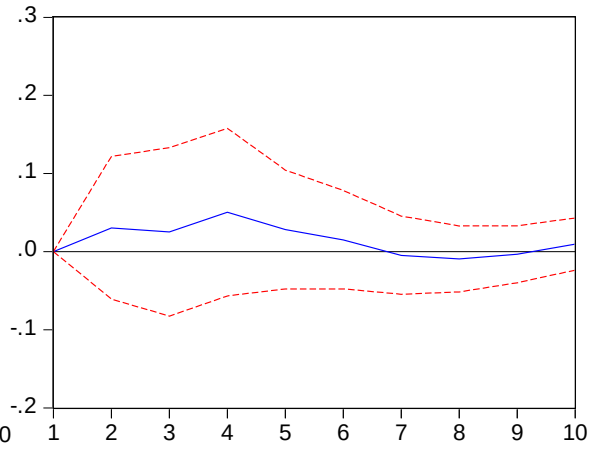
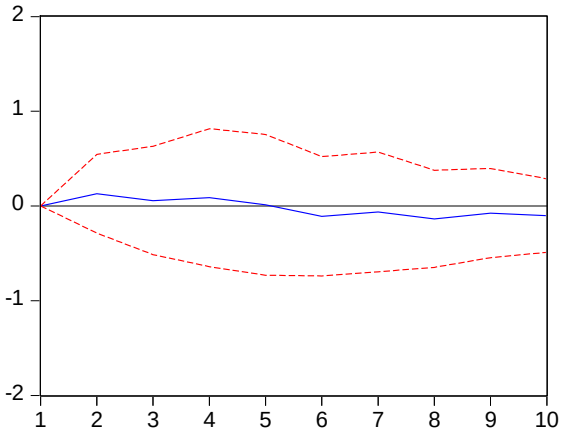


