SOVEREIGN DEBT AND FISCAL CONSOLIDATION IN THE UNITED STATES OF AMERICA AND GREECE: A COMPARATIVE ECONOMETRIC APPROACH

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THESIS SUBMITTED FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN ECONOMICS AT THE NORTH-WEST UNIVERSITY (MAFIKENG CAMPUS)

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DECLARATION

I, Gisele Mah, declare that the thesis entitled 'Sovereign debt and fiscal consolidation in the United States of America and Greece: a comparative econometric approach', hereby submitted for the degree of Doctor of Philosophy (PhD) in Economics has not previously been submitted by me for a degree at this or any other university. I further declare that this is my work in design and execution and that all materials and secondary information contained herein have been duly acknowledged.

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DEDICATION

This study is dedicated to the Almighty God, my late father, Chifor Boniface Seh (RIP) and my father-in-law, Bam Christopher.

ABSTRACT

One of the most challenging macroeconomic policies is sovereign debt reduction. The purpose of this study is to estimate the determinant of government debt in the USA and approximate comparative debt reduction models for the USA and Greece. It also evaluates methods of reducing government debt, decreasing government spending and increasing taxes and finally, consequences of fiscal consolidation in the USA and Greece. The frequently used debt reduction measures are: inflation, fiscal consolidation, economic growth, financial repression, debt restructuring and debt default. The Vector Error Correction Model, Granger causality, variance decomposition and the Generalised Impulse Response Function techniques were employed to analyse the data. The results of the determinants of real federal debt for the USA revealed that there is a negative and significant relationship between consumer price index and real federal tax receipts with real federal debt in the USA. There is a positive and significant relationship between real federal interest payment and real government spending with real federal debt. The comparative analysis revealed a significant and negative relationship between general government debt and inflation in the USA while in Greece, the relationship is negative and insignificantly negative. A positive and insignificant relationship is observed between gross domestic product growth in the USA and negative and insignificant relationship in Greece. There is a negative and significant relationship between general government debt and primary balance in the USA while a positive and significant relationship exists in Greece. A negative and insignificant relationship exists between general government debt and net transfer from abroad in the USA while a negative and significant relationship exists in Greece. From the findings, in order for the US government to reduce its debts, there is a need to increase consumer price index to a sustained level and federal government current tax receipts. There is also a need to cut down federal interest payment and government spending on goods and services. This comparative study revealed that sovereign debt could be reduced in the USA by increasing inflation (sustained level) and primary balance while in Greece, government debt could be reduced by decreasing primary balance and increasing net current transfers from abroad.

Key words: Sovereign Debt, Fiscal Consolidation, Vector Error Correction Model, Granger Causality, Variance Decomposition, Generalised Impulse Response Function, Greece, USA

JEL Classification: H62, H63, H68, H71, C1, C32, C51, C53

GLOSSARY OF TERMS

Aggregate demand: the total quantity of output demanded at alternative price levels in a given time period, all things being equal.

Aggregate supply: the total quantity of output producers are willing and a able to supply at alternative price levels in a given time period, all things being equal.

Austerity measure: the official action taken by the government during a period of adverse economic conditions to reduce its budget deficit using a combination of spending cuts or tax rises.

Bailout: an instance of coming to the financial rescue of a country.

Budget deficit: spending that includes interest payments on the debt, minus taxes of net transfer.

Cointegration: when the combination of nonstationary (I(1)) variables in a series becomes stationary(I(0)).

Crowding out: the reduction in private sector borrowing caused by increased government borrowing.

Debt ceiling: an explicit legislated limit on the amount of outstanding national debt.

Debt default: when debtors do not meet their legal obligations as stipulated in their debt contract.

Debt limit: the maximum amount of outstanding federal debt the US government can incur by law.

Debt overhang: a situation when the sovereign government debt stock exceeds its future capacity to repay it.

Debt restructuring: altering the terms of debt agreements of an outstanding debt in order to achieve some advantages.

Debt service: the interest required to be paid each year on outstanding debt.

Debt sustainability: the ability of a country to meet its debt obligations without requiring debt relief or accumulating arrears.

Debt trap: a situation where a government has to incur new debt in order to honour its existing debt servicing obligation.

Disposable income: the personal income less personal taxes.

Error correction model: a dynamical system characterised with deviation of the current states from its long run relationship which fits into its short run dynamics.

Eurozone: the economic region formed by member countries of the European Union that have adopted the Euro as a common currency.

Fiscal cliff: the sharp decline in the budget deficit that occurred at the beginning of 2013 due to increased taxes and reduced spending as required by previously enacted laws.

Fiscal consolidation: a policy intended to reduce deficit and the accumulation of debt according to the Organisation of Economic Cooperation and Development.

Fiscal sustainability: relates to current as well as intergenerational aspects of government expenditure and revenue.

Generalised Impulse Response Function: shows the effects of shocks on the adjustment path of variables.

Government spending: when government spending increases, planned expenditures will be higher at the level of income.

Monetary policy: the action of the central bank to determine the size and rate of growth of money supply which in turn affects interest rates.

Primary deficit: the conventional deficit less interest payment.

Sovereign debt crisis: the resulting economic and financial problem caused by the inability of a country to pay its public debt.

Sovereign debt: the amount of money that a country's government has borrowed which is mostly issued as bonds dominated in a reserve currency.

Variance decomposition: the measure of the contribution of each type of shock to the forecast error variance.

Vector Error Correction Model: a system where deviation of the current state from its long run relationship will be adjusted into its short run dynamics.

LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
CDS	Credit Default Swaps
CPI	Consumer Price Index
ECM	Error Correction Model
EMU	European Monetary Union
FDEBT	Federal Debt as a Percentage of GDP
FRTAXG	Real Federal Government Constant Tax Receipts as a percentage of GDP
GDEBT	General Government Gross Debt
GDP	Gross Domestic Product
GDPG	Gross Domestic Product Growth
GIRF	Generalised Impulse Response Function
GNEX	Gross National Expenditure
GNI	Gross National Income
HQ	Hannah-Quinn Information criterion
IBC	Intertemporal Budget Constraint
IMF	International Monetary Fund
INF	Inflation
IRF	Impulse Response Function
LM	Lagrange Multiplier

OECD	Organisation for Economic Co-operation and Development
OLS	Ordinary Least Squares
PB	Primary Balance
PP	Phillips-Perron
P-value	Probability value
RFDEBT	Real Federal Debt as a percentage of GDP
RFINTPG	Real Federal Interest Payment as a Percentage of GDP
RFINTPG	Real Federal Interest Payment as a percentage of GDP
RGSPENG	Real Government Spending as a Percentage of GDP
RGSPENG	Real Government Spending as a percentage of GDP
RNTRA	Net Current Transfers from Abroad
SC	Schwarz Information Criterion
T –value	Test statistics value
US	United States
USA	United States of America
VAR	Vector Autoregressive Regression
VECM	Vector Error Correction Model

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CHAPTER ONE
INTRODUCTION

"The government's view of the economy can be summed up in a few short phrases: if it moves, tax it, if it keeps moving, regulate it and if it stops moving, subsidise it."

Ronald Reagan, US President

1.1 BACKROUND OF THE STUDY

Sovereign debt reduction has recently proven to be one of the most challenging macroeconomic policies while debt crises are a matter of concern in developed economies (Calitz, 2012). Sovereign debt, also referred to as public or government debt, refers to debt owed by a country's national government directly or indirectly by virtue of that government's guarantee to repay capital as well as interest. Whenever a government intends to borrow, it issues bonds or treasury bills to private investors both within the country and abroad. Normally, governments borrow in order to increase economic activities, economic growth and decrease unemployment. This is done in order to finance health, education, defence, infrastructure, research, consumption, investment and expansionary fiscal policies. Nelson (2013) argues that there is a difference between sovereign debt and private debt. This is because there is no international bankruptcy court which can reinforce debt contracts between private investors and a sovereign nation. Also, public debt contracts are unsecured even though a government will want to pay its debts in order to build a good reputation in capital markets.

Many developed economies are currently reviewing their fiscal policy with the aim of cutting down the rising debt to the ratio of Gross Domestic Product (GDP). In the past, these countries were able to sustain their economies while at the same time, helping African countries to come out of their debts. The observation is that sovereign debt crises in advanced economies keep increasing with values more than those stated in the growth and stability path (Mah, Mukuddem-Petersen, Petersen & Hlatshwayo, 2013). According to Reinhart and Rogoff (2013), the most popular and significant ways of reducing debt to GDP ratio are through fiscal austerity and restructuring measures, despite the fact that they slow down economic growth. Other researchers such as Panizza, Strurzenegger and Zettelmeyer (2010) consider debt default as a measure of reducing rising government debt. On the other hand, Nelson (2013) maintains that governments normally have five major tools they use to address debt. These tools are: fiscal consolidation (spending reduction and/or increase in taxes); debt restructuring (reprogramming of the debt amount); inflation (increase in prices of goods and services); growth (increase in GDP output); and financial repression (increase in interest rates). Despite the fact that there are many ways of cutting down rising government debt, most governments in developed economies are implementing contractionary fiscal policies as a strategy to reduce debt. This phenomenon is widely observed in some economies in America and Europe.

Even though there are major economic differences between the United States of America (USA) and Greece, this is, however, not the focus of this study. The present study examines the major challenges faced by these countries in terms of sovereign debt. These two countries were chosen based on the fact that their debt rates were more than 100% debt to GDP ratios in 2013. They both implemented measures such as decreasing government spending and increasing taxes in order to reduce debt rates. The two countries are also regarded as insolvent since politics, in a way, limits increase in taxes to a certain level, hence, they cannot finance their liabilities completely through increase in taxes. Lastly, both countries were affected by the financial crisis of 2008. As a member of the Eurozone, Greece had to follow the conditions imposed on the country because of its indebtedness while the USA on the other hand, had no restrictions.

The 2007/2008 sovereign debt crisis affected some countries in Europe such as Greece, Italy, Ireland, Portugal and Spain (Mah *et al.,* 2013). Greece had access to low interest loans as well as Eurobond when it adopted the Euro as a currency in 2001. This contributed to an increase in consumption spending (Nelson, Belkin & Mix, 2011). Taking all these into consideration, Greece experienced an increase in growth rates alongside a decrease in unemployment and a stable government debt to GDP ratio of 100% from 2001 to 2008 (Mah *et al.*, 2013). In 2009, Greece's credit access, world trade and domestic consumption were affected by the 2007 to 2008 financial crisis. At the same time, the USA was hit by the subprime mortgage crisis (Arghyrou & Tsoukalas, 2010). The impact of these crises was the increase in fiscal deficit, borrowing cost and fear of default. The fiscal deficit in Greece worsened and bonds were downgraded to junk status.

On 2nd May 2010, the first bailout package of €110 billion was given to Greece by the International Monetary Fund (IMF) and the European Union (EU) (Calice, Chen & Williams, 2011). A second package of €130 billion was disbursed in 2012 (Castel, 2012). With this financial assistance, Greek government debt rose from 112.9% in 2008 to 175.1% in 2013 when measured as a percentage of debt to GDP ratio. (See the European commission database (AMECO), Table 1.1). Comparably, the US (United States) government did not experience debt crisis in the same way as Greece despite its increased debt rates.

Thornton (2012) argues that the USA had a large deficit which was mainly as a result of wars (1812 War, the Civil War and the First and the Second World Wars). Abel, Bernanke and Croushore (2008) suggest that the debt to GDP increased to more than 100% during World War II and later reduced over a 35 year period. Another huge deficit occurred in 1933 during the Great Depression with the USA experiencing a deficit of 6.6% (IMF, 2013). According to Thornton (2012), problems began in the USA when the government decided to increase spending significantly without corresponding tax revenue increases in the 1970s. From mid-1974, the USA Congressional Budget Act was reformed in order to prevent Congress from challenging the president's budgets. This led to difficulties in the control of deficit. In 1980, the USA experienced a rise in debt due to budget deficits with the percentage lower than 50% (Abel *et al.,* 2008). From 1980 to 1989, military spending was increased while taxes were lowered and congressional democrats blocked any attempt to reverse spending on social programmes. Public debt reduced due to decreases in military spending after the Cold War from 1993 to 2001 (Thornton, 2012).

It is argued that in the early 21st century, sovereign debt increased due to President Bush's tax cuts, increase in military spending (two wars) and the entitlement Medicare programme. From 2001, public debt in the USA stood at $5.7 trillion. By the end of 2008, it rose to $10.7 trillion due a reduction in tax rates and two unpaid wars. Furthermore, public debt increased due to the Global Financial Crisis (GFC) that started in 2008. In 2010, the debt increased due to a reduction in tax revenues and tax cuts and by early 2012, sovereign debt was estimated at $15.5 trillion, about 101.99% of GDP (Baccia, 2013).

Despite the debt ceiling of $15.2 trillion (in 2011) that rose to $16.4 trillion in 2012 through the Budget Control Act of 2011, US debts kept on increasing. In February 2013, the president and the Congress suspended the debt limit and in May 2013, the debt ceiling was increased to $16.7 trillion (Baccia, 2013). By October 2013, the US government had to increase the May 2013 debt limit in order to avoid default.

Some of the causes of the rising debt in Greece were due to trade imbalances, inflexibility in its monetary policy, global recession experienced by many countries, loss of confidence from investors and previous values of government debt (Mah *et al.,* 2013).

The sovereign debt rates of the USA and Greece are illustrated in Table 1.1. The Table shows the rise in debt rates from 73.3% to 104.5% and 113% to 175% respectively between 2008 and 2013.

Table 1.1: Sovereign debt rates for the USA and Greece

Year	2008	2009	2010	2011	2012	2013
USA (in percentage of GDP)	73.3	86.3	95.2	99.5.1	102.9	104.5
Greece (in percentage of GDP)	112.9	129.7	148.3	170.6	161.6	175.1

Source: European commission database (AMECO)

These two countries responded differently to high levels of debt. In Greece, the increase in debt led to the implementation of austerity measures as a cure to the debt crisis while in the USA, the fiscal cliff was implemented as a preventive measure.

1.2 PROBLEM STATEMENT

Developed economies are highly indebted with values exceeding 100% of debt to GDP ratio. As indicated in Table1.1, government debt has constantly been increasing in both the USA and Greece even though the rate of growth is faster in Greece than in the USA where it rose from 66.8% in 2007 to 104.5% in 2013 for the USA and from 107.2% in 2007 to 175.1% in 2013 for Greece (AMECO). As pointed out by Keynes (1939), governments usually borrow for good reasons. For instance, when a government borrows, it invests in projects that are expected to increase investment, employment and output growth rates. In certain cases, high government debt has forced many developed economies to implement contractionary policies as well as other measures to reduce debts. As mentioned earlier, some of these measures include austerity measures implemented by Greece and fiscal cliff in the USA.

Rising government debt has negative effects on the economy of a country. Public debts are detrimental because they create a burden for future generations since taxes have to be raised. Another reason is that high public debt can cause an economy to go bankrupt. This is based on Smith's (1776) notion that a government should not get into deficit spending because it is not good for a nation even if the debt is domestic. Smith argues that when a government borrows and has to repay the debt, it adopts the following measures: increase in taxation, increase in the flight of domestic capital as well as devaluation of the local currency. Pannizza and Presbitero (2012) maintain that sovereign debt seriously reduces the growth of a country towards wealth and prosperity because resources that could have been used by the private sector in a positive way are directed to the government and used in unproductive activities. It is therefore recommended that government should not get into deficits except in cases of emergencies such as wars or natural disasters.

When government finances deficit through taxation, it reduces capital accumulation but not necessarily savings. Taxation may affect investment and the new accumulation of capital, but not the existing productive capital. When a government borrows to finance its deficit, there is a reduction in existing productive capital. Hence, borrowing has more negative effects on the economy as well as the amounts of money borrowed by the government and crowds out private investment. This is because borrowed savings which maintained productive labour may be used for unproductive investment (Smith, 1776).