Fig. 6.15: Response of DEVEXP due to shock of GPD



Fig, 6.16: Response of DEVEXP due to shock of PD

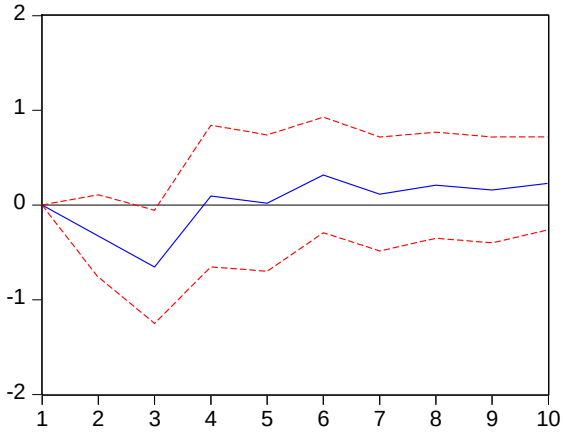


Fig.6.17: Response of DEVEXP due to shock of IP

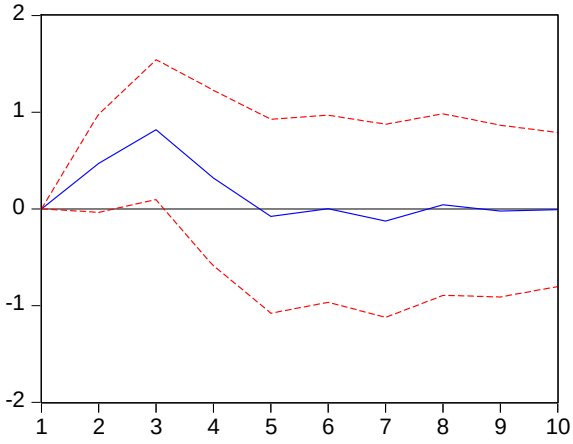


Fig.6.18: Response of DEVEXP due to shock of OG

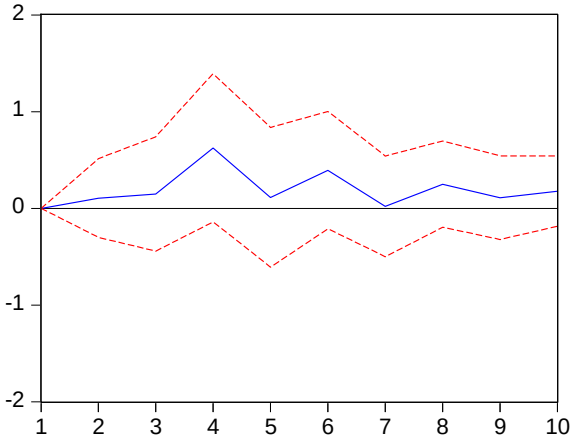


Fig.6.19: Response of OG due to shock of GPD

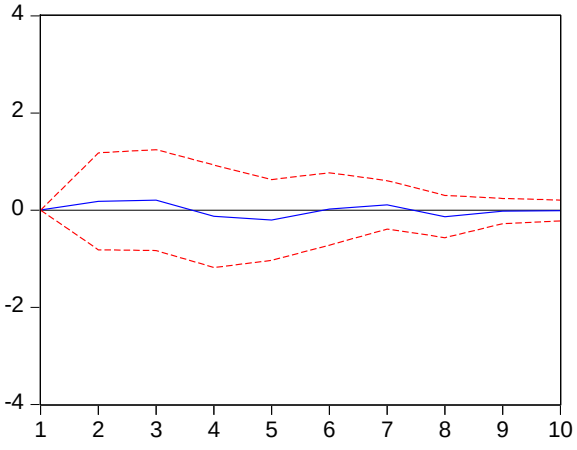


Fig. 6.20: Response of OG due to shock of PD

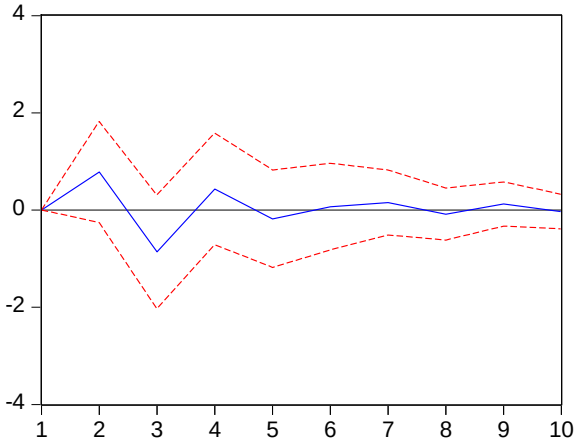


Fig. 6.21: Response of OG due to shock of IP

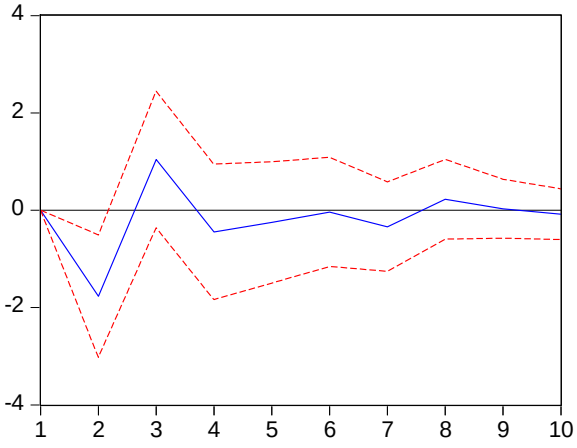
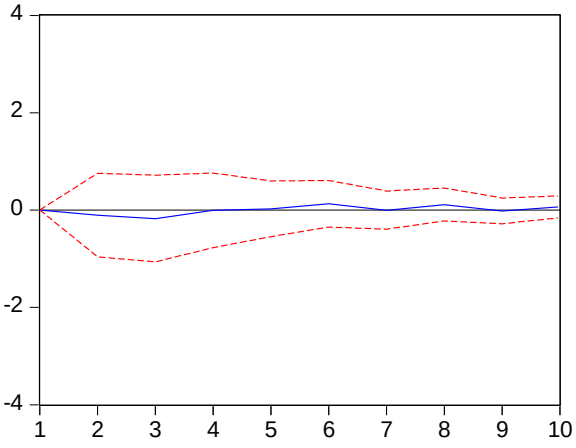


Fig. 6.22: Response of OG due to shock of DEVEXP



The Figure 6.13 shows the response of interest payment which is significantly showing positive because of the shock of developmental expenditure in the 10th period horizon. The response of interest payment because of the shock of output gap is presented in Figure 6.14 which is significantly positive up to the seventh period and then it moves towards the negative direction up to the last part of the ninth period after which it moves upwards. The Figure 6.15 shows that the response of development expenditure is statistically significant and is positive up to fifth period

and then it moves towards negative direction because of the shock of gross primary deficit. The response of development expenditure shows statistically significant and is negative up to the third period and it becomes insignificant because of the shock of public debt which is presented in Figure 6.16. Finally, Figure 6.17 shows that the response of development expenditure is statically insignificant because of the shock of interest payment The Figure 6.18 illustrates a positive response towards developmental expenditure because of the shock of output gap in the entire 10^{th} period. The response of output gap because of the shock of gross primary deficit, public debt, interest payment and development expenditure are presented in Figures 6.19, 6.20, 6.21, and 6.22, respectively.

6.5. Conclusions

The chapter estimated the burden of public debt by using the fiscal reaction function of augmented Bohn (1998) and investigate the relation between gross primary deficits, public debt, interest payment, development expenditure and output gap. Using SVAR framework, this study observed a positive response of interest payment due to shock of gross primary deficit. This leads to widening the interest payment. Similarly, the results concluded that higher level of public debt leads to high level of interest payment. Therefore, this creates monetary burden for the Indian economy. Further, this chapter concluded that the shock of interest payment is negatively affect the development expenditure. This implies that government spends heavily on non-developmental expenditure, which in turn reduces the developmental expenditures. Thus, the level of public debt bearing interest payment leads to the accumulation of the burden of the country. Lastly, this chapter rejected the Bohn's hypothesis which stated that a positive correlation can be observed between public debt and gross primary deficit, but the empirical findings of this chapter do not get any significant relation between public debt and gross primary deficit. Thus, this chapter concludes

that public debt is insolvent in the case of India. In the final step, this study presents a 10^{th} step ahead forecast horizon with the help of impulse response function.

The major policy implication can be derived from this chapter are explained here. First, it suggested to policy makers to focus in the area of public debt and implement a suitable debt management policy, so that higher economic growth can be achievable. Second, the increasing rate of interest payment can be one reason to raise short term debt, and hence raises the marketable loan of the country in the recent years. It might be one of the reasons for raising the interest rate as the total saving of the economy is reduced and may leads to crowding out the private investment, and thereby affecting the economic growth. Based on the empirical results, this chapter suggested taking certain attention to the policy maker for reducing high level of interest payment. Finally, it is suggested that the government can utilize the level of public debt in the developmental expenditure, so that the repayment of principal as well as interest payment can be easier in the future.

Chapter VII
Conclusions and Policy Implications

7.1. Summary

The continuous rise in government spending widens the gap of fiscal deficit, and thereby forces the government to depend on public debt from both internal as well as external sources. Though the Indian government tries hard to reduce the fiscal deficit through promoting FDI and disinvestment, sustaining a lower fiscal deficit becomes challenging mainly due to high subsidies on food and fertilizer. The economic consequences of high fiscal deficits results in heavy public debt during post-reform periods, which is likely to affect the economic growth of the nation. On the other hand, the reduction in economic growth poses challenge in reducing the public debt as a percentage to GDP. Through the preliminary results obtained from chapter three indicated a positive relationship between public debt and economic growth, but the interest payment as percentage to GDP has been increasing over the years.

Bulk of the studies in India found that higher public debt negatively affects the economic growth. A chunk of other studies also concluded that the Indian public debt is at sustainable position. The novelty of the present thesis can be highlighted in three ways. First, there is hardly any study in India which examines the non-linear relationship between public debt and economic growth. The trends in public debt and economic growth from 1970-71 to 2013-14 show an oscillatory pattern, which motivated us to examine the non-linear relationship between debt and growth. Second, this thesis not only examined the non-linear relationship between public debt and economic growth but also made an attempt to identify the key channels through which debt can affect the economic growth. Based on the review literature, we considered private saving, household saving, public investment and total factor

productivity channels. Theoretically, public debt could affect private saving either positively or negatively. If public debt of a country increases then countries like India where the government borrow heavily from the internal sources, as a result long-term interest rate will increase, which motivates the private to save more. But if the increased public debt resulted in raising the tax rate of the government then it reduces the private savings. Theoretically, higher level of public debt would reduce the total gross investment of any nation through crowding out effect. Most of the developing countries raise their public debt in order to increase the gross fixed capital formation by spending on productive expenditure, which increase the total factor productivity in the short-run. But in the long-run if public debt increases continuously then it will have the detrimental effect on total factor productivity. Second novelty of this thesis is related to calculating the optimum debt for India. Though the Governor of the Reserve Bank of India recently made a statement that India is safe as far as public debt is concerned, but there is hardly any study which tells up to what level of public debt to GDP, India is at comfortable zone. In other way, if India targets to achieve 8 to 10 percent growth, then what should be the optimum level of public debt? We made an attempt to fill the research gap. Third, even if the countries combined central and states debt are around 70 percent to GDP, is it creating a burden for society. This study tried to answer this question by measuring the debt burden.

The study used annual data covering the period from1970-71 to 2013-14. The results derived from 2SLS and OLS method concluded that the public debt is positively affecting the economic growth in the short run, but shows a negative relation in the long run. Further, the study found the existence of a non-linear impact of public debt on economic growth. The study also observed that the channels, such as household savings, public investment, and total factor productivity, are through which public debt significantly affect the economic growth. Subsequently, the results of the optimum level of public debt for India derived from ARDL method concluded

that the economic growth, real interest rate, and gross fiscal deficit are significantly determined in influencing the public debt of India, whereas other key variables like financial depth, current account deficit, exchange rate misalignment, and government size have no significant effect. In order to find out the optimum level of public debt, the study used genetic algorithm (GA) approach and the results indicated that the optimum debt of India ranges between 61–64% of GDP, beyond which it might have an adverse impact on the economy. Finally, this study examined the burden of public debt, and the results derived from structural vector autoregressive (SVAR) model concluded that the public debt and the rising level of interest payment are burden for the economy of India. The results that the public debt is likely to affect the allocation as well as distribution of resources and stabilization function of the government. The decision taken by the government to allocate and distribute public debt necessarily affects both present and future generation.