Ricardo (1951) concurs with Smith (1776) on the way a government spends on unproductive investments as well as the effects of government borrowing. Ricardo is of the opinion that public expenditure that is financed both through taxation and public borrowing, has the same effect. To him, government is expected to redeem its debt in future which can take place in a closed economy through taxation. In a closed economy, when government issues bonds and individuals buy them, the amount is the same as public deficit, hence, the interest rate remains the same according to the rational expectation hypothesis. There is no crowding out of private investors and total demands in the economy remain the same. In an open economy, when public debts are redeemed through sales of assets to international agents (due to inadequate income), the government increases taxes.

According to Mill (1848), when government competes with the private sector for the same capital, it leads an increase in the price of capital. When prices increase, a negative effect is experienced on the investment, employment and output of the economy. Mill maintains that when public debt increases, it leads to an increase in interest rates and falling real wages. Williamson (2008) explains Ricardian Equivalence and the burden of government debt as a burden which must be paid off by taxing citizens in the future. At the individual level, debt represents a liability that reduces an individual's lifetime wealth. In practice, the government can postpone taxes needed to pay off the debt until long in the future, when consumers who received the current benefits are either retired or dead.

Most governments borrow large sums of money resulting in an increase in interest rates. This may discourage private investors from borrowing. When government expenditure increases, aggregate demand also increases. This leads to an increase in income resulting in an increase in the demand for money in the economy. If the supply of money is constant in real terms, interest rates will increase due to an increase in the demand for money. Higher interest rates discourage private investments and aggregate expenditures (Calitz, 2012). Some of the negative effects of government debt are as follows: it affects bond markets, the banking sector and balance of trade; and government debt may lead to an increase in interest rates, decrease in remittances and loss in investor confidence (Mah *et al.,* 2013).

As pointed out by Calitz (2012), government debt causes future generations to pay interest rates and debt capital meanwhile, the debt was borrowed to finance projects for the present generation. Debts also increase government expenditure and reduce the amount of money to be invested in productive activities. High government debts may lead to a decline in investor confidence relative to credit worthiness. It also increases interest rates since lenders demand a higher risk premium. Ultimately, higher levels of debt may also affect economic growth (Chercherita & Rother, 2012).

According to IMF (2013), fiscal consolidation was implemented following the peak of the debt crisis in 2009. Some studies have been conducted on fiscal consolidation as a measure to reduce government debt in other countries (Heylen, Hoebeeck & Buyse, 2013). In a study of 21 member countries of the Organisation for Economic Cooperation and Development (OECD), the authors found that increase in taxes and decrease in expenditure contribute significantly to debt reduction in the long run. The cut in expenditure, especially on the wage component of public spending makes fiscal consolidation more successful than tax increases (Von Hagen & Strauch, 2001). When there is fiscal adjustment, reduction in spending is more effective than an increase in taxation when government debt is stabilised and also when economic downturns are experienced (Alesina & Ardagna, 2009). Agnello, Castro and Sousa (2013) argue that when there are fiscal consolidation programmes driven by spending reduction, higher rates of success are expected than tax-driven fiscal consolidation and cuts in public investment. These authors focused on tax and expenditure as a measure of reducing government debt.

Furthermore, Amo-Yartey, Narita, Nicholls, Okwuokei, Peter and Turner-Jones (2012) examined debt dynamics in the Caribbean. They maintain that debt can be reduced by strong growth and lasting fiscal consolidation efforts. They used panel data of 155 countries to analyse the determinants of global large debt reduction from 1970 to 2009. Their variables were probability of large debt reduction, real GDP growth, cyclically adjusted primary balance, interest rate payment, debt to GDP ratios and inflation. These results show that globally, large debt reduction is caused by decisive lasting fiscal consolidation. Strong economic growth and high debt servicing costs are positively related to the probability of large debt reduction while inflation does not have any effect on debt reduction. The implementation of fiscal consolidation needs to be associated with tax policy reform and structural reform.

Using the VECM and Granger causality, the different debt reduction measures are examined in order to determine the best measures that adequately reduce government debt in the USA and Greece and their direction of causality. Also, the response of shocks is examined through the variance decomposition and Generalised Impulse Response Function (GIRF).

1.3 OBJECTIVES OF THE STUDY

The objectives of this study were to:

i. Evaluate various methods of reducing government debt, analyse reduction in government spending and increase in taxes in the USA and Greece respectively and assess the consequences of fiscal consolidation;

ii. Empirically investigate the determinants of government debt in the USA and shocks of variables on others;

iii. Empirically undertake a comparative analysis of government debt reduction strategies in the USA and Greece using variables not used in the analysis above; and

iv. Make policy recommendations for reducing government debt in the USA and Greece.

1.4 SIGNIFICANCE OF THE STUDY

This study estimates the determinants of government debt in the USA and approximates measures of reducing government debt in the USA and Greece comparatively. It uses various econometric techniques to estimate these models. It will thus assist policy and decision-makers to determine which variables to first target in order to reduce rising government debt. This will go a long way in building confidence among policy and decision-makers in the implementation of policies and strategies to reduce rising government debt.

The study has formulated a debt reduction model for the USA and comparative model for the USA and Greece. This study is the first of its kind on government debt reduction using VECM, Granger causality, GIRF and variance decomposition. The purpose is to provide a useful empirical framework which might help in policy formulation for the USA and Greek governments, countries with high debt rates as well as those experiencing debt crises.

An extensive review of literature on various measures of reducing government debt, reduction in government spending and increase in taxes and the impact of fiscal consolidation in the USA and Greece enhanced the existing body of knowledge. This study will also assist readers to better appreciate the immediate and long-term impacts of contractionary fiscal policies as well as other measures of reducing government debt in the USA and Greece.

Finally, the study is envisaged to enlighten citizens, academics, students, professionals and governments on the positive effects of fiscal consolidation against the consequences thereof.

1.5 DATA AND METHODOLOGY

This section presents the methods used to analyse the secondary data in this study. The same method was used for the USA and Greece. The different variables are mentioned and the various techniques used to analyse the data are discussed.

1.5.1 Research data

Several measures can be implemented in order to reduce rising government debt. Based on theoretical and empirical literature, the following variables were chosen to estimate the debt reduction model for the USA: Real Federal Debt (Percentage of Gross Domestic Product), Consumer Price Index Index (2010=1), Real Federal Interest Payment (Billions of dollars), Real Government spending (Government consumption and Gross investment) (Billions of dollars) and Real Federal Government Current Tax Receipts (Billions of dollars). Seasonally adjusted quarterly data was used in the study.

For the comparative model for the USA and Greece, annual data was used for the following variables: General Government Debt (Percentage of GDP), Inflation (GDP deflator to annual %), Gross Domestic Product Growth (Percentage), Primary Balance (constant LCU) and Net Current Transfers from abroad (constant LCU).

1.5.2 Statistical methodology

The same techniques used for the USA were employed for the comparative analysis of the USA and Greece since it achieved the objective of this study.

The Vector Error Correction Model (VECM) was used to estimate the relationship between variables that determine and reduce government debt. The VECM is good when there are cointegrating relationships among the variables of the study. Also, VECM revealed both the short and long-term relationships between the variables. Finally, the direction of causality could be identified in the VECM using the Granger causality test (Oh & Lee, 2004).

The Granger causality test was used to determine the direction of causality among the variables in this study through testing if the current and lagged values of one time series help in predicting the future values of another time series (Stock & Watson, 2012).

The Generalised Impulse Response Function (GIRF) test was employed to trace the effects of a shock from one variable to the other in the system of equations. GIRF was used since it is not sensitive to the way variables in the system of equations are ordered.

Variance decomposition test is also computed in order to assess how shocks to these economic variables reverberate through the system. This estimates the contributions of each type of shock to the forecast error variance.

VECM was used in the following manner: first by describing the economic variables, descriptive statistics and visual inspection in order to understand how variables change over time. A Stationarity test was conducted with the Augmented Dickey-Fuller, Phillip Perron and Ng Perron unit roots test. This was followed by the lag order selection test and Johansen cointegration test. In order to obtain good VECM estimates, a weak exogeneity test and linear restrictions in the cointegrating vectors were tested. After estimating the model, stability and diagnostic tests were conducted to confirm if the estimated models are good. The Granger causality test, GIRF and variance decomposition were finally estimated to analyse the causality and response on shocks on the economies of the USA and Greece.

1.6 LIMITATIONS/ DELIMITATIONS OF THE STUDY

This study estimates a comparative debt reduction model in the USA and Greece. However, quarterly data was not available for Greece. Annual data was thus collected from 1970-2012 for the comparative analysis between the USA and Greece.

This study is current and ongoing, most papers related to this study are working papers and/or still in press.

1.7 STRUCTURE OF THE STUDY

The rest of the study is organised as follows:

Chapter 2 consists of the theoretical and empirical literature review of the study. Various fiscal policy theories related to government debt are discussed in this chapter such as: Ricardian, Structural and Keynesian approach to fiscal policy. Other theories such as debt overhang, tax smoothing and government budget constraint are also discussed. Empirical literature related to this study is discussed in order to determine the variables and their relationship in this study as well as identify gaps. Measures of reducing government debt are presented and reduction in government spending and increase in taxes in the USA and Greece are examined. Lastly, the consequences of fiscal consolidation are reviewed.

Chapter 3 focuses on the research techniques used in conducting this study. The same techniques are used for the USA and Greece in order to have the same analytical techniques to analyse the data. In this chapter, the debt reduction models are specified, the source and definition of the variables used are explained in detail. In addition, detailed explanations of the various techniques employed are presented starting with ADF, PP and NP for stationarity testing, followed by Johansen cointegration and VECM. Furthermore, the GIRF and the variance decomposition techniques are employed in examining the response to shocks of the variables used to reduce government debt in the USA and Greece.

Chapter 4 presents the results and discussion of the findings in the application of techniques used in chapter three for the USA with variables such as real federal debt, Consumer Price Index, real federal interest payment, real government spending and real federal government current tax receipts. The results are presented in tables and graphs. After each graph and table, interpretations and discussions are done where necessary in relation to the theories and results of empirical studies.

Chapter 5 presents the results and discussion of the comparative study for the USA and Greece for variables such as general government debt, inflation, gross domestic product growth, primary balance and net current transfers from abroad. The results of both countries are presented in tables and graphs. After each graph and table, interpretations and discussions are done and the similarities and differences between the various results highlighted.

Chapter 6 is the conclusion of the study. It provides a summary of the study, policy implications of empirical results and recommendations for future research. It also presents new concise understandings of how debt could be reduced in the USA and Greece as well as how this study could assist in the advancement of knowledge in the field.

CHAPTER TWO

THEORETICAL AND EMPIRICAL LITERATURE

"A man who reviews the old so as to find out the new is qualified to teach others."

Confucius

2.1 INTRODUCTION

This chapter discusses the theoretical and empirical literature related to this study with the hope that such review helps in justifying the selected variables as well as identifying the research gaps in this field. The flow chart in Figure 2.1 illustrates the various aspects of the theoretical and empirical literature covered in this section.

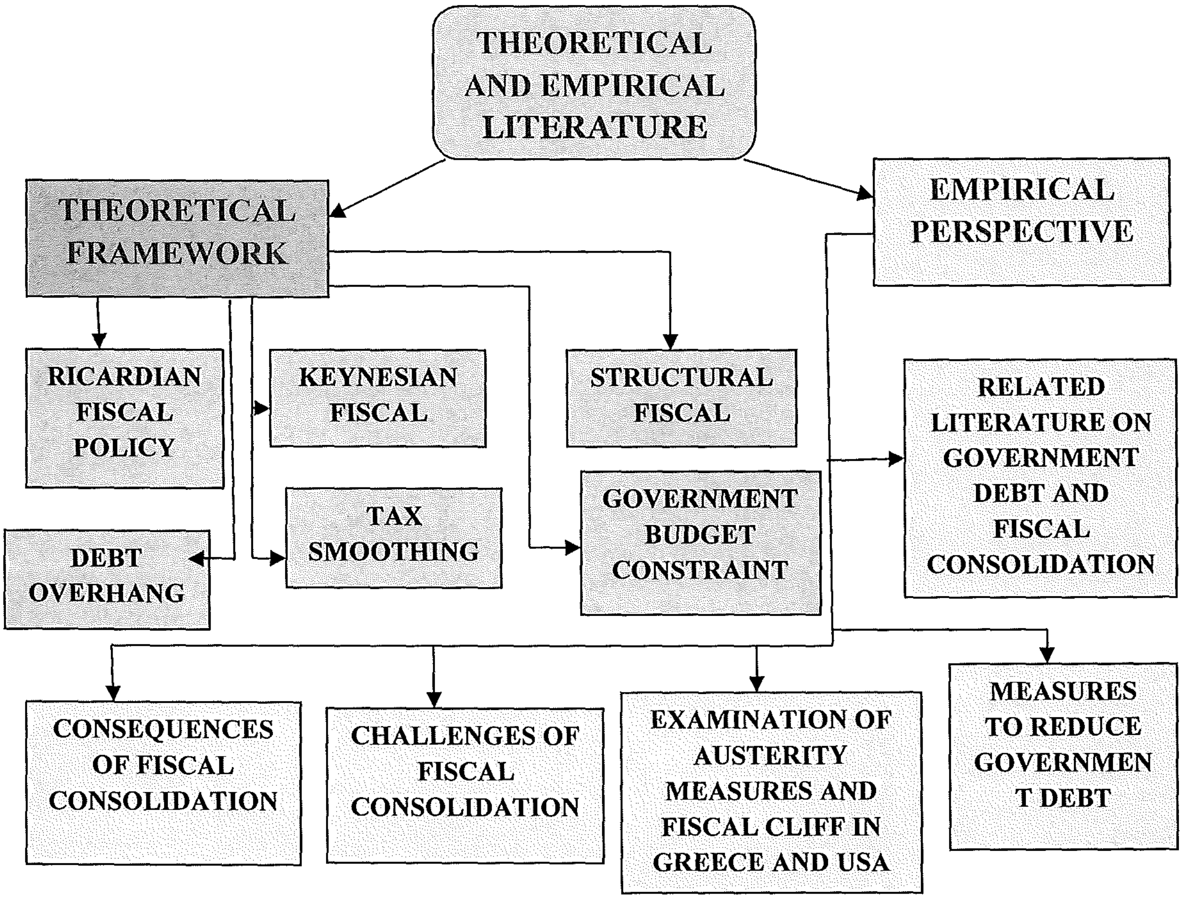

Figure 2.1: Theoretical framework and empirical literature

2.2 THEORETICAL FRAMEWORK

This section discusses theories of fiscal policy as measures to reduce government debt. Fiscal policies are decisions taken by governments in relation to government expenditure, taxation and borrowing in order to achieve a goal. According to Chamberlin and Yueh (2006), a fiscal policy involves government policies that relate to taxes and spending. The macroeconomic goals of fiscal policy are: economic growth; creation of jobs; stabilise prices; stabilise balance of payment; alleviate poverty; and maintain a socially acceptable distribution of income. In addition, the macro instruments used to achieve the goals mentioned above are: national debt, national consumption and capital expenditure, taxation and deficit in budget (Calitz & Siebrits, 2012).

The policy widely used in reducing government debt is the contractionary fiscal policy. It involves decreasing government spending and increasing taxes. There are different viewpoints regarding fiscal policy. Thus, the focus is on the Ricardian, Structural and Keynesian approaches to fiscal policy. Notwithstanding, other theories such as debt overhang, tax smoothing and government budget constraint are also discussed in this section.

2.2.1 The Ricardian view

Ricardian economists are of the opinion that fiscal policy has no effect on aggregate demand and national income. They focus on the type of consumption function used since the consumer is forward-looking and consumption smoothers (Chamberlin & Yueh, 2006). According to Ricardian economists, people decide what to consume based on their disposable income which can be affected by the fiscal policy. This suggests that consumers forecast and make a decision on consumption based on their income. They may only change their consumption patterns if they expect their permanent income to change. As such, their permanent income, consumption, aggregate demand and national income are not affected by the fiscal policy.