7.2. Summary of the Trends, Composition, and Structure of India's Public Debt

The combined central and states debt have significantly increased from 44.50 percent at the end of March 1970 to 66.24 percent of GDP at the end of March 2013. Although the share of external debt declined from the end of March 1980 to the end March of 2013, the share of internal debt at the centre was substantially rising from 78.23 percent to 93.51 percent from the end of March 1980 to 2013, respectively (Database on Indian Economy published by RBI). The share of internal debt to total public debt is a sizeable portion of the central government debt. This chapter further classified the internal debt into three categories, which are marketable debt, non-marketable debt, and other debt. Among them, it shows that the share of marketable securities to total internal debt is approximately 78 percent and the rest constitute of non-marketable and other debt in the year 2012. Further, this chapter discusses the components of marketable securities which consist of dated securities and treasury

bills. It shows that approximately 91 percentages of total marketable loans is borrowed from dated securities, and the rests are from treasury bills.

As per the sovereign external debt is concerned which shows decline trend, the contribution to total public debt of India cannot be ignored. So, this chapter shows that the share of commercial borrowings in total external debt increased from 19.29 percent in the year 2004 to 34.26 percent at the end of March 2013. The share of multilateral debt is also a major source of external debt in India. It shows that the share of IDA is the major components of total multilateral sovereign debt. In case of bilateral debt for India, this chapter pointed out that Japan is the major creditor countries followed by Germany, Russia, USA and France. Although India's external debt declared by International debt statistics to be less vulnerable in 2014, it stands third largest debtor countries after China and Brazil among the most developing countries.

With related to debt service payment, each and every government has to repay the public debt amount with interest payment within the maturity period of the loan. In this contest, Taylor (1970) defined public debt as "The debt is in the form of promised by the treasury to pay to the holders of these promises a principle sum and in most instances interest on that principle". Therefore, it is always advisable by the policy makers to clear the debt amount as soon as possible, because public debt creates demoralizing effects on the people. A higher amount of public debt to GDP ratio can possibly affect the willingness to work, save and invest in the future. So, this chapter concluded that the public debt can have both monetary burden and real burden to the society. It generally depends on the government to manage the procedures of the loan to invest either in productive or unproductive purposes. Further, the analysis of the trend and composition of public debt found that the public debt does have both revenue as well as consumption expenditure effects. It is

because, in the first place public debt raise the money, and thereby, creates inflationary situation in the economy.

7.3. Summary of the Impact of Public Debt on Economic Growth and its Channels

The aim of this chapter is to investigate the impact of public debt on economic growth and through which channels public debt affects the economic growth. First, the study examined whether public debt has any non-linear impact on economic growth or not. Second, this chapter explored the key channels through which public debt non-linearly associated with economic growth. To examine both the objectives, the present paper uses both 2SLS and OLS techniques using annual data spreading from 1970 to 2013. The results derived from 2SLS method support the existence of non-linear relations between public debt and economic growth. After identifying the non-linear relationship between public debt and economic growth, in the second stage, this chapter tried to explore the channels through which public debt could affect the economic growth non-linearly. The present chapter recognizes from theoretical literature that four channels, viz. private saving, public investment, household saving and total factor productivity, can be influenced by public debt, thereby, affecting the economic growth. The study further calculated the channels through which public debt affects the economic growth by using OLS method. It is, therefore, the results of each key channel that were derived from OLS method separately. First, the results implied that the coefficients of public debt and square of public debt were not statistically significant, and hence, public debt does not have any impact on private saving. However, there are other control variables such as economic growth, domestic credit to private sector and openness that affect the private saving. Second, the results of other three channels showed a non-linear impact of public debt on economic growth. Further, the results demonstrated that public debt positively affects public investment, household saving and total factor

productivity up to a certain threshold level, beyond which it follows the negative path. Thus, an inverted 'U' shaped curved are observed between public debt and the channels, such as public investment, household saving and total factor productivity. By looking through the channel of public investment, this chapter found that the financial depth positively affects and real interest rate negatively affects public investment. Similarly, in case of household saving channel, apart from public debt, the other variables like economic growth and the financial depth positively affect the household saving, whereas, domestic credit to private sector and the tax rate have statistically significant negative impact on household saving. Finally, the results of TFP channel revealed that apart from public debt and square of public debt, the economic growth does positively affect the productivity.

Further to check the robustness of the OLS method, this chapter estimated the Wald test to know the existence of long run relation between the public debt and the channels, such as private saving, public investment, household saving, and total factor productivity. Those results clearly rejected the null hypothesis of no long run relation among them at 1% level of significance. In addition to Wald test, this chapter also conducted the Ljung Box Q statistics for the standardized residuals, which test the presence of autocorrelation in the residuals. The results showed there is absence of serial correlation in the equation at different lag order. Lastly, ARCH LM test was conducted to check the heteroscedasticity, and the values indicated the absence of heteroscedasticity.

7.4. Summary of the Optimum Level of Public Debt

This chapter attempted to estimate the optimum level of public debt for India by identifying the key factors that affect the public debt of India. The determinants of public debt were estimated using the ARDL model. The results derived from long run elasticity of ARDL model showed that economic growth has a significant

negative effect on public debt in India. Similarly, the real interest rate and gross fiscal deficit positively determined the public debt of India. The findings of the chapter corroborated with *a priori* information. Finally, the chapter estimated the error correction representation of the ARDL model which comprises the short-run parameters and speed-of-adjustment term. The results of the error correction model presented that the negative sign and significance of the error term confirms that the series is non-explosive and there exists a stable long-run relationship among the variables. The coefficient of the error correction term shows the speed at which the endogenous variables adjust to changes in the equilibrium level and *ECM* (-1) term suggests adjustment to equilibrium takes place after one year. Further, the results revealed that in the short-run economic growth negatively affects the public debt, while gross fiscal deficit has positive effect on public debt of India. To check the robustness of the model, the stability of the regression coefficient is tested through CUSUM and square of CUSUM test and the plots showing a stability condition is satisfied as the plot did not exceed the 5% level of significance.

The results derived from Genetic Algorithm optimization technique confirmed at the cross over probability of 0.7 level that the optimum value of public debt is 62.25% of GDP. The optimum value converges at the 98^{th} generation. To check for robustness, the model was further re-estimated using GA by taking the crossover probability value of 0.8 and 0.9, respectively. The results show that the optimum value of public debt is 60.69% and 63.56% of GDP, respectively. The optimum values are converging at 70^{th} and 32^{nd} generations, respectively. Therefore, based on the findings, it can be concluded that the optimum value of public debt ranges from 60.69–63.56% of GDP and beyond this, the public debt might have an adverse impact on India's economic growth.

7.5. Summary of the Burdens of Public Debt

This chapter examined whether the public debt causes burden for India. Although India is not a default country, but the recent ranking by some of the credit rating agencies' put forward the major question about debt repayment worthiness of the nation. The sharp deterioration in the economic growth, increasing current account deficit, and growing government expenditures supposed to be the major driving force for declining fiscal health as reflected by worsening the fiscal and primary deficit. The high fiscal deficits with low economic growth in recent years anticipate higher government borrowings in the coming years. Thereby, the degree of public debt burden on interest payments will be a fascinating research issue that has been examined.

This chapter used the augmented Bohn (1998) test to show the burden of public debt on fiscal behavior. Bohn (1998) showed that the response of the primary budget deficit occurs because of the changes in the public debt ratio. This chapter tested the burden of public debt for India by using the augmented Bohn (1998) test through structural vector auto regressive (SVAR) framework. The reason behind to test SVAR method instead of regression analysis as tested by Bohn (1998) was to remove the endogeneity problem in the model. It is because both public debt and primary deficit are interrelated to each other. The study took interest payment, development expenditure and output gap in the Bohn (1998) equation.

The empirical results illustrated that the response of interest payment shows significantly positive due to unexpected shock of gross primary deficit. The results reveal that higher level of gross primary deficit leads to higher pressure of interest payment. Country like India, which experiences high level of gross primary deficit and hence pressure of deficit leads to widening the interest payment. As a result, it created monetary burden in the case of India. Similarly, this chapter observed a

significant positive response of interest payment because of the unexpected shock of public debt, that is, one percent increase in public debt leads to 0.29 percent increase in interest payment. Therefore, it is always better to avoid the public debt as it involves the interest payment and this interest payment is significantly positively responding to the public debt in case of India. Hence, it shows that the public debt is burden for India. The response of output gap because of the unexpected shock of public debt is not significantly affecting each other. The results also showed that the response of public debt is significantly and negatively affecting because of the unexpected shock of interest payment. It means that higher interest payment leads to decrease in public debt. It is because of the level of interest payment as the percentage of GDP is continuously rising and for repaying the interest payment the government increases the tax level (Panandiker, 2010). It is also clear that government cannot impose high level of tax as it affects the willingness to work, save and investment, and thereby the economic growth. Therefore, it could be the possible reason behind government's desire to reduce the level of public debt instead of raising the taxation for repaying high level of interest payment. Further, the results showed significantly negative response to development expenditure and were observed because of the unexpected shock of interest payment. It indicates that higher interest payment leads to decline in the development expenditure. That means government is cutting the revenue from developmental expenditure in order to repay the interest payment of the public debt. This result clearly showed that the interest payment of the public debt is burden for India.