Chamberlin and Yueh (2006) maintain that based on the Ricardian perspective, government can borrow a large sum for a long period of time but this is subject to constraints. The government always ensures that its books are balanced, in such a way that at the end of the time, the national debt must be zero. In the second lag, the evolution of government's debt is as follows:

$$0 = (1+r)(G_1 - T_1) + (G_2 - T_2) \quad \text{(2.1)}$$

This constraint means that any deficit or surplus would have to be reversed eventually in the present value terms. According to the Ricardian equivalence, when faced with taxes or government spending, it is anticipated that the policy will eventually be reversed in present value term hence, the fiscal policy has no effect on the economy. Drawing from the permanent income hypothesis, consumption changes only when lifetime resources change. Consumption is constrained by the budget constraint as shown below:

$$C_1 + \frac{C_2}{1+r} \leq Y_1 - \Delta T_1 + \frac{Y_2 - \Delta T_2}{1+r} \quad \text{(2.2)}$$

Assuming government spending to be zero and that there is no debt, the cut in tax will create a deficit of ΔT_1 which is the amount that the government is giving to each household, (Chamberlin & Yueh, 2006). Since government must have no deficit at the end of the period, this means that:

$$0 = (1+r)\Delta T_1 + \Delta T_2 \quad \text{(2.3)}$$

where $\Delta T_2 = -(1+r)\Delta T_1$

Substituting into the budget constraint, the following is obtained:

$$C_1 + \frac{C_2}{1+r} \leq Y_1 - \Delta T_1 + \frac{Y_2 + (1+r)\Delta T_1}{1+r} \quad \text{(2.4)}$$

Then $C_1 + \frac{C_2}{1+r} \leq Y_1 - \frac{Y_2}{1+r}$ ....(2.5)

As long as the government runs a balanced budget, timing of taxes is irrelevant and may not affect intertemporal budget constraint. Hence, the tax policy has no change on the intertemporal budget constraint and consumption.

When government spending increases in one period and the way to finance it is through borrowing, in this situation, the budget constraint will be:

$$(C_1 + \Delta G_1) + \frac{C_2}{(1+r)} \leq Y_1 + \frac{Y_2 - \Delta T_2}{(1+r)} \qquad (2.6)$$

Budget constraint implies that future taxes will have to rise by:

$$\Delta T_2 = (1+r)\Delta G_1 \qquad (2.7)$$

Substituting this expression for a change in future taxes, it is once more observed that nothing has happened to the intertemporal budget constraint faced by households as:

$$(C_1 + G_1) + \frac{C_2}{(1+r)} \leq Y_1 - G_1 + \frac{Y_2}{(1+r)} \qquad (2.8)$$

Increasing government spending raises household consumption in the first period but households know that they will face a higher tax bill in the second period. Government spending crowds out household spending on a one-to-one basis and there will be no change to aggregate demand.

According to Barro (1974), there is no effect on capital accumulation, output and employment when taxes are used to finance government spending of an exogenous path. Hence, if taxes are cut today, they will not affect consumption or labour supply. This is because households will save the additional disposable income and use the interest to pay the higher future taxes required to repay the debt.

Buchanan (1976) and Feldstein (1976) criticised the Ricardian equivalence on the grounds that there are constraints to liquidity which makes the lifetime income hypothesis invalid. Also, the behaviour of people are not consistent, hence, cannot be used for a laboratory experiment. Feldstein also argues that Ricardo did not take into consideration economic growth as well as growth in population. He further mentions that when public debt increases, it discourages savings in the economy (that is growing). Seater (1993) is of the opinion that the Ricardian equivalence needs much logical consistency to hold, hence, this becomes impractical. To him, there is a measurement as well as an econometric methodology problem in the Ricardian equivalence which makes it difficult to come out with clear solutions.

Even though the Ricardian equivalence proves that government does not influence the macro economy, it can only be true under the following assumptions: taxes need to be lump sum; households need to have an infinite horizon; and households need to be able to borrow and lend at the same time as government. Since the Ricardian equivalence is of the opinion that government has little role to play in the macro economy, this theory seems to contradict expectations of this study because it is expected that fiscal policies can reduce government debt. As such, this study estimates the debt reduction model before any conclusions can be drawn if it is in line with the Ricardian opinion or not.

2.2.2 The Structural view

Structural economists believe that the public sector in most countries is very broad and when there is an increase in tax burdens and tax rates, it discourages work, output and people to save, invest and ultimately stifles economic growth. They advocate the reduction of marginal tax rates as well as government spending. These supply side economists emphasise that structural measures be implemented aimed at increasing the creation capacity of the economy and the redistribution of the impact of the budget. The structural approach to fiscal policy focuses on the following aspects: public debt should be kept at a sustainable level in order to avoid budget deficits; the tax burden should not discourage people to work, save and invest; and government spending should be kept under control in order to avoid crowding out of private activity, inflationary finance and disincentives effects of an excessive tax burden (Calitz & Siebrits, 2012).

This school of thought considers fiscal policy as a tool to sustain public debt so that taxes should be increased to a point where it does not affect the economy. Also, government spending should be maintained so that it does not affect the economy. They emphasise on the fact that fiscal policy should be at a sustainable level.

It is not easy to determine the sustainability of public debt through budget deficit. However, the policy is good in order to reduce government debt. While this theory advocates for a sustainable debt level, this study determines the coefficients of taxes and government spending which could be implemented to have a sustainable and or reduce debt level.

2.2.3 The Keynesian view

Keynesian economists argue that fiscal policy could be used to maintain a high level of output and unemployment. The Keynesian approach, also referred to as the anti-cyclical fiscal policy, became prominent after the Second World War. The global financial crisis of

2008 to 2009 generated renewed interests in the Keynesian perspective. Keynesian economists believe that spending and taxation can be used to stabilise aggregate demand and the national level of income. Also, taxes from income and benefits from unemployment are automatic stabilisers as they encourage demand and stabilise active fiscal policy. Change in income will cause change in tax revenue and transfer payment, hence, aggregate demand, income and output.

According to Calitz and Siebrits (2012), government revenue and expenditure is a function of national income. The government sets annual outlay such that its public expenditure is not related systematically to its economic activity while its tax rates are set in a manner that the yield on the different taxes vary with the level of economic activity. When an economy experiences a shock to the extent that it reduces its income and taxes, budget becomes negative.

When income is increased at the beginning, it will increase disposable income, consumption and aggregate expenditure. Higher expenditure will generate higher income, higher disposable income and higher consumption. Since the marginal propensity to consume (MPC) is less than one, the increase in expenditure gets smaller and smaller each time. The multiplier is:

$$K = \frac{1}{1-c} \quad \text{.......(2.9)}$$

where K is the multiplier and C is the MPC.

The total change due to a change in government spending is:

$$\Delta Y = \frac{1}{1-C}\Delta G \quad \text{.......(2.10)}$$

where ΔY represents the change in output and ΔG represents the change in government spending. When government spending increases, output will increase by a multiplier effect. When MPC is higher, any increase in income as a result of increase in the initial expenditure will generate further increase in expenditure.

When lump sum taxes are levied, the expenditure function will shift downwards. An increase in taxes will lower disposable income, autonomous consumption and thus planned expenditure. Planned expenditure will be lowered by $c\Delta T$, where ΔT is a change in tax. A drop in expenditure will have a multiplier effect on the level of national income. On the other hand, a drop the fall in consumption leads to lower income, which in turn, leads to lower consumption and so on. The effect of the increase in taxes on national income would be:

$$\Delta Y = \frac{-c}{1-c}\Delta T \text{ ....} (2.11)$$

A rise in MPC has two effects: initial drop in consumption following tax cuts will be larger as consumption is more responsive to changes in disposable income and the multiplier will be larger.

When government increases spending and taxes by the same amount, the effect on income will be zero. Taxes to finance government spending may have an impact on national income. A tax-finance government spending is represented as: $\Delta G = \Delta T$. A rise in government spending will lead to an upward shift in the expenditure function and an increase in taxes to a corresponding down shift. The combined effects of government spending and taxes are:

$$\Delta Y = \frac{1}{1-c}\Delta G - \frac{c}{1-c}\Delta T \text{ ....} (2.12)$$

Government's fiscal policy can play a significant role in determining aggregate demand and the level of national income. According to the Keynesian model, changes in government spending or taxes will only affect consumers to the extent that their disposable income changes. On the other hand, forward-looking, rational and utility maximisation consumers must make a more complicated decision. This is because a government's current tax and spending policies may influence its future tax and spending policies and therefore, have repercussions for future disposable income of a household.

The Keynesian model suggests the ability of the automatic stabiliser to moderate cyclical fluctuations in economic activities. In a recession, Keynesians maintain that governments should increase spending or reduce taxes and do the opposite in a boom. The widely used barometer of anti-cyclical fiscal policy is budget deficit.

The shortcomings of the Keynesian perspective are as follows: a fiscal policy entails many stages with delays at each stage; and governments are unwilling to implement such policies consistently. Most governments are more involved in adopting expansionary policies during recessions than to impose short-term hardships associated with contractionary policies in economies facing the danger of overheating. According to Calitz and Siebrits (2012), governments of most developed economies are implementing fiscal rules such as expenditure limiting rules, current balance rules, overall balance rules and public debt rules and not a contractionary fiscal policy. This theory is in line with this study but many other variables are included and a debt reduction model estimated for countries under consideration.

2.2.4 Debt overhang

According to Myers (1977), debt overhang is a scenario where the debt of a nation is larger than earnings acquired from the new investment undertaken by the existing debt holders such that the positive net present value cannot reduce the country's stock of debt. Sachs (1989) developed a theoretical model for debt overhang. In this model, when debt is forgiven, the current market value will change as well as it will increase the value of the expected obligation payment from the debtor's country. Higher debts may lead to higher interests on debts, reduce the possibility of the nation to pay its debts and increase the possibility of default. When the debt face value is greater than the expected value, a reduction in the debt face value will decrease the possibility of default on the interest payments or on the principal amount of debt.

Krugman (1989) maintains that debt overhang acts as a disincentive to current investment since it acts as a marginal tax on investment. This is a situation where a country's debt obligation exceeds the amount it has to pay. This is so because investors are scared that proceeds from new investments will be taxed away to service pre-existing debts. When current investment is low, it reduces growth, government revenues, the ability to reimburse the debt and thus the value of the expected debt. Countries experiencing debt overhang will experience a reduction in expected tax burden when their debts are reduced. It will make the borrower and lender better off, increase investment, growth and taxation revenue. Debt cancellation requires a mechanism that will enable creditors to accept their losses. When a country recovers from its debt, creditors reap the benefits and not the debtors. This discourages the country from improving its economic performance.

Krugman (1989) used the debt Laffer curve to illustrate the relationship between the debt face value and the debt market value. This curve starts by increasing progressively up to a certain point where the market value begins to increase slowly. More debt being accumulated leads to an overall decrease in the market value. The marginal return of debt still increases, but if the debt continues to increase beyond the threshold point, the absolute face value cannot compensate the marginal decrease in the market value. When this happens, the country is said to experience a debt overhang. Workie (2001) derived a debt overhang which starts with the assumption that the previous amount of external debt will have to be carried over and to be paid in final period. They assume two conditions: favourable and unfavourable where productivity is expected to vary. After investment, there could be either a favourable or an unfavourable condition. A country is said to be experiencing a debt overhang when the amount of debt is greater than the output less fixed output amount, since enough resources are not available to service the contract debt obligation in a bad state. When the amount of debt is less than the output less fixed output amount, then the debt is service during favourable time.

Forgha (2008) maintains that debt overhang, also referred to as debt-driven capital flight, influences the incentive to save and invest. It assumes that there will be an expectation of exchange rate devaluation, fiscal crisis, crowding out of domestic capital and expropriation of asset to pay for the debt. Capital flight leads to poor growth which promotes indebtedness (Dim & Ezenekwe, 2014). Indebtedness increases capital flight which leads to poor economic growth. Pattillo, Poirson and Luca (2002) posit that when there is expectation that future debt may be higher than the ability of the country to pay the debts, the debt services would increase. This increase will be a function of the country's output level. Return on investment in the country attracts higher marginal tax. External creditors, new domestic and foreign investments are discouraged. This theory exposes the negative effects of accumulated sovereign debt as experienced by Greece and the need for appropriate measures to reduce debt as examined in this study.

2.2.5 Tax smoothing

Barro (1979) bases his argument on the fact that the government of a country minimises tax distortion by allocating tax over a period of time. According to Romer (2012), tax distortion creates an increase in revenue. A government may desire to smooth the path of taxes over a period of time in order to avoid the effects of tax distortion since its variation is higher when taxes are steady. By so doing, five assumptions as explained by De Haan and Zelhorst (1993) have been advanced as follows:

- The aggregate demand is not affected by the time path of tax over a period;
- The time path of future government spending is given;
- The discounted values of government spending plus the initial stock of public debt is equal to the discounted value of taxes;
- The collection costs of taxation are homogenous in taxes and the tax base; and
- The marginal collection costs are an increasing function of the tax rate.

Furthermore, Barro (1979) argues that government makes a choice to minimise the present values of the excess tax burden. Tax burden is the distortion of allocative decisions and administrative costs incurred by the raising institution.

This tax burden is represented mathematically as follows:

$$Z = \sum_{t=1}^{\infty} T_t f(T_t / Y_t) / (1+r)^t \qquad (2.13)$$

where z is the tax burden, t is the net tax collection, Y is the tax base and r is return on public debt. The present value of net tax collection is given as:

$$\sum_{t=1}^{\infty} [G_t / (1+r)^t] + b_o = \sum_{t=1}^{\infty} [T_t / (1+r)^t] \qquad (2.14)$$

where G is government expenditure and b_o is the initial amount of outstanding government debt. When tax rates are subsidised over a period of time, public debt is affected. When this happens, large temporal government purchases should be financed by debt issue while higher level of government spending ought to be financed by taxes. Secondly, when real government expenditure is cyclical, a tax smoothing policy entails deficits during recession and surplus during booms. Thirdly, anticipated inflation is reflected in the growth rates of nominal debt. Lastly, the policy maintaining stable tax rates is independent of the initial stock of government debt.

According to Romer (2012), tax smoothing under certainty, in a discrete time in an economy, gives rise to the following exogenous situations paths of output (Y), government purchases (G) and real interest rates (r). This real interest rate is constant and b_0 stands for the initial stock of outstanding government debt. It is shown that the distortion of tax relative to output is a function of taxes relative to output and rises more than proportionally with taxes relative to output. The government is expected to choose the path of taxes to ensure that it minimises the present value of the distortion cost subject to the budget constraint. Romer (2012) showed that marginal benefit and the marginal cost of tax must be equal as well as the change share of output and tax rate must be constant. Tax smoothing minimises distortion cost from higher taxes. When tax rates increase, marginal distortion cost per unit is increased, so a smooth tax rate minimises distortion.

For tax smoothing under uncertainty, the government minimises the expected present value of the distortion from increasing revenue. The budget constraint is the same as under certainty with the present value of tax revenues equal to the initial debt plus the present values of purchases (Romer, 2012). Reinhart and Rogoff (2013) are of the opinion that this theory adds value to this study because it is used to reduce government debt since financial repression is taxation that leads to distortion. This theory is related to this study in that, many other variables that affect government debt are included as well as the effects of tax increases in the economy.

2.2.6 Government budget constraint

According to Romer (2012), the federal government of the USA has been in large budget deficits for over the years with increases in pension and medical care programmes for the elderly as well as impending retirement based on baby-boom. Government budget constraint should be in a manner that the present value of its purchase of goods and services must be less than or equal to its initial wealth plus the present value of its tax receipt. Government budget constraint does not stop the government from staying in permanent debt nor from increasing the amount of its debts.