Further, the result showed significantly positive response of gross primary deficit because of the structural shock of interest payment. This indicated that the pressure of interest payment is widening the gross primary deficit of India. Hence, the study concluded that the pressure of interest payment of the public debt results in deterioration of the developmental expenditure and raises the gross primary deficit which is really burden for the developing country like India. Lastly, the results are

not getting any significant results of the response of gross primary deficit because of the unexpected shock of output gap and also the results observed insignificant results of the response of gross primary deficit and development expenditure because of structural shock of public debt. This insignificant result of the response of gross primary deficit because of the structural shock of public debt is rejecting the views of Bohn's (1998) test. Bohn (1998) said the positive correlation between debt-to-GDP ratio and primary deficit can be interpreted as solvency of public debt. As this coefficient shows an insignificant result and can be seen that public debt is insolvent in the case of India and hence can be treated as burden for India. The results also can be interpreted as public debt is burden for the country as developmental expenditure is responding because of the structural shock of public debt. This means public debt does not have a significant role for raising the developmental expenditure of the country. As the public debt to GDP ratio does not have a significant role to contribute towards developmental expenditure, therefore, can be interpreted as the burden for the country. It is because of the repayment of both principal and interest payment for the government can be burden and hence there is possibility of raising one new types of borrowing in order to meet this unproductive expenditure. Therefore, these vicious circles of borrowing for the government can hamper both the willingness to save and investment of the people. The report stated that the dated securities which are commonly known as market loans constitute of the most significant component of instruments which are used for financing the fiscal deficit of the central government. As at the end March 2013, central government of India borrowed 91.42 percent of total marketable loans from the dated securities, and the rest amount was borrowed from treasury bills (Government Debt Status paper, 2013). Thus, the level of public debt to GDP ratio creates a real burden to the society.

7.6. Concluding Observations and Policy Suggestions

To sum up, the present thesis made an attempt to revisit the relationship between public debt and economic growth in the context of India using annual data from 1970-71 to 2013-14. This thesis started with identify three research gaps in the introduction chapter and analyzed those research issues throughout the thesis. First, we examined the relationship between economic growth and public debt using four key channels through which public debt can affect growth. The results based on non-linear regression analysis found a positive relationship between public debt and economic growth in the short-run, whereas, a negative relationship exists in the long-run. The results indicated that public debt affects economic growth through public investment, household saving and TFP. In the next stage, we identified the key determinants that affect the public debt. The results concluded that economic growth, real interest rate, and gross fiscal deficit significantly determine the public debt of India. By using those variables as input, this study calculated the optimum debt using Genetic Algorithm technique. The results found that the optimum debt of India ranges between 61-64% of GDP, beyond which it might have an adverse impact on the economy. Since the public debt was more than the optimum level, this study in the final stage examined whether the public debt creates burden on society. We observed a positive response of interest payment due to shock of gross primary deficit. This leads to widening the interest payment. Further, the result concluded that a higher the level of public debt leads to high level of interest payment. Therefore, this creates monetary burden for the Indian economy. The results also found that the shock of interest payment negatively affect the development expenditure. This indicates that government spend its revenue to repay the interest payment by cutting down from developmental expenditures. Thus, the level of public debt which bears interest payment perhaps could lead the debt burden for the country.

From the policy perspective this study suggests that the increasing rate of interest payment as a percentage to GDP can dampen the economic growth. Though in the short-run, debt has a positive impact on growth, but if we keep on increasing the public debt beyond a threshold level around 64 percent, this may not achieve the targeted growth of 8 to 9 percent. India is one of the better countries in the world in terms of debt management and certainly not in dangerous zone, but the higher fiscal deficits particularly during post reform period may push the debt to GDP ratio beyond threshold level. The increase in internal debt will lead to put pressure on interest rate which could leads to crowding out effect. The government must be conscious when the public borrowings are used in the revenue expenditure. Finally, it suggested that the government can utilize the level of public debt in the developmental expenditure, which could lead to positive economic growth in the long-run.

7.7. Limitations and Scope for Future Research

The present thesis analyzed the impact of public debt on economic growth through key macroeconomic channels using 2SLS approach. But in case of 2SLS, we need to correctly identify the equation and choosing the appropriate instruments are challenging task. The better way of dealing this research question is through application of dynamic general equilibrium model. This thesis has considered time-series data using 44 years of annual data without checking the structural breaks. However, the study noticed the breaks points through the graphs, but the length of the breaks are very shorter, which made impossible for us to apply any time-series analysis. The study made an attempt to estimate the optimum level of public debt using a novel Genetic Algorithm approach, but the drawback of this method is it gives the global optimum at a point of time. In other words, the optimum debt for today may not be optimum for India after 10 years. Finally, most of our analysis has

restricted to 44 years data. If we go for out of sampling estimation, then the findings of this thesis may vary.

With regard to future research, one can extend this work to explore the linkage between public debt and economic growth across the Indian states. Second, this study is not dealing with borrowing pattern of the country. That means, there are different patterns involve with the borrowing. In other words, some borrowing has less time maturity and some have long maturity with different interest payments. In this context, one can examine whether burden of public debt is instantaneous or inter-generational by looking at pattern of borrowing. Third, this study confines debt as public liabilities, but in the recent years the private borrowings particularly in the form of commercial borrowings are increasing in India. Therefore, one can study the impact of heavy commercial borrowings on economic growth, and thereby create the burden for future in the country.

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Appendix -1

Measuring Capital Stock

The physical capital stock data are not readily available for India. Thus, following Easterly and Levine (2002), we use a Perpetual Inventory Method (PIM) to compute capital stocks. Specifically, let K (t) equal the real capital stock in period't'. Let I (t) equal the real investment rate in period't'. The real investment is defined in this paper as gross fixed capital formation at constant 2000 US$. Let'd' equal the depreciation rate, which we assume equals 0.07. Thus, the capital accumulation equations states as:

K (t) = (1-d) K (t-1) + I (t). To make an initial estimate of the capital stock, we make the assumption that the country is at its steady-state capital-output ratio. Thus, in terms of steady-state value, let k = K/Y, let g = the growth rate of real GDP, Y is the real GDP and let i = I/Y. Then, from the capital accumulation equation plus the assumption that the country is at its steady-state, we know that k = i /[g + d]. Thus, if we can obtain a reasonable estimate of the steady-state values of 'i', 'g' and'd', then we can compute a reasonable estimate of 'k'. Then, using the calculated value of 'k',

an initial estimate of capital stock (k) multiplied with initial GDP(Y) can be obtained. In order to work out the initial estimate of 'k', we assume the steady state capital output ratio (d) = 0.07. We construct the steady-state growth rate (g): a weighted averaged of the countries average growth rate during the first ten years for which we have output and investment data and the world growth rate. The world growth rate is computed as 0.0234. Based on Easterly et al. (1993), we give a weight of 0.75 to the world growth rate and 0.25 to the country growth rate in computing an estimate of the steady-state growth rate for each individual country. We then compute 'i' as the average investment rate during the first ten years for which there are data. Thus, with values for'd', 'g', and 'i' for each country, we estimate 'k' for each countries. To reduce the influence of business-cycles on estimates of Y, we use the average real GDP value between 1969 and 1971 as an estimate of initial output. Thus, the capital stock, for example, in 1970 is given as: Y*k.

Appendix -2

Detail Coding of Genetic Algorithm

```
clc

clear all

data=xlsread('input data.xlsx','Sheet1');

Npop=data(1,1);

Ngen=data(2,1);

Pc=data(3,1);

Pm=data(4,1);

opt=data(5,1);

Nv=data(6,1);
```

```
L=zeros(1,Nv);
for v=1:Nv
    L(1,v)=data(7,v);
end
B=zeros(Nv,2);
B(:,1)=data(8,:);
B(:,2)=data(9,:);
% opt=1;%if minimization give 1 else 0%
syms u v w x y;
X1=[u, v, w, x, y];
f=5.13+0.54*u-0.51*v-0.32w+0.37*x+0.78*y;
%Initialisation of string%
G=randi([0 1],Npop,sum(L));
G1=G;
for i=1:Ngen
    DV=decoded_value(G,Npop,L);
    X=var_calc(B,L,DV,Npop);
    [F,f1]=fitness(f,X1,X,Npop,opt);
    A=actual_count(F,Npop);
    Mp=mating_pool(G,A,Npop,L);
    Gnext=new_pop(Mp,Npop,L,Pc,Pm);
    G=Gnext;
```

```
%     G1=[G1 Gnext];
    if i==1
    f2=f1;
    X2=X;
    [f3,g1]=max(f1);
    X3=X(g1,:);
else
    f2=[f2 f1];
    X2=[X2 X];
    [f4,g2]=max(f1);
    if f4>f3
        f3=f4;
        X3=X(g2,:);
    end
end
%    Y=X(:,1);
%    Z=X(:,2);
%    clf
%    plot(Y, Z , 'h')
%    axis([0 6 0 6]);
%
%    pause(.2)
```

```
end
[fopt,g]=max(f2(:,100));
Xopt=X(g,:);
fopt
Xopt
f3
X3
% XLSWRITE('abc.xlsx',f2);
% XLSWRITE('abc1.xlsx',X2);
```