Deficit is defined as the amount of money which a government can borrow during a period of time. Interest payment is the real interest payment, which is a product of the real interest rates times the existing debt rather than an actual interest payment that is a product of the nominal interest rate and the existing debt (Blanchard, 2011). The budget deficit of the year t is given as:

$$Deficit_t = rD_{t-1} + G_t - T_t \text{ ......(2.15)}$$

where D_{t-1} is government debt at the beginning of year t, r is the constant interest rate, rB_{t-1} is the real interest payment on government debt in period t, G_t is government spending on goods and services during year t, T_t is taxes minus transfer during year t.

According to Blanchard (2011), government budget constraint is the change in government debt during a period of time t which is the same as the deficit during year t:

$$D_t - D_{t-1} = Deficit \text{ ......(2.16)}$$

If a government runs a deficit, government debt increases, if a government runs a surplus, government debt decreases. This is rewritten as:

$$D_t - D_{t-1} = rD_{t-1} + G_t + T_t \text{ ......(2.17)}$$

where $G_t - T_t$ = Primary deficit, $D_t - D_{t-1}$ = change in the debt, rD_{t-1} = interest payment.

It becomes:

$$D_t = (1+r)D_{t-1} + G_t - T_t \text{ ......(2.18)}$$

At the end of the period t, debt equals $(1+r)$ multiplied by the debt at the end of period $t-1$. The implication of a one period decrease in taxes for the path of debt and the future taxes assume that until year 1, the government has balanced its budget so that the initial debt is equal to zero. To repay such debt, the government must have a surplus which equals to $(1+r)^{t-1}$ for the year t. If taxes are reduced by 1 in period 1, this would cause an increase in taxes of $(1+r)^{t-1}$ during period t. If the government does not change its spending, there will be an increase in future taxes, real interest rates will increase and an eventual increase in taxes. During a recession, a government may desire to run large deficits such that the cyclically adjusted deficit is positive. As such, the debt may not be stabilised by the output returns. The government needs to cut spending and increase taxes in the future in order to decrease deficit. This theory constitutes the basis of the framework for this study. Equation 2.18 is adopted and adjusted to sort out the aims of this study.

2.3 EMPIRICAL PERSPECTIVES

From an empirical perspective, literature review was conducted on sovereign debt and fiscal consolidation. An examination of literature on government debt and fiscal consolidation was carried out in order to identity research gaps in the literature. Studies and sources similar to the topic under discussion constituted the focus of the review. Furthermore, the literature review also focused on measures of reducing government debt, a review of reduction in government spending and an increase in taxes and finally, the consequences of fiscal consolidation.

2.3.1 Related literature on government debt and fiscal consolidation

Fiscal consolidation refers to a period where government spending is decreased and taxes are increased with the aim of obtaining a sustainable debt trend. Larch and Turrini (2008) define consolidation as an improvement of the cyclically adjusted primary budget balance to a minimum of 1.5% of GDP. According to IMF (2013), fiscal consolidation was implemented in 2009 in some developed countries after the European debt crisis of 2008. Some of the countries that implemented the policy are currently experiencing positive primary balances which may bring about stability in their sovereign debt levels. In some countries, growth has been retarded due to high debts and also because the economy has been exposed to shocks in the markets due to the implementation of discretionary policies. The challenge is that there could be structural changes in the debt markets that may destroy the involvement of countries such as the USA and Japan. With these reasons in mind, establishing a sustainable debt level in developed economies will have negative economic effects both in the short and long-term periods. Sustaining consolidation as a measure of reducing sovereign debt level is essential even though it is difficult to know the amount of debt. If advanced economies maintain a 1% point of primary surplus, it may cause sovereign debt level to decrease to 60% of debt to GDP in 2030 even though it is a difficult task to maintain these surpluses over time (IMF, 2013).

The USA set a target to reduce its primary deficit to 1.75% of GDP by 2013 when they implemented the fiscal cliff. The tightening of the fiscal policy turned out to be the most severe one in the last decades and the USA projected 6.5% GDP in 2013 to decrease in deficit but the decline will be due to reduction in the support of financial sectors. The overall fiscal tightening is one of the largest in recent decades. In Greece, adjustments will continue and institutional reform will be renewed focussing more on revenue administration and expenditure control which may bring primary balance to zero in 2013 (IMF, 2013).

According to Sterdyniak (2010), fiscal consolidations were not seriously taken into consideration during the 1998-2000 since growth was satisfactory. This is because of the 5% unemployment rate target which is supposed to be below the 9.3% estimated by the commission. The growth and stability pact was the only component where the commission had effective disciplinary power, but had the following shortcoming: its rules had no economic basis and could not be changed. There is no sanction implemented against countries that had restricted their policies so much or increased their imbalances; they do not take into account external balances of 3% deficit, 60% public debt and medium balance of public finance. The process of coordination of economic policies seems purely formal.

Heylen *et al.* (2013) maintain that both permanent cut in expenditure and increase in tax contribute significantly to the reduction of debt in the long run. Cutting down subsidies and public sector wage bill are effective in reducing debt when the public sector is efficient in administration. Cutting down social benefits has more effects in the long run compared to the short run. Von Hagen, Hallett and Strauch (2002) argue that expenditure cuts, especially on the wage component of public spending, makes fiscal consolidation succeed than tax increases.

Alesina and Ardagna (2009) state that when there is fiscal adjustment, spending cuts are more effective than tax increase in stabilising debt and avoiding economic downturns. When there is permanent increase in tax and/or decrease in spending, it reduces the danger of costly fiscal adjustment in the future thus, generating a positive effect on wealth. Also, if agents believe that government debt will be stabilised and that there will be no default, they can ask for lower premiums for government bonds. Reduction in interest rates can lead to the appreciation of stocks and bonds but increasing the financial weather of agents and triggering consumption boom. Reduction in government employment reduces the probability of finding a job. This makes the utility of union members to decrease as well as the demand for wages by union members to decrease hence increasing profits, investment and competitiveness.

The argument advanced by Ismihan and Ozkan (2012) is that, contractionary fiscal expansions are observed by countries where financial depths are limited. This is based on the notion that a rise in government expenditure crowds out private investment. According to these authors, a country that gives credit to its government makes up a major share of total bank lending. This internal public debt is likely to harm the financial development of the country concerned. Contractionary fiscal expansions are thus recommended for countries with limited financial depth and financial development. Ferreire de Mendonca and Machado (2012) examined public debt in Brazil. Their findings revealed that commitment with public debt increases fiscal credibility which is important in managing public debt.

According to Agnello *et al.* (2013), spending-driven fiscal consolidation programmes have a better chance of success than tax-driven fiscal consolidation and cuts in public investment. Agnello *et al.* (2013) maintain that interest and inflation rates need to be carefully addressed as a means of obtaining a signal of the successfulness of the fiscal consolidation programme. As emphasised by Heylen *et al.* (2013), when a government is efficient, fiscal consolidation is more effectively realised. Also, a government that uses expenditure cut is more significant in fiscal consolidation than other governments. With product market deregulation, fiscal consolidation policies are significantly more successful because where there is competition, there is productivity and growth as well. According to Alesina and Perotti (1995), fiscal consolidation programmes tend to be more successful with a single party government than coalition governments.

In the same vein, Larch and Turrini (2011) point out that fiscal consolidations are successful when there is qualified governance in place. This is achieved through disciplined-oriented budgets and implementation of budgetary plans. Furthermore, fiscal consolidation is effective and long lasting when accompanied by structural reforms. Reforms that aim at improving the functioning of labour and products markets make consolidation more successful. According to Larch and Turrini (2011), structural reforms help fiscal consolidation by directly capping or flattening existing trends and indirectly by spurring economic activity. Direct cuts in government wages or employment do not play any important role in the success of fiscal consolidation. This is because they contribute to wage moderation. Successful consolidation involves more expenditure, less revenue, fiscal governance and structural reforms.

As emphasised by Agnello *et al.* (2013), factors that may have an impact on the probability of having successful fiscal adjustments are the timing of austerity measures, the size of the austerity as well as its composition. When the consolidation is gradual, it is more successful than when it is done with full force. On the other hand, Von Hagen *et al.* (2002)

maintain that when fiscal consolidation lasts for a relatively long period of time, the adjustment process will last for a relatively long period, the reverse is higher. The size of the fiscal consolidation programme is determined by the commitment of the government to achieve long-term sustainability of public debt (Giavazzi & Pagano 1996).

According to Tagkalakis (2009), labour and product market institutions are determinants of initiating and getting a successful fiscal consolidation programme. Institutional reforms involve lowering unemployment benefits. Also, there should be more bargaining coordination and low centralisation to get a successful fiscal adjustment. Also, less unionisation makes consolidation more successful. IMF (2013) examined the effects of fiscal consolidation on economic activities. The results revealed the reduction of output and increase in unemployment in the short run due to fiscal consolidation. Alongside reduction in interest rates, depreciation of the currency and increase in exports reduce the effects of contractionary policies. When fiscal consolidation relies on primary tax increase, it becomes more painful. This is because the central banks of countries provide less monetary stimulus during the period of indirect tax increases that raises inflation. Budget deficit cuts are painful when these cuts occur at the same time in countries where no monetary policy has been put in place to offset them. They focus on policy actions that reduce budget deficits. Their method is closer to that of Romer and Romer (2010) who examined the effects of changes in monetary policy and tax rates in output in the US. The findings revealed a contractionary effect of fiscal policy on output. When there is a 1 % change in GDP of fiscal consolidation, then GDP will be reduced by 0.5% in two years while unemployment will increase by 0.3% point. Likewise, domestic demand, consumption and investment will decrease by 1%. Moreover, when interest rates are reduced, output is supported during fiscal consolidation by the central bank. They offset some pressure of fiscal consolidation by cutting policy interest rates and reducing long-term rates alongside weighing its impact on consumption and investment. Fiscal consolidation is costly in terms of output loss where interest rates are zero. A decrease in the real value of domestic currency causes net export to decrease as well. When fiscal consolidation increases by 1% of GDP, the currency will decrease by 1.1% while net export to GDP will increase by 0.5% point. When the fiscal contractionary relies on spending cuts, the contractionary effects are smaller compared to tax-based adjustments. This is because central banks make available substantial stimuli on spending based on contraction than on tax based on contraction. Likewise, a 1% reduction in debt to GDP ratio will cause output to increase by 1.4% in the long run.

Sinha, Arora and Bansal (2011) conducted a study on the determinants of public debt using panel data for various countries. Their results revealed the effects of central government expenditure, education expenditure and current account balance on public debt in these countries. Similarly, inflation and foreign direct investment of these countries did not determine public debt in high income groups and it turned out that GDP growth rates are the only variables that affect debts the most in all the countries. When the average of the public debt was considered, the forecasts results of countries with high income revealed a constant increase over the periods while middle income ones showed that the debt may worsen over the next 5 years.

Greiner (2012) argues that a higher debt ratio leads to crowding out of private investment thus, decreasing long-run growth when government reduces public spending to fill its inter-temporal budget constraint. When the government reduces lump-sum transfer, public debt does not affect the long run balance growth rate. Reinhart and Rogoff (2010) studied the growth and debts of 44 countries. The results for advanced economies and emerging economies revealed that for debt to GDP ratio below 90% of GDP, there is a weak relationship between government debt and real GDP (Chang & Chiang, 2012). Above the threshold limit of 90%, the average growth drops even further. The total external debt of emerging markets is more of foreign currency than local currency. When external debt is about 60% of its GDP, annual growth decreases by about 2%, above 60% of GDP growth rates are reduced by 50%. Also, no relationship exists between inflation and public debt in developed economies while for developing economies, debt increases as inflation increases.

Similarly, Kumar, Leigh and Plekhanov (2007) believe that structural reforms in health care, unemployment benefits and pensions have assisted fiscal consolidation. This occurs through raising the efficiency and reducing cost of public service provision and by strengthening incentives to work indirectly (Tagkalakis, 2009). Increase in taxes discourages the supply of labour. The government can lower wage-related public expenditure which has a direct effect on the economy or it can indirectly affect the economy by wage moderation, boosting employment creation and growth.

Alesina and Perotti (1997) examined the success and consequences of a large number of fiscal consolidations implemented by OECD countries from 1960 to 1964. They maintained that fiscal consolidations carried out by cutting down expenditures are more successful than those based on increasing taxes. Moreover, they found that when fiscal consolidation is expansionary, it is more successful while contractionary effects are unsuccessful. According to Agnello *et al.* (2013), higher budget deficits and increase in public debt levels require a longer consolidation process. Increase in economic growth reduces consolidation periods. Lower real interest, higher inflation rates and more trade openness lead to a faster consolidation process and a fiscal or financial crisis may end the adjustment process sooner than expected.

Blanchard and Perotti (2002) and Agnello *et al.* (2013) are of the opinion that positive government spending shocks increase output and private consumption and have a crowding-out effect over private investment while positive tax shocks have a negative effect on output and private spending. When tax reforms are implemented alongside labour market reforms, fiscal adjustment is increasingly successful. Furthermore, Agnello *et al.* (2013) assessed the causes of the duration of fiscal consolidation for industrial countries from 1978-2009. The results revealed that budget deficits, level of public debt, degree of openness, inflation, interest rates as well as GDP per capital are important for the implementation of fiscal consolidation. Also, when consolidation is spending-driven, it is short in the implementation period than when it is tax-driven. But both types of fiscal consolidation have longer duration periods in countries out of Europe compared to countries in Europe which does not significantly affect duration. Hence, spending cuts brings an economy into sustainable path for public debt.

According to Agnello *et al.* (2012), higher per capital GDP, lower real interest rates, higher inflation and more trade openness help in shortening the adjustment period of fiscal consolidation. Larger budget deficits lead to a longer consolidation process, therefore, spending-driven is shorter and more successful than tax-driven consolidation. The size of a consolidation programme does not affect the duration. Agnello *et al.* (2012) used data from 17 industrialised countries for the period 1978 to 2009. They found out that higher budget deficits takes longer periods for the consolidation process, increase in public debt levels makes consolidation to take a longer period to end, good economic conditions contribute to shorter consolidation, lower real interest rates, higher inflation rates and more trade openness lead to a faster consolidation process and economic fiscal crisis may end the adjustment process sooner than expected.

Blanchard and Perotti (2002) carried out a study in order to identify exogenous changes in fiscal policy and estimated fiscal multiplier both on the tax and spending side of government using the structural VAR. They found that positive government spending shocks increase output and private consumption and have a crowding-out effect over private investments while positive tax shocks have a negative effect on output and private spending.

Afonso and Sousa (2009) identified fiscal policy shocks and the posterior uncertainty of impulse response functions by using a Bayesian structural vector Autogression (B-SVAR) model. The results revealed that government spending shocks have a negative effect on GDP. This shock leads to a fall in both private consumption and private investment. Also, government spending shocks impact positively on price level and the average cost of refinancing debt. Government revenue shocks have a negative impact on GDP on private consumption and on private investment and leads to a fall in price level.

Blanchard and Perotti (2002) studied the response of fiscal policy using the elasticity of fiscal variables. Their findings revealed increases in fiscal shocks that have a negative effect on private investment while a positive effect on private consumption was found. As far as Ardagna (2004) is concerned, debt as a ratio of GDP will decrease if the size of the adjustment increases as well as GDP growth. But it does not have to depend on tax weight hikes. Meanwhile, Alesina and Perotti (1997) also found that when GDP growth is higher, primary spending will decrease largely, especially when the cuts focus on public employment and wage bills. On the other hand, Joumard and Andre (2008) argue that direct taxes on households contributed to growth in revenue in Canada, New Zealand, the United Kingdom and the USA. Increase in personal income tax receipts caused an increase in capital gains and a rise in interest income. Finally, Sheikh, Muhammad, Muhammad and Khadija (2010) maintain that there is a positive relationship between sovereign debt and growth. Also, a negative relationship between debt servicing and economic growth is revealed.

As far as Cimadomo, Hauptmeier and Sola (2011) are concerned, when fiscal shocks are not accompanied by expected future reduction in government expenditure, there is an increase in the burden of public debt and a decrease in confidence that reduces real activities. Also, when fiscal shocks are put together with expectations or future reduction in government spending, fiscal stimulus will effectively boost economic activities and reduce the accumulation of public debt in the long-term. Contrary to this notion, Blanchard and Perotti (2002) argue that when government expenditure increases, its output as well as taxes will also increase. Government expenditure shocks stimulate an increase in private consumption, but at the same time, private investment is crowded out while there is a drop in export and import.

Positive government expenditure shocks affect output positively while positive tax shocks have negative effects on output. Increase in taxation and government expenditure have strong negative effects on private investment.

Romer and Romer (2010) maintain that some of the reasons for changes in tax levels in the US are to counteract other influences in the economy, pay for increase in government spending, address an inherited budget deficit and promote long-term growth. The consequences are that: there is a large effect on output; an exogenous increase of 1% of GDP lowers real GDP by about 3% while investment falls in response to exogenous tax increases; and the effect of tax is highly persistent.

Wheeler (1999) studied the impact of government debt in the USA using variance decomposition and impulse response functions for the 1980s and 1990s. He tested the Ricardian Equivalence hypothesis focusing on the effects of government debt on output, price level and interest rates. The results revealed significant negative relationships between government debt on interest rates, price level and output (Batool & Zulfiqars, 2013). Bildirica and Ersin (2007) also believe that the cost of domestic debt increases because of inflation. Sbrancia (2011) assessed the effects of inflation on government debt for 12 advanced countries after the World War II that led to inflation. The findings revealed that inflation reduces government debt. A further analysis by Atique and Malik (2012) using the OLS to estimate the regression model shows that there is a negative significant effect between domestic debt and economic growth as well as external debt and economic growth. Also, external debt has a stronger effect on economic growth.

In addition, Ajai and Oke (2012) point out that external debt burden has an effect on income and per capital income of the nation. Also, a high level of external debt causes devaluation of currencies, increases the retrenchment of workers, strikes and poor educational. They based their theory on the dual cap analysis which states that development is a function of investment and the investment should not depend on domestic savings but could be obtained from abroad through import and export.

Amoateng and Amoako (2002) concluded that there was one directional positive causal relationship between foreign debt service and GDP growth for sub-Saharan African countries from 1983-1990. Dinca and Dinca (2013) examined the relationship between GDP growth rates on other variables for five communist bloc countries from 1996 -2010. The results revealed that public debt negatively affects the economy in these countries when the debt is above 44.42% of GDP. Sheihk *et al.* (2010) analysed the impact of domestic debt on economic growth in South Pakistan using the OLS from 1972 to 2009. The results revealed that there is a negative effect of domestic debt serving on economic growth compared to the effect of domestic debt on economic growth.

Taylor, Proano, Carvaldo and Barbosa (2012) continued this analysis by studying the relationship between GDP, net federal debt, primary deficit, primary incomes, primary expenditure and real rate for the USA from 1961-2011. The results revealed that primary federal deficit and net government financing have an expansionary evolution during recessions which prove the counter cyclical role of fiscal policies. On the other hand, Reinhard and Rogoff (2010) show a weak relationship between government debts above 90% of GDP. Herdon, Ash and Pollin (2013) maintain that public debt to GDP ratio of over 90% as shown by Reinhard and Rogoff (2010) is 2.2% and not 1%. Also, there is a non linear relationship between public debt and GDP growth for public debt to GDP ratio of 0-30% and 30-60% which is not a problem for policy debate. Moreover, the conclusion that countries with public debt to GDP ratio above 90% will have their GDP growth reduced was a wrong conclusion. Also, the median interest rate will decrease by 1 percentage point. In a similar manner, Rahman (2012) analysed the impact of federal government debt on economic growth in Malaysia and their outcomes revealed that in the long-run, high domestic debts have a negative impact on economic growth. In the short-run, there is no significant impact of domestic and external debt on economic growth.

Amo-Yartey *et al.* (2012) used panel data set of 155 countries from 1970 to 2009 to econometrically analyse the determinants of global debt reduction. They focused on fiscal consolidation, growth and debt servicing cost in explaining the probability of large debt reduction. They measured fiscal consolidation as cyclically adjusted primary balance to potential GDP ratio. Other variables include GDP growth, inflation and interest payment to GDP. The results showed that large debt reduction globally is achieved by decisive and lasting fiscal consolidation. Also, strong economic growth as well as high debt services cost positively reduce large debts. Inflation does not reduce debt significantly and it is negative. These results are confirmed by Nickel, Rother and Zimmermann (2010) who maintain that reduction in debts are achieved by a decisive and lasting fiscal consolidation which focuses on government expenditure, particularly cuts in social benefits and public wages. Their findings revealed that revenue-based fiscal consolidations are less successful while real GDP growth increases the probability for debt reduction. Reinhard and Rogoff (2013) maintain out that there are five ways in which debt could be reduced. These ways include economic growth, fiscal adjustment austerity, explicit default or restructuring, inflation surprise and steady financial repression and inflation. According to these authors, financial and fiscal austerity may reduce debt but restructuring is needed, especially for countries in the periphery of Europe.

2.3.2 Measures to reduce government debt

Nelson (2013) argues that because of the Global Financial Crisis and the recession, many advanced economies experienced large fiscal consolidation, the nationalisation of private sector debts, a reduction in tax revenue and high government spending. These factors led to high budget deficits and an increase in debt. Most developed economies are restructuring their fiscal policy in order to reduce government debt. Burdan and Wyplosz (2010) propose the following methods in order to reduce rising government debt: contracting fiscal policy; inflationary finance; and debt default. Similarly, Aizenman and Marion (2011) mention four mechanisms through which debt could be reduced as follows: They include growth in GDP; increase in inflation; tax revenue; and debt default. In line with that, Nelson (2013) also proposes similar mechanisms which include fiscal consolidation, debt restructuring, inflation, growth and financial repression. Out of all these methods, this study dwells more on fiscal consolidation. The frequently used measures to remedy sovereign debt are: restructuring, default, inflation, economic growth, financial repression and fiscal consolidation which are discussed below.

2.3.2.1 Debt restructuring

Das, Papaioannou and Trebecsch (2012) define sovereign debt restructuring as a legal process where outstanding debt instruments are exchanged for new ones. Debt restructuring could be in a form whereby debt is rescheduled or reduced. When debt is rescheduled, it implies that there is an increase in the maturities date of the debt owed and maybe a lowering of the interest rates while debt reduction is the decrease in the face value of the debt owed. Debt restructuring also means extending the time over which the debt is to be repaid, reducing the interest rates or reducing the principal debt balance by cancelling some of the debt (Nelson, 2013). Nelson also points out that restructuring could be done by extending the period of debt payment and lowering the interest rate in several emerging markets. Debt restructuring is thus undesirable, especially if the debt is domestic. The challenge is that restructuring is rather difficult to organise and negotiate with many individual bondholders since it is cumbersome and time consuming. Even though African countries have undergone a series of debt restructuring, most developed economies, especially the USA and the Eurozone did not experience it after the second World War until the debt crisis in 2008 (Das *et al.*, 2012).

Greece restructured its debt in March 2012 whereby 97% of private bonds held by Greece (€197 billion) had a 53.5% cut to the value of the bond and its net present value reduced to about 75%. According to IMF (2013), Greece restructured its debt to the tune of €205 billion in February 2012. Belize restructured its debt in 2007, Jamaica in 2010 and 2013, Dominica in 2004 and Grenada in 2005. Nelson (2013) reiterates that debt restructuring in developed countries is good because most of their debts are held domestically. Restructuring debt will cause great loses on private owners and may put pressure on the government to bring surplus faster than if it had not been restructured. This may increase interest rates thus, increasing the cost of borrowing. Das *et al.* (2012) and Wright (2011) revealed some negative effects of debt restructuring. They maintain that the process is costly, may cause exclusion from capital markets, financial instability and spill over effects to other sectors of the economy.

2.3.2.2 Sovereign debt and default

Sovereign debt default occurs when a government does not promptly pay its interest or principal debt when it is due. Default could be partial or complete. Partial default is when just part of the debt is not paid while complete default is when the entire debt is not paid. Some of the possible sanctions of sovereign default are as follows:

Panizza, Strurzenegger and Zettelmeyer (2013) maintain that the principle of sovereign immunity states that sovereigns cannot be sued in a foreign court without their consent. Sovereign immunity does not totally protect the sovereign debtor. Sovereign debt is difficult to enforce since the ability of creditors to recover their debt is limited to the fact that only assets located outside the sovereign's borders can be legally attached but countries tend to hold most of their assets within their borders. The classical theory of sovereign debt focuses on the actions of non-residents. Positive lending can be sustained even when creditors have no means of punishing defaulting countries.

When a sovereign borrower defaults on a debt contract, the legal remedies is limited by the doctrine of sovereign immunity. Since the sovereign debtor is not penalised for defaulting, the ability of the sovereign's creditor is limited in the sovereign court of the debtor country. The principle of sovereign immunity has been weakening over time due to the United States' Act of 1976 on foreign sovereign immunity and the United Kingdom' State Immunity Act of 1978. These Acts recognised the immunity of the sovereign with regard to acts of states but not with respect to private acts. With this in mind, foreign creditors can sue a sovereign in default on its debts in their own and other jurisdictions but only on assets. In the absence of legal remedies, the creditor country government can punish the sovereign debtor in default (Wright, 2011). Resolving default on debt is negotiable and is not a legal enforcement of contractual penalties. The principle of sovereign immunity has been criticised on the following grounds: the threats of not lending in the future to the default sovereign hurts potential future lenders and once a sovereign defaults, its ability to pay increases. Also, if a country purchases an insurance contract that pays in low output, the threat of credit denial loses its grip entirely from borrowing from international lenders (Panizza *et al.,* 2013).

Sovereign states could be sanctioned by preventing their access to financial markets when they fail to pay part or complete their debts. Also, when a country defaults, it prevents its creditors from giving the country new loans (Wright, 2010). In this case, the cost of its default is much on the creditor's countries since they may lose a certain percentage of their outstanding debts. The default damages the country's reputation with its creditors hence the ability to obtain credit from the capital market could be restricted. Furthermore, when government creditors are nationals, it may lead to the devaluation of the monetary wealth. In general, government default may cause banking, economic and currency crises (Rose 2005).

According to Taylor (n.d), default is done through a currency reform when government debt is held domestically and by devaluation if debt is in a foreign currency. Lascelles (2013) emphasises that most countries rarely default debt held by their own banks, pension funds and others in order not to cause a financial crisis. In the event of default, the government decides on the amount of debt to default (Lascelles, 2013). When a government defaults its debt service, cost is reduced as well as a gain in the ability to sustain existing debt. Based on Greece's experience of defaulting twice, it appears that default is not always a good measure to be used to reduce government debt.

As consequences of default, Lascelles (2013) maintains that when a country defaults, its creditors could claim some of their assets. A classic example is that of Argentina where assets (ships in foreign ports, international patent and satellites) were claimed in 2002 due to debt default. Default makes it difficult for a country in default to borrow again as was the case in Russia in 1998. The country was not granted access to the bond market for 12 years after the default. Default countries experience increase in borrowing cost which affects firms and households in the country. Finally, default may cost loss of confidence on the part of international good will givers which may affect the trade prospects of the default country as well as their international financial flows.

2.3.2.3 Inflation

Inflation is the general increase in price and the fall in the value of money. A country whose debt is dominated by domestic currency can use inflation to reduce the real value of its debts. Abedian and Biggs (1998) confirm that inflation reduces both public and private debt. Inflationary debt reduction is done by creating money which will be used to pay creditors. It helps reduce interest rates, debt-servicing and enables the government to allocate resources to sectors such as health, welfare and education, among others. There are negative effects to this policy such as relative price changes thereby undermining investment decisions, especially when the inflation generates inflationary expectations and uncertainty about the future. Sectors of the economy such as social welfare and fixed income earners are usually affected. Inflation mostly affects the poor since they cannot defend themselves from the consequences of rising prices and because government cannot fully compensate for welfare losses.

This is not a good policy as the value of goods and services are reduced compared to the loan value when issued. It has not been implemented in less developed countries because most creditors are from foreign countries. Advocates of the policy believe that it is less complicated to debt restructuring but is not also a good policy. This is because when investors are expecting a rise in inflation, they will increase their interest rates both in the present and future thus increasing the cost of borrowing. Also, inflation reduces savings investments and causes more inflation.

According to Taylor (n.d), debt can be reduced by inflating it away. When inflation rate is high, the nominal GDP grows faster than the deficit thus reducing the debt to GDP ratio. This imposes high cost on bond holders who get paid back in inflated currency and at the same time, relieving taxpayers of their burden. Inflation works well for non-recurring debts but not for permanent debt. Inflation and default have been used by many countries in the past to reduce government debt, especially during the First World War in Germany. In France and Italy, debt was cancelled during the Second World War through inflation, while currency reform eliminated debt in Germany.

According to Lascelles (2013), even though the nominal value of debt is constant, inflating it will make it easier for debtors to make loan payment in money that has an inflated value and thus diminishing the debt level. Even though inflating debt will cause the nominal investment return to increase as well, inflation affects real GDP growth rates. High inflation rates make lenders to increase nominal interest rates. The US used inflation to reduce debt in the 1940s and 1950s. It was successful because of the unanticipated inflation rate that lasted only for a short period of time. Also, debts of the USA, the UK, Japan and Canada were reduced from 1970 to 2009 through an increase in inflation from one to three percentage point per year.

Nelson (2013) argues that inflation is good when debt is domestically held. This notion seems irrelevant in emerging markets because debts tend to be dominated by foreign currencies. Inflation should be expected in order to avoid interest rates by investors but this may happen in future. Inflation reduces the value of savings, creates shortage of goods and reduces future investments since there is uncertainty in the economy. Inflating debt away is limited in certain regions such as the Eurozone with a common currency (Euro). Individual countries from this area do not have control over monetary policy and cannot use inflation to reduce debt.

2.3.2.4 Growth

Economic growth is the steady growth in the productive capacity of the economy. According to Nelson (2013), expansionary fiscal and monetary policies can be used to stimulate growth as well as structural reforms. Expansionary fiscal policies will increase debt and lower interest rates. If people do not borrow, this policy will be ineffective. When some structural reforms are implemented, growth will increase and enable the country come out of debt in the long-run. A country experiencing a debt crisis may not reduce its debt in the short run. Also, most countries with high debt rates have difficulties in growing.

Lascelles (2013) maintains that economic growth reduces debt in an indirect manner. Countries with rapid growth in GDP experience a surplus budget balance as growth increases. After the Second World War, economic growth contributed in reducing the debt burden. In contrast, rapid economic growth has not been able to reduce excess debt burden in the developed world for over 40 years. Nowadays, central banks are focussing on fiscal stimulus to reduce debt and indications are that innovations and productivity growth can reduce growth. On the other hand, Nelson (2013) maintains that government can reduce its debt through economic growth achieved through expansionary fiscal and monetary policies or through structural reforms at microeconomic levels.

2.3.2.5 Financial repression

According to Reinhart, Kirkegaard and Sbrancia (2011), financial repression is the implementation of government policies whereby funds are channelled into government coffers from deregulated market environments that could go elsewhere. They sell bonds at lower interest rates to inflation hence the real interest rate is negative. When nominal interest rates are low, the debt servicing cost is reduced and when real interest rates are high, the real value of government debt is also reduced. Financial depression is effective when inflation is steady and when the debt is dominated in domestic currency. Reinhart, Reinhart and Rogoff (2012) maintain that policies in favour of this financial repression are as follows: lending to the government through pension funds or domestic banks; cap interest rates; regulation of cross border movement of capital; and a tight connection between the government and the bank. To some extent, high reserve requirements, securities transaction taxes, prohibition to purchase gold and placement of significant amount of government debt that is non-marketable is also advised.

Shaw (1973) and Mckinnon (1973) conducted a study on financial repression and found that most advanced economies used this policy during the Second World War to reduce debt to GDP ratio and is currently being used by some developed economies. According to Nelson (2013), this policy may be good because it avoids austerity and necessitates surprise inflation to be introduced in the economy. However, it will be difficult for government to control capital flight thus, making foreign investment unattractive. It may also be difficult politically since investors will not want restrictions on their investment opportunities or buy bonds at artificial low interest rates. Financial repression is therefore the use of government policies to induce or force domestic investors to buy government bonds at artificially or low interest rates. Bonds are sold at rates lower than inflation hence negative interest rates. Many advanced economies used this measure after the Second World War. In the USA and the UK, financial repression helped to reduce debt by 3 to 4% of GDP a year and 30 to 40% each decade after the Second World War and in the 1970s. Financial repression measures damage the ability of a country to attract foreign investment. In most cases, investors will disagree with policies that are meant to reduce investment opportunities and/or buy bonds at low interest rates. According Lascelles (2013), financial repression measures put emphasis on keeping interest rates lower as well as minimising the rate at which sovereign debt compounds. Interest rate repression has been well used in the past, especially during the Second World War period alongside growth and higher inflation. Keeping interest rate low discourages borrowing.

2.3.2.6 Fiscal consolidation

According to the Organisation for Economic Co-operation and Development Economics (OECD) outlook, fiscal consolidation is a policy aimed at reducing government deficits and accumulated debt. Austerity or fiscal consolidation can be used to reduce high government debt. It involves increase in taxation and/or decrease in spending. This can increase growth since it can increase investor confidence and lower interest rates. Fiscal consolidation is costly and difficult to implement, it reduces demand in the short-run, and increases unemployment. According to Ball, Furceri, Leigh and Loungani (2013), fiscal consolidation raises inequality, decreases wage income shares and increases long-term unemployment. Therefore, as indicated by Alesina, Favero and Giavazzi (2012), fiscal consolidations, based on spending reduction, are costly in relation to output loss than fiscal consolidations based on tax increases. The study by Reinhart and Rogoff (2010) supports the implementation of austerity measures in Europe and the USA.

Taking into consideration the aspects mentioned above, Nelson (2013) argues that if fiscal consolidation is taken serious, it has the potential to increase investor confidence since the interest rates of their bonds are lowered. This is beneficial because lower interest rates reduce the cost of borrowing and lending interest rates as well. Spending by consumers and firms will also decrease while investment will increase, leading to an increase in economic output. However, fiscal consolidation is costly to implement, as it reduces aggregate demand in the short-term, slows down economic growth and increases unemployment. It is politically difficult to implement fiscal consolidation due to protests in countries such as Belgium, Greece, Ireland and Spain. Lascelles (2013) emphasises that even though it is difficult to implement fiscal consolidation (since taxes are increased while spending is reduced), this is generally the most reliable measure to reduce debt.

According to Am-Yartey *et al.* (2012), fiscal consolidation is difficult to implement when debt rates are high. When this happens, interest payment will be high as well. Higher level debt means that substantial fiscal adjustment is needed to bring down debt discouraging efforts to consolidate government finances. Government expenditure mostly involves wages, interest payment and social security. It is difficult to change this expenditure, hence making fiscal policy rigid. Furthermore, when revenue decreases, current expenditure is more rigid than capital expenditure. This rigidity in current expenditure is as a result of non-discretionary expenditures which include transfers, interest payment, wages and salaries. The global recession and high commodity prices affect growth, high commodity prices exert more pressure on fiscal stance and current account for commodity importing countries. Some countries have less room for tax collection since taxes are already high.

According to Reinhard and Rogoff (2013), when government debt is reduced through default or restructuring, it leads to a drop in output before, during and immediately after the crisis. When debt is dominated by domestic currencies, financial repression and inflation are mostly used for debt reduction. Sovereign debt in emerging countries was resolved in the past through default or restructuring of external debts and financial repression on domestic debts.

Despite the fact that all the five techniques of reducing government debt have advantages and disadvantages, this study focuses more on fiscal consolidation as a policy to reduce debt. The point of departure is fiscal policy and its theories. According to Lascelles (2013), some changes have been observed in the implementation of these measures over the years. In the 1880s, default and fiscal consolidation were mostly used. In the 1930s, default was used but between the 1940s and 1950s, growth, inflation and interest rates were used. From the 1970s, inflation was used and from the 1980s till date, primary surplus has been the main measure implemented in order to reduce rising government debt in countries around the world.

2.3.3 Decrease in spending and/or increase in taxation in the USA (fiscal cliff)

Most economies are reviewing their fiscal policies. Fourie and Burger (2009) argue that the primary effect of a decrease in government expenditure in the Keynesian model is that aggregate expenditure will decrease and cause lower production and income. In this situation, interest decreases and may have a secondary effect which encourages private investment and durable consumption expenditures. The main effect of taxation is on the demand side in a simple Keynesian model. Taxation decreases household disposable income thus, reducing aggregate expenditure. Reduction in aggregate expenditure reduces the cost of products thus affecting the supply side. Indirect tax causes upward pressure on prices.

Fiscal cliff refers to the sharp decline in the budget deficit that occurred at the beginning of 2013 due to an increase in taxes and a decrease in spending as required by previously enacted laws. The idea behind the fiscal cliff in USA was to avoid these two events from proceeding as planned. If they did, they would have had a detrimental effect on an already shaky economy. Some policy cuts implemented in the USA were as follows: increase in top income tax rates; changes in tax credit and allowances; and increase in income tax base. There was also a once-off introduction of additional tax on income as well as a special tax on pensions. Furthermore, there were also cuts in public pensions, public sector pay, an increase in standard and reduced rate of VAT, a rise in excise duty and a reduction in tax credits.

In the USA, marginal tax rates were lowered for almost all tax payers through an Act enacted in 2001 referred to as the Economic Growth and Tax Relief Reconciliation Act and in 2003 by the Act of Jobs and Growth Tax Relief Reconciliation Act. US citizens enjoyed low tax rates until the implementation of the Alternative Minimum Tax (AMT) to reduce the benefit of upper-middle income earners from the 2001 and 2003 Acts. These tax cuts were supported on the grounds that when taxes are reduced, economic growth will speed up leading to the creation of jobs. The tax cut was criticised because it increased budget deficits, tax burdens shifted from the rich to the middle and working class and increased income inequalities among citizens.

In 2012, the Congressional Budget Office (CBO) estimated that debt had increased in the USA from 2001 to 2011 excluding interest by $1.6 trillion as a result of the tax cuts of 2001 and 2003. These taxes had to expire on 31st December 2012. In 2010, the Tax Relief, Unemployment Insurance Reauthorisation, and Job Creation Act of 2012 was signed (November 12, 2010).

Laws that led to the fiscal cliff were:

- The Economic Growth and Tax Relief Reconciliation Act, Jobs and Growth Tax Relief Reconciliation Act and Tax Relief, Unemployment Insurance Reauthorisation, and Job creation Act;
- Across the broad spending cut to most discretionary programmes as mentioned in the Budget Control Act of 2011 which aimed to resolve the debt ceiling crisis;
- Reversion of the AMT thresholds to their 2000 tax year levels;
- Expiration of the measures delaying the Medicare Sustainable Growth Rate from going into effect;
- Expiration of the 2% Social Security payroll tax cut;
- Expiration of the unemployment benefit; and
- New taxes imposed by the Patient Protection and Affordable Care Act and Health Care and Education.

The Congressional Budget Office (CBO) maintains that rising government debt in the USA is as a result of increased government spending, tax reductions and the great recession that affected many countries. The increase in government spending was mostly in Medicare and Medicaid, defence, social security, unemployment benefits and food stamps. Reduction in taxes included payroll taxes, corporate income taxes, and individual income taxes, among others.

The content of fiscal cliff in the USA focuses on increasing revenue, spending cut and debt ceiling. In 2001, 2003 and 2010, there were tax cuts and the alternative minimum tax (AMT) patch. This series of legislation is often referred to as the Bush tax cuts which expired on 31st December 2012. The USA increased all income tax rates (from 35 to 39.6%) as well as rates on estate and capital gains taxes. The AMT will also automatically apply to million more citizens. There was a payroll tax cut on social security which also expired on 31st December 2013. There were other provisions for policies such as the research and experimentation tax credit, most of which were enacted retroactively and were due to terminate at the end of 2012. Lastly, Affordable Care Act taxes such as provision in the Obama health care legislation, including increase in tax rates on high income earners, were set to take effect in January 2013.

In terms of spending cut, automatic spending cuts or sequester legislated by the Budget Control Act of 2011 hit on January 2, 2013. Half of the scheduled annual cut (£109 billion per year from 2013 to 2021) was to come directly from the national defence budget and half from non-defence. However, some 70% of mandatory spending was to be exempted. The fiscal cliff was avoided through the American Tax payer Relief Act of 2012.

Debt limit is the maximum amount of outstanding federal debt that the US government can incur by law, and it is currently capped at $16.39 trillion. In the US, the debt ceiling was raised from $14.3 trillion to $16.4 trillion which boosted fiscal credibility and reduced uncertainty in the markets. In October 2013, the US government had to further increase debt limits. This helped the US government not to default its debts and avoid abrupt fiscal adjustments which could result in severe economic disruptions.

2.3.4 Decrease in spending and/or increase in taxation in Greece (austerity measures)

Greece, has recently, increased taxes and/or reduced spending (austerity measure). Austerity is a government fiscal discipline to its creditors and credit rating agencies such that revenue is brought closer to expenditures. It could be politically imposed by external agencies. Austerity in the short-run, increases unemployment as in the case of Greece where unemployment keeps on increasing. Greece has implemented seven austerity measures in order to reduce sovereign debt rates while in the USA, fiscal cliff has been implemented to prevent the country from entering into a debt crisis. Both measures are related to fiscal policies which involve reduction in government spending and an increase in taxes.

Austerity measure (also referred to as fiscal consolidation), is a precondition for the reduction of public debt, consolidation of public budgets, increase in international competitiveness and eventually, economic recovery. Austerity programmes were needed to overcome major public deficits caused by expenses on social welfare during the financial and economic crisis. The Greek government cut down its deficit from 2010 by decreasing spending (decease in benefits and public services) while at the same time, increasing taxes and cutting down on spending. The government adopted a number of austerity packages where the first three packages had to yield a reduction of €30 billion among other severe measures. These measures were geared towards reducing government deficit, debt and rebalancing the current account by cutting wages.

Greece's first austerity measure was signed in a memorandum by the International Monetary Fund (IMF) and the European Central Bank (ECB) in February 2010. It consisted of the following: a cut in public sector wages, increase in fuel prices and a cut in the following: 10% bonuses, overtime workers and the target of tax evasion. The objective of the first austerity measure was to save €0.8 billion and enable Greece have access to private capital markets by 2012. However, this objective was not achieved. Also, in the first quarter of 2010, the Greek government was neither able to pay its matured debts nor raise new capital. As a result, an economic protection bill was passed by parliament in order to prevent bankruptcy in the country (Matsaganis & Leventi, 2011).

The second austerity package was approved in March 2010 by the Hellenic Parliament with the expectation to save €6.5 billion from tax increases and a reduction in spending. It was made up of a 30% cut in bonuses for Christmas, Easter and leave, an additional cut of 12% in public bonuses, 7% cut in the salaries of public and private employees, an increase in Value Added Tax (VAT) from the range of 4% to 5%, a rise in petrol tax from 9-10% to 15% and an increase in the duties of imported cars from 10% to 30% (Matsaganis & Leventi, 2011). These two measures did not meet the target from an economic perspective. The European Commission, the IMF and ECB setup a tripartite committee (Troite) to prepare economic policies regarding the loan. The Greek government accepted to implement further austerity measures.

Matsaganis and Leventi also point out that a third austerity measure was approved in June 2010. This package had to save €38 billion between 2010 and 2012. This was the biggest package received in a generation and led to protests causing the deaths, injuries and several arrests. The €30 billion austerity package passed included a reduction in the salaries of the public sector and pensions, increase in VAT and excise tax, increase in the retirement age raised to 65 years for public servants, privatisation, reduction in the number of municipalities and labour reforms. This austerity measure consisted of an additional 8% cut in public sector allowances, 3% cut in public sector utilities of employees, 10% increase in imported cars, increase in VAT from 19% to 23%, 10% increase in luxury, alcohol, cigarettes and fuel, increase in the retirement age from 61 to 65, reduction in public-owned companies from 6000 to 2000 and a reduction in the number of municipalities from 1000 to 400. Even though these measures were observed, Greece could not improve its public finance.

In the second quarter of 2010, after realising that the austerity measures could not improve the economic position of Greece, the government asked for the activation of the first bailout package from the EU and the IMF. The IMF contributed €30 billion while other Eurozone partners provided an additional €80 billion. Anand *et al.* (2012) and Calice *et al.* (2011) confirm that on 2 May 2010, a bailout package of €110 billion was given to Greece and was to be followed by the implementation of the austerity measures on the 9th of May 2010. Alogoskoufis (2012) concurs and adds that alongside the first bailout package, the European Financial Stability Facility (EFSF) was created to issue bonds and other debt instruments in the markets.

The fourth austerity measure was implemented in June 2011 to achieve €6.5 billion through progressive tax increases, cuts in pension and privatisation of government properties. Privatisation and the sale of government properties increased by €50 billion, taxes increased for those earning over €80.000 billion per year and an extra tax for those with a yearly income of €12.000. Furthermore, there was an increase in VAT in the housing industry, a lowering of pension payments from 6% to 14% to the previous 4% to 10% and many other taxes. It was finally agreed that 50% of the debt should be written-off as a condition for more aid by the troika. In October 2011, private investors agreed to take a 50% cut on the face value of bonds and not the 21% agreed upon in July 2011. Public sector wages were cut by 20%, further increases in taxes, and cuts in public investment and social benefits as well as privatisation.

In February 2012, the Greek cabinet approved a draft bill for the fifth austerity measure which was to improve the 2012 budget deficit by €3.3 billion. It included a 22% cut in the minimum wage from the €750 per month. Holiday bonuses were to be cancelled, 150000 jobs shed, and pension to drop by €300 in 2012. Spending on health and defence was to drop while privatisation was to increase to €15 billion by 2015.

According to Castel (2012), Greece was granted a second bailout package of €130 billion in March 2012. The package was authorised to be released in instalments with the first representing €39.4 billion of loans from EFSF. Austerity measures have effects on the economy in particular and the world in general. Malkoutzis (2011) reiterates that Greece reduced its public deficit by 5% GDP in 2010 by reducing public spending by €9 billion and increasing revenue by another €4 billion. This was achieved through the following: reformation of the pension system; liberalisation of certain sectors in the economy; reduction in bureaucracy by foreign and domestic investors; and set out a blue print for the privatisation of €50 billion worth of state assets by 2015. The June austerity package was to save €6.5 billion in 2010 and €30 billion by 2015. This was to be achieved through the shedding of 150000 jobs in the public service, €2 billion reduction from defence spending in 2010 and additional taxes.

Despite the protests, a sixth austerity measure was implemented in October 2012.The Greek parliament approved an austerity package of €13.5 billion. This included a reduction in pension between 5 to 15% and an increase in the retirement age from 65 to 67 years. There was a further 20% cut in the wages of civil servants.

The seventh austerity package was approved in July 2013 to secure the payment of a €2.5 billion instalment. This package consisted in laying-off 15000 public employees.

2.3.5 Analysis of the impact of fiscal consolidation on the domestic economy

Fiscal policies have so many effects on the economy of the indebted country as well as on other economies in the world. Despite the fact that this measure is used to reduce sovereign debt, it also has both positive and negative impacts on the economy a country and the world at large. Some impacts of fiscal consolidation are:

Deficit reduction

The main aim of implementing fiscal consolidation is to reduce government deficit. This will assist the indebted country to come out of debt and recession. According to Fama (2009), austerity is required to ensure an efficient private sector spending which drives the economy to recovery. Cochrane (2010) is of the opinion that austerity is needed to counter economic crises in countries experiencing financial difficulties. The premise is that an increase in taxes will be used by the government to increase research and development as well as motivate the opening of new businesses. When taxes are favourable, foreign direct investment may be attracted into the country and might stimulate the economy. Additional taxes will bring about a balanced budget and increasing taxes will help the government to generate new resources faster.

Government debt reduction

Due to lack of adequate budget, many governments become indebted. The expectation is that the austerity measure will help to reduce annual government borrowing in the public sector. This happens because taxation will increase while government spending will decrease. Despite the envisaged advantages of austerity measures, they have had several negative impacts on the economy of Greece and the world as indicated below.

Unemployment

According to Malkoutzis (2011), in order for the Greek government to achieve 5% GDP reduction in public deficit, about 150000 civil servants had to lose their jobs. The Hellenic Statistical authority shows that unemployment rate in Greece has been escalating as illustrated in Table 2.1.

Table 2.1: Unemployment rate in Greece from 2007 to 2012

Year	2007	2008	2009	2010	2011	2012
Greece	7.9	7.8	10.3	14.1	20.8	27

Unemployment rates increased from 7.9% in 2007 to 27% in 2012. According to statistics from Hellenic Statistical Authority (2012), there are more unemployed females than males in Greece. Those aged between 15 and 24 years constitute the highest group of unemployed followed by the 25-34 years age group. The concern is that a high level of unemployment may ruin people financially. The high rate of unemployment in the country is due to the fact that there is no formal system to assist young people to get into the job market as well as assist those who have lost their jobs to be retained for other positions. This effect may be long-term unemployment which might force some people to immigrate. On the other hand, an increase in taxes might cause disincentives to work. As such, there will be a drop in productivity and aggregate supply. However, higher taxes do not necessarily reduce incentives if the income effect dominates.

Consumption

Fiscal consolidation has led to the cutting down of purchases of goods and services by both government and households (Blanchard & Perotti, 2002). This has led to a drop in demand, hence lowering production, employment, investment and consumption. An increase in direct tax reduces the post-tax income of those who are still working. This is because there is due lower income while more work is being done. When indirect taxes change, the demand for certain goods and services is affected.

Disposable income

An increase in personal income tax, contribution by pensioners and indirect taxes, have greatly reduced the disposable income of the Greek population. Reduction in disposal income is bound to affect consumption, investment and savings. It also leads to a cut in household income, increase in unemployment rates, reduction in the number of consumers and producers confidence.

Investment

Investment expenditures decrease when there is an increase in dividends, increase in capital gains and a rise in income taxes. When corporation taxes and other business taxes increase, fixed capital investment may decrease. If planned investment decreases, the nation's capital stock can decrease and the capital stock per worker employed can also decrease. Taxes reduce the internal investment of firms since profit funds are used to pay taxes.

Savings

The level of savings has decreased since the implementation of fiscal consolidation in 2010. Increase in taxes means that citizens and businesses of the country will have to pay more of their income to the government. This can create disincentives to save and invest. This discourages them and may lead to retardation on the economy of the country. Reduction in direct spending reduces demand. Increase in taxes or decrease in transfer payment reduces savings and a decrease in demand may influence the hiring of workers thus, reducing output. Reduction in income also reduces spending. When there is no change in government spending alongside a decrease in taxes, future taxes are bound to increase. The longer the period the government wants to increase taxes or the higher the real interest rate, the higher the eventual increase in taxes.

Closing business

Due to increase in taxation, disposable income will decrease as well as lack of liquidity and loss of consumer confidence which cause most businesses to close down. Based on the Hellenic Statistical Authority, Greece relied on private consumption which has dropped by 8.6% in the last quarter of 2010. This shows that households reduced their expenditures by €1.6 billion compared to the 2009 reduction in consumption which brought about the recession. Given the increase in taxes and reduction in government spending, businesses are shutting down.

Interest rates

Countries that lend money to others charge interests. The implementation of austerity measures reduces the amount of debt servicing, hence the lending country's income will decrease since the interest rates have also decreased. According to Master (2013), debt ceiling causes uncertainty in bond markets and interest rates. Increase in interest rates will increase the future cost of borrowing, increase capital costs of struggling U.S businesses and cash strapped buyers. Therefore, raising interest may divert tax payers' money away from government investments.

Decrease in remittances

The loss of jobs in Greece has reduced remittances sent to African countries. As a result, austerity measures increase the rate of unemployment in a country. This affects remittances sent to third world countries to decrease as well. Also, the government of countries experiencing rising debt make immigration into these countries very difficult.

Decrease in economic growth

With austerity measures, there is bound be a decline in investment, consequently, a decline in economic growth as well. Countries concerned are forced to reduce their import as well as export which affect GDP growth. Another concern is that austerity measures reduce aggregate demand, output and employment in the economy. Due to large and unsustainable sovereign debt, most governments are implementing these measures or fiscal consolidation. They involve cutting down government spending and increasing taxes that may slow growth in the country concerned. When growth in advanced economies is slowing down, investment could be less attractive thus, shifting investors away from these countries. The portfolio may now be shifted away from advanced economies towards emerging markets. Massa, Keane and Kennan (2011) maintain that when growth decreases, there is a possibility that demand for commodities by developed economies will decrease and increase unemployment. Countercyclical fiscal policies may be implemented which may result in high volatility and lower growth (Aghion & Kharroubi, 2007;Woo, 2009).

Taxation

Taxes have different effects in a country. In households with low income, increasing child tax, credit as well as income tax will affect payroll tax and income tax. High income households are mostly affected by increases in income tax on unearned income such as capital gains.

Social

Reduction of government spending has left many people homeless in Greece. Social workers and municipalities in Athens have reported a 25% increase in homelessness. The average age of those seeking assistance dropped from 60 to 47 years between 2012 and 2013. Many non-governmental organisations that provided social care are threatened with closure due to dwindling funds. The abrupt increases in taxes, alongside cutting spending without giving time to families, businesses, state and local government affected them severely since they did not have time to plan and adjust. Reduction in government spending can affect public services such as transport and education leading to market failures and social insufficiency.

Burden

Government debt adds economic burden to future generations. This is because when the government borrows now, the present generation is taxed less while the future generation will be taxed higher. Also, the repayment of debt becomes a burden in government budget since it has to pay higher interests as well as debt instalments. Higher government debt leads to future tax distortions, inflation and uncertainty about government prospects and uncertainty (Barro, 1979; Cochrane, 2010).

When government borrows from the central bank, there is an increases in the supply of money and its potential inflationary effect. When government borrows from domestic and international capital markets, there is an increases public debt. Sustainability becomes a crucial criterion for judging the soundness of fiscal policy and macroeconomics management in general. The burden of the present borrowing is placed on future generations who have to pay the interest and repay the debt as well. It is even a bigger problem when these borrowed funds are used to finance current expenditure that only benefits the current generation. Large public debts are often accompanied by interest burdens and when the government pays the interest, they are left with less money to use for productive purposes.

2.4 SUMMARY OF CHAPTER

Six different theories on fiscal policy in relation to government debt have been examined. The Government budget constraint theory (change in debt is equal to interest payment and primary balance) was adopted and modified for this study. The other theories provided gave guidance in choosing appropriate variables for this study as well as in explaining fiscal policy in detail and in relation to debt theoretically.

At the empirical level, despite the different methods used, the results show that cut in expenditure and increases in taxes contribute significantly to government debt reduction in the long-run. During fiscal adjustments, spending cuts are more effective than tax increases when debt is stabilised and also when the government wants to avoid a down turn in the economy. The timing, size and composition of austerity measures have an impact on the success of fiscal adjustments. Literature revealed various methods of reducing government debt. The most frequently used are inflation, fiscal consolidation, debt restructuring, debt default, growth and financial repression. In the USA and Greece, reduction in spending and increase in taxes implemented to reduce the level of debt was explained and the analysis of the impact of fiscal consolidation on the domestic economy examined.

Increasing government revenue and decreasing government spending in both countries was also discussed. Fiscal cliff was implemented in order to prevent the economy from experiencing the detrimental effects of fiscal adjustment which could result in severe economic disruptions. Similarly, austerity measures were implemented in order to reduce public debt, consolidate public budget, increase international competitiveness and economic recovery. Greece has implemented seven austerity measures so far. Both fiscal cliff and austerity measures are carried out to reduce government spending in certain sectors of the economy while increasing taxes in other sectors.

Fiscal consolidation (increase in taxes and decrease in government spending) may reduce government debt and deficits but its effects on individuals are enormous. They include drop in employment, balance of trade, consumption, disposable income, investment, savings, remittances and economic growth. In addition, businesses are bound to close down, middle class people are affected by the payroll tax as well as social care.

CHAPTER THREE

METHODOLOGY

"These economic downturns are very difficult to predict but sophisticated econometric modelling houses like Data resources and chase Econometrics have successfully predicted 14 of the last 3 recessions."

Linux Science

3.1 INTRODUCTION

This chapter explains and justifies the methodology used in conducting this study. The previous chapter reviewed theories and empirical literature on fiscal consolidation related to sovereign debt. The theoretical basis for this model is government budget constraint as stated by Blanchard (2011) which shows that change in debt is equal to interest payment and primary balance as shown in equation 3.1.

$$B_t - B_{t-1} = rB_{t-1} + G_t + T_t) \qquad (3.1)$$

The position maintained by Sahay (2005) that change in debt is equal to interest payment, GDP growth, primary balance was adopted and adjusted to estimate the model of this study as presented in equation 3.2.

$$b_{t+1} - b_t = \overline{r_t} - \overline{g_t^r} - pb_t + \varepsilon_t \qquad (3.2)$$

The first stage of data analysis was to introduce the econometric model. This was followed by the definition and justification of selected variables, hypotheses and data. The various techniques used in the analysis are explained below. EViews 8 was used as the analytical software.

3.2 HYPOTHESES

Two hypotheses were raised and tested in the study as follows:

3.2.1 Null hypothesis: consumer price index (CPI), real federal interest payment as a percentage of GDP (RFINTPG), real federal government constant tax receipts as a percentage of GDP (FRTAXG) and real government spending as a percentage of GDP (RGSPENG) do not significantly determine real federal debt (RFDEBT) in the USA.

3.2.2 Null hypothesis: inflation (INF), gross domestic product growth (GDPG), primary balance (PB) and net current transfers from abroad (RNTRA) do not significantly reduce general government debt (GDEBT) in the USA and Greece respectively.

3.3 MODEL SPECIFICATION

Based on Sahay (2005) and the government budget constraint, the following variables were selected for the US model using quarterly data: Federal Debt (FDEBT); Consumer Price Index (CPI); Federal Interest Payment (FINTP); Federal Government Current Tax Receipts (FTAX); and Government Spending on goods and services (GSPEN). Quarterly data could not be obtained for Greece in this study thus, only the determinants of government debt was estimated for the USA.

On the other hand, the comparative models for the USA and Greece with annual data employed the following variables: General Government Debt (GDEBT); inflation (INF); gross domestic product growth (GDPG); Primary Balance (PB); and Net Current Transfers from abroad (RNTRA).

The functional form of quarterly data for the US model of this study is as follows:

$$FDEBT_t = f(CPI_t, FINTP_t, GSPEN_t, FTAX_t) \quad \text{.........}(3.3)$$

The expected signs are shown in Table 3.1.

Table 3.1: Variables and their expected signs

Variables	CPI	FINTP	GSPEN	FTAX
Signs	Negative	Positive	Positive	Negative

Equation 3.3 can also be expressed in linear regression form as follows:

$$FDEBT_t = \beta_o + \beta_1 CPI_t + \beta_2 INTP_t + \beta_3 GSPEN_t + \beta_4 FTAX_t + \varepsilon_t \text{ ......(3.4)}$$

where ε_t is the residual term.

All the variables are expressed in real terms and as a percentage of GDP. The estimation model is presented as follows:

$$RFDEBT_t = \beta_o + \beta_1 CPI_t + \beta_2 RFINTPG_t + \beta_3 RGSPENG_t + \beta_4 RFTAXG_t + \varepsilon_t \text{ ......(3.5)}$$

where R stands for real and G_t for percentage of GDP.

As a general trend, most economic time series tend to exhibit strong trends with time, hence the data is transformed into logarithmic values. This brings about a stable pattern in the data over time and avoids heteroskedasticity throughout the period of study. Asteriou and Hall (2006) argue that this brings about the elimination of fluctuation tendencies when individual variables are expressed as logarithms. The coefficients of such variables are interpreted as elasticities. Therefore, the debt reduction model for the USA using quarterly data is expressed as follows:

$$l(RFDEBT_t) = \beta_o + \beta_1 l(CPI_t) + \beta_2 l(RFINTPG_t) + \beta_3 l(RGSPENG_t) + \beta_4 l(RFTAXG_t) + \varepsilon_t \text{ ......(3.6)}$$

The functional form of the comparative model for the USA and Greece is as follows:

$$GDEBT_t = f(INF_t, GDPG_t, PB_t, RNTRA_t) \text{ ......(3.7)}$$

The expected signs are shown in Table 3.2.

Table 3.2: Variables and their expected signs for the comparative analysis

Variables	INF	GDPG	PB	RNTRA
Signs	negative	negative	positive	negative

Equation 3.7 can also be expressed in linear regression as follows:

$$GDEBT_t = \beta_0 + \beta_1 INF_t + \beta_2 GDPG_t + \beta_3 PB_t + \beta_4 RNTRA_t + \varepsilon_t \text{ ....(3.8)}$$

where ε_t stands for residual term.

As employed by Hosseini, Ahmad and Lai (2011), the comparative debt reduction model in natural logarithm for the USA and Greece are expressed as follows:

$$l(UGDEBT_t) = \beta_0 + \beta_l l(UINF_t) + \beta_2 l(UGDPG_t) + \beta_3 l(UPB_t) + \beta_4 l(URNTRA_t) + \varepsilon_t \text{ ......(3.9)}$$

$$l(GGDEBT_t) = \beta_0 + \beta_l l(GINF_t) + \beta_2 l(GGDPG_t) + \beta_3 l(GPB_t) + \beta_4 l(GRNTRA_t) + \varepsilon_t \text{ ... (3.10)}$$

3.4 DATA

This study used secondary data collected from different sources as presented in Tables 3.3 and 3.4.

Table 3.3: Sources of the quarterly data for the USA from 1980Q1 to 2013Q3

Variables	Unit of measurements	Sources	Data adjustment
Federal Debt (FDEBT)	Percentage of Gross Domestic Product	Federal Reserve Bank of St. Louis	Seasonally adjusted
Consumer Price Index (CPI)	Index 2010=1	Organisation for Economic Co-operation and Development	Seasonally adjusted
Federal Interest Payments (FINTP)	Billions of dollars	United States Department of Commerce, Bureau of Economic Analysis	Seasonally adjusted annual rate
Government consumption and Gross investment (GSPEN)	Billions of dollars	United States Department of Commerce, Bureau of Economic Analysis	Seasonally adjusted annual rate
Federal government current tax receipts (FTAX)	Billions of dollars	United States Department of Commerce, Bureau of Economic Analysis	Seasonally adjusted annual rate
Gross Domestic Product (GDP)	Billions of dollars	United States Department of Commerce, Bureau of Economic Analysis	Seasonally adjusted annual rate

It is a seasonally adjusted quarterly data ranging from the first quarter of 1980 to the third quarter of 2013. On the other hand, the comparative model of the USA and Greece uses annual data ranging from 1970 to 2012.

Table 3.4: Sources of the annual data for the USA and Greece from 1970 to 2012

Variables	Unit of measurements	Sources
General Government Debt (GDEBT)	Percentage of GDP	AMECO
Inflation (INF)	GDP deflator to annual %	World Data Bank
Gross Domestic Product Growth (GDPG)	Percentage	IMF: World Economic Outlook
Primary Balance (PB)	At constant LCU	World Data Bank
Net Current Transfer from abroad (RNTRA)	At constant LCU	World Data Bank

From Table 3.3, federal debt is the accumulated sum of unpaid borrowing by the federal government over time (Austin, 2011). FDEBT is obtained by dividing the total public debt by GDP and then converting it to percentage. The dependent variable, FDEBT is in current terms, so it is converted to real terms by dividing federal debt by the consumer price index in order to obtain real federal debt (RFDEBT).

Consumer Price Index (CPI) is used as a proxy for measuring inflation and refers to the total of all items in the USA. According to Fourie and Burger (2010), CPI is the measure of the weighted average cost price of a basket of consumer goods and services. Since the base year of CPI is 2010, and the value is 1, the other baskets in other periods are expressed relative to the base value of one. Inflation is the percentage change in the value of CPI during a period of time, hence CPI is chosen as the proxy for inflation. As stated in Table 3.3, if CPI increases, federal debt will decrease. Federal Interest Payments (FINTP) is the federal government's current expenditures on interest payments. The data is in billions of dollars (nominal values), hence it was divided by CPI to convert it to real terms and further divided by GDP to convert it to a ratio of GDP as done by Sahay (2005). Therefore, FINTP becomes the real federal interest payments as a percentage of GDP (RFINTPG). It is expected that as RFINTP increases, RFDEBT should increase as well.

According to Blanchard (2010), Government spending (GSPEN) is expressed as government consumption and gross investment, excluding interest payment. Furthermore, it is deflated by using CPI in order to transform it to a ratio of GDP. The purpose is to express real government spending and gross investment as a percentage of GDP (RGSPENG). It is expected that when RGSPENG increases, RFDEBT should increase as well. Federal government current tax receipts (FTAX) were collected and transfers payments were subtracted from FTAX as stipulated by the debt theory of Blanchard (2010). It was also deflated to real terms in order to express it as a ratio of GDP. The purpose of this is to get real federal government tax receipts (RFTAXG) which is an income to the government. According to theory, a negative relationship is expected.

Data for Gross Domestic Product (GDP) was obtained to express the variables as a percentage of GDP. From Table 3.4, data of the following variables were collected and presented:

Inflation rate (INF) is the rate at which the general level of prices for goods and services is rising and the subsequent decrease in purchasing power. All the variables were deduced from both theoretical and empirical literature.

Gross Domestic Product Growth (GDPG) is the annual percentage growth rate of GDP at market prices based on constant local currency. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products.

Primary Balance (PB) is derived by subtracting gross national expenditure from gross national income. This could either be positive (surplus) or negative (deficit) if the government of USA and Greece are spending more or less. Gross national expenditure is the sum of household final consumption expenditures, general government final consumption expenditure and gross capital formation. Since government spending does not involve gross capital formation, this explains why it is subtracted from gross national expenditure. Gross National Income is the sum of Gross National Product and the terms of trade adjustment. It is used as collected.

Finally Net Current Transfers from abroad (RNTRA) as defined by the World Data Bank (2014) is when income is transferred from resident countries to the world and vice-versa with no provision of repayment.

3.5 ESTIMATING THE MODEL

This is achieved by employing various time series econometric techniques to analyse the data. Vector Autoregression (VAR) does not incorporate cointegration in the analysis, hence the Vector Error Correction Model (VECM) is preferred. VECM incorporates the Johansen cointegration (long run relationship) technique used to estimate cointegration equations. It is then followed by the short run dynamics (VECM) to examine the short run relationships between federal debt reduction function and its regressors variables. Various diagnostic and stability tests were used to test if the estimated model is good. Furthermore, the Granger causality approach was employed to determine the direction of causality in VECM. The VECM system was also used to analyse shocks in the system together with Variance Decomposition and Generalised Impulse Response Function (GIRF) techniques. Before analysing the data, it was examined through the following tests: descriptive statistics, graphical analysis of visual inspection, unit roots tests and lag order selection criteria. The same steps were followed for the comparative analysis as well. The step-by-step technique used in the analysis is presented in Figure 3.1.

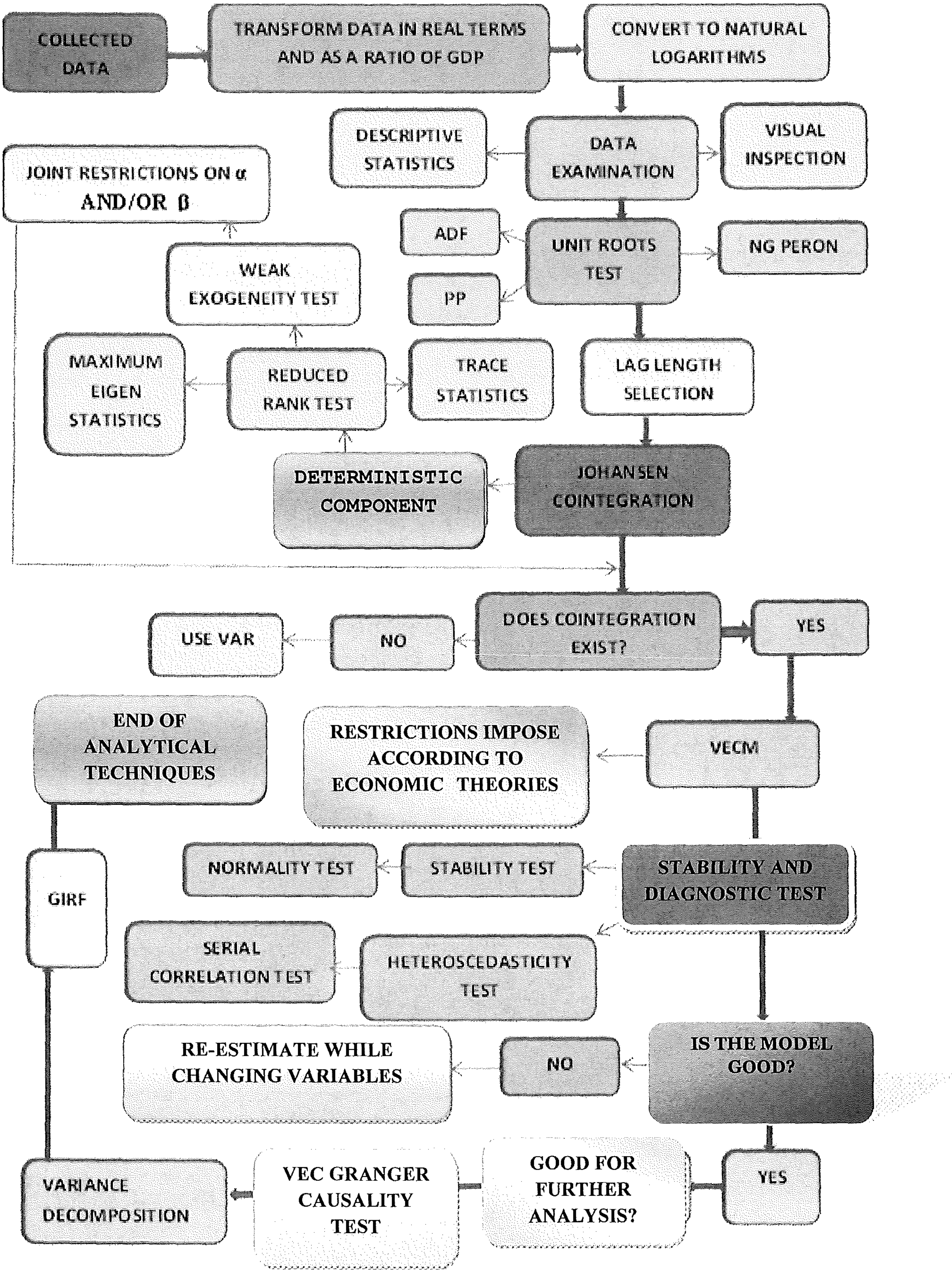

Figure 3.1: Step-by-step procedure of analytical techniques

3.5.1 DATA DIAGNOSTIC

This helps to determine the nature of data and to determine if it will be good for analysis. This process involves descriptive statistics and visual inspection.

3.5.1.1 Descriptive statistics

Descriptive statistics provides summary results of variables using the central tendency (mean, median and mode) measures as well as variability. Standard deviation, minimum, maximum, kurtosis and skewness are measures of central variability. The probability value of the Jarque-Bera in the descriptive statistics reveals the normality of the residuals of the variables at level form, hence indicating that stationarity test may not be done using unit roots. According to Gujarati and Porter (2009), this test is good because it helps in further analysis as well as making statistical inferences easier.

3.5.1.2 Visual inspection

This procedure is used to determine how data changes over time. In this study, graphical analysis was used to show a plot of the variables over time. As maintained by Gujarati and Porter (2009), visual inspection gives an easy and clear picture of how variables change over time. It shows how far and how close they deviate from their mean and covariance over time. Its shortcoming is that it does not state explicitly if the variables are stationary at first differenced or second differenced, hence the need for unit roots tests.

3.5.2 UNIT ROOT TEST

Unit root test is testing for nonstationarity in an autoregressive model in a time series data by considering the following autoregressive model:

$$y_t = \delta y_{t-1} + \mu_t \quad \text{.......(3.11)}$$

According to Asteriou and Hall (2011), u_t is the white-noise process. For stationarity, $/\delta/ < 1$ and a stationarity series can be obtained when the series y_t is differenced in order to obtain Δy_t. The number of times a variable needs to be differenced before it becomes stationary is equivalent to the number of unit roots in that variable. The unit roots test is important because it shows the effects of shocks on variables over time. It is also good in forecasting and furthermore, helps to identify if a regression is spurious. Spurious regression may have very high R squared and significant estimates but the results are meaningless in economic sense (Asteriou & Hall, 2011).

Testing for the order of integration is done at three stages, the first being at level form where $y_t \sim I(0)$, hence it is integrated to the order zero. At first difference, $y_t \sim I(1)$ and at second difference, $y_t \sim I(2)$. This is done until it becomes stationary but EViews stops at second difference. For unit roots testing, this study employed the Augmented Dickey-Fuller (ADF), Phillip Perron (PP) and Ng Perron (NP) tests in order to obtain a confirmative test of stationarity. The lag lengths were chosen automatically by EViews 8.

3.5.2.1 The Augmented Dickey-Fuller (ADF)

This test is an augmented version of the Dickey-Fuller test used to eliminate autocorrelation by including the dependent variable extra lagged terms which is determined by the Akaike information criteria or the Schwart information criteria chosen automatically by EViews 8 (Asteriou and Hall, 2011). The null hypothesis of this test states that there are unit roots in the variable under consideration. If the probability value is greater than the chosen significant level, the variable is insignificant, hence the null hypothesis is not rejected and vice-versa. The ADF is tested in three different specification tests for intercept and trend, intercept and none as follows:

For intercept and trend, the specification is: $$\Delta y_t = \partial + \beta t + \sigma y_{t-1} + \sum_{i=1}^{p} \gamma_i \Delta_{t-1} + \mu_t \quad \text{........(3.12)}$$

For intercept, the specification is: $$\Delta y_t = \partial + \sigma y_{t-1} + \sum_{i-1}^{p} \gamma_i \Delta_{t-1} + \mu_t \quad \text{................(3.13)}$$

For none, the specification is: $$\Delta y_t = \sigma y_{t-1} + \sum_{i-1}^{p} \gamma_i \Delta_{t-1} + \mu_t \quad \text{....................(3.14)}$$

where Δ is the change in the y variable, t is the time and n represents the number of lags. Furthermore, y is the variable tested for unit roots and ε_t is a white noise random error term.

Even though there are several advantages in using ADF tests, there are however, certain shortcomings such as the presence of heterogeneity of the distribution of the disturbance term. This shortcoming makes it necessary to conduct other tests as confirmative tests.

3.5.2.2 The Phillips-Perron tests (PP)

Phillips and Perron (1988) developed a test that allows the generalisation of ADF tests with fewer assumptions on the distribution of the error terms. The test regression as written by Asteriou and Hall (2011) in the autoregressive process is:

$$\Delta y_{t-1} = \partial + \gamma y_{t-1} + \mu_t \qquad (3.15)$$

The PP test corrects the t-statistics of the coefficient γ in the autoregressive regression model (Asteriou and Hall, 2011). The PP test can also be done with specifications such as intercept and trend, intercept and none. The null hypothesis is the same as that of ADF which states that there are unit roots in the variable under consideration. If the probability value is less than the chosen significant level, then it is regarded as significant and as such, the null hypothesis is rejected and a non-stationarity conclusion is made.

3.5.2.3 The Ng Perron (NP)

Both the ADF and the PP tests have a low power in their null hypothesis against the alternative for stationarity (Dejong, Nankervis, Savin and Whiteman, 1992). Their results are distorted when the series has a large negative average root that is moving (Chukwu, Agu amd Onah, 2010). The NP test deals with these problems by detrending through the Generalised Least Square (GLS) estimator. This helps in improving the power of the tests when there is a large Autoregressive (AR) root and when there is reduction in the size of distortion if there is a large negative Moving Average (MA) root in the differenced series. Also, NP test modifies lag selection criteria accounts, hence avoiding the choice of wrong lag length. After a stationarity test, the next step is to select appropriate lag length.

3.5.3 LAG LENGTH SELECTION CRITERIA

VAR models are mostly used in forecasting and analysing the effect of structural shocks. It is therefore critical to determine the appropriate VAR lag length in order to avoid inconsistencies in VAR results. According to Asterious and Hall (2007), it is also advantageous to select an appropriate lag length in order to have error terms that are normally distributed, homoscedastic and do not have autocorrelation.

Enders (2010) suggests the following criteria in selecting an appropriate lag length: sequential modified LR test statistic (LR); Final prediction error (FPE); Akaike information criterion (AIC); Schwarz information criterion (SC); and Hannan-Quinn information criteria (HQ).

According to Asterious and Hall (2011), each of the criterion is inspected to get the model with the lowest values. The optimal lag length is the one with the lowest value and it is marked by an asterisk sign in EViews 8 output. Also, heteroskedasticity, autocorrelation, normality and stability tests are conducted to ensure that residuals are in line with these classical assumptions. Enders (2010) argues that SC is better than AIC for a large sample of observations. This argument is based on the fact that SC is asymptotically consistent while AIC is biased. Also, if there is difference, the results with the different lag length suggested have to undergo diagnostic testing and the lag length with the best diagnostic test is chosen. On the other hand, Liew (2004) emphasises that AIC and the FPE lag length results are superior with observations of sixty and below while with observations above sixty, SC and HQ criteria are best in choosing the appropriate lag length. Ivanov and Killian (2001) maintain that HQ gives accurate results with the exception of sample size smaller than 120 but SC gives the best accurate results for all realistic sample sizes.

3.5.4 JOHANSEN COINTEGRATION

A time series x_t and y_t are said to be cointegrated if both series are integrated to the order d and have a linear combination integrated to an order less than d or stationary. According to Harris (1995), when a series is differenced n-times before it is stationary, then it contains n-unit roots. If two or more series contain stochastic trends (nonstationary) in the long run equilibrium form, they will move closely together with time and their difference will be stable.

Cointegration analysis builds an error correction model (ECM) such that the dynamic co-movement among variables and the adjustment process towards long-term equilibrium may be examined. According to Chang, Fabiola and Carballo (2011), Johansen cointegration allows the possibility of having more than one cointegrating relationship. Harris (1995) suggests the following steps to be followed in carrying out the Johansen cointegration test:

- The order of the integration of each variable is tested by using the unit roots tests mentioned above;
- The appropriate lag length of the VAR is estimated as shown above by using any of the selection criteria;
- The trends in the data are identified alongside the deterministic variables (constant and trend);
- The reduced rank is tested;
- Weak exogeneity test is carried out; and
- A joint test of restriction of the adjustment parameters in the vector error correction model (α) and the cointegrating vector (β) are carried out.

The Johansen cointegration test was the first step used in the study with an unrestricted VAR with p- lags of Y_t vector as stipulated by Harris (1995) as shown in equation (3.16) of order q:

$$y_t = \mu + A_i \; y_{t-1} + \ldots + A_p y_{t-p} + \varepsilon_t \qquad (3.16)$$

where y_t represents a vector $n \times 1$, A_i is an $(n \times n)$ parameters