Actual Count Function

```
function [A]=actual_count(F,Npop)
 E=F./(sum(F)/Npop);
% E
A1=floor(E);
A2=E-A1;
count=Npop-sum(A1);
index=(1:Npop);
for i=1:count
    for j=i+1:Npop
        if A2(j)>A2(i)
```

```
            temp=A2(i);
            A2(i)=A2(j);
            A2(j)=temp;
            temp1=index(i);
            index(i)=index(j);
            index(j)=temp1;
        end
    end
    A1(index(i))=A1(index(i))+1;
end
A=A1;
end
```

Decoding Value Function

```
function [DV] =decoded_value(G,Npop,L)
 v=size(L,2); %To know the no of variable%
DV=zeros(Npop,v);
for p=1:Npop
    k=0;
    for i=1:v
        sum=0;
        for j=1:L(i)
```

```
            temp=G(p,k+j)*2^(L(i)-j);
            sum=sum+temp;
        end
        DV(p,i)=sum;
        k=k+L(i);
    end
end
```

Fitness Function

```
function [F,f1]=fitness(f,X1,X,Npop,opt)
% v=size(X,1);
F=zeros(Npop,1);
for i=1:Npop
    F(i)=subs(f,X1,X(i,:));
end
f1=F;
if opt==1
    F=1./(1.+F);
end
end
```

Mating pool Function

```
function [Mp] =mating_pool(G,A,Npop,L)
Lsum=sum(L);
Mp=zeros(Npop,Lsum);
j=1;
for i=1:Npop
    if A(i)~=0
        n=A(i);
        Mp(j:(j+n-1),:)=repmat(G(i,:),n,1);
        j=j+n;
    end
end
end
```

New Population Function

```
function [Gnext]=new_pop(Mp,Npop,L,Pc,Pm)
 Gnext=Mp;
Pop_cross=randperm(Npop);
Npop_cross=2*ceil(Npop*Pc/2);
Pop_cross=Pop_cross(:,1:Npop_cross); %stores the index
of the population which will do cross over%
Pop_cross=(Pop_cross)';
Cs=randi([1,(sum(L)-1)],[Npop_cross/2,1]); % decides the
cross over site position%
```

```
k=1;
for i=1:Npop_cross/2

Gnext(Pop_cross(k),Cs(i)+1:sum(L))=Mp(Pop_cross(k+1),Cs(
i)+1:sum(L));

Gnext(Pop_cross(k+1),Cs(i)+1:sum(L))=Mp(Pop_cross(k),Cs(
i)+1:sum(L));
    k=k+2;
end
Nmut_bit=floor(Pm*sum(L)*Npop);%Number of mutation bit%
if Nmut_bit~=0
    mut_rand=rand(sum(L)*Npop,1);
    mut_loc=find(mut_rand<Pm,Nmut_bit);
    m=size(mut_loc);
    if m~=0
        for l=1:m
            c=0;
            for r=1:Npop
                for s=1:sum(L)
                    c=c+1;
                    if c==mut_loc(l)
```

```
                        Gnext(r,s)=1-Gnext(r,s);
                        break;
                    end
                end
                if c>=mut_loc(l)
                    break;
                end
            end
        end
    end
end
end
```

Number of Variables Function

```
function [X] =var_calc(B,L,DV,Npop)
 v=size(L,2); %To know the no of variable%
X=zeros(Npop,v);
for p=1:Npop
    for i=1:v
        X(p,i)=B(i,1)+((B(i,2)-B(i,1))/(2^L(i)-
1))*DV(p,i);
    end
```

```
end

end
```

Input Data for GA Analysis

Number of population	100				
Number of generation	100				
Cross Over Probability	0.8				
Mutation Probabiity	0.05				
Type of optimisation	1				
No of variable	5				
Bit length of each variable	10	10	10	10	10
minimum value of variables	33.69	-5.2	-5.2	5.15	4.05
Maximum value of variables	83.22	10.15	10.15	14.12	10.99

Appendix 3

SVAR Short run Restriction Identification Matrix

$$A=\begin{bmatrix} 1 & NA & NA & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & NA & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} e_t^{gpd} \\ e_t^{pd} \\ e_t^{ip} \\ e_t^{devt} \\ e_t^{og} \end{bmatrix} \quad B=\begin{bmatrix} 1 & 0 & 0 & 0 & NA \\ 0 & 1 & 0 & 0 & 0 \\ NA & NA & 1 & 0 & 0 \\ 0 & 0 & NA & 1 & 0 \\ 0 & NA & 0 & 0 & 1 \end{bmatrix}\begin{bmatrix} \mu_t^{gpd} \\ \mu_t^{pd} \\ \mu_t^{ip} \\ \mu_t^{devt} \\ \mu_t^{og} \end{bmatrix}$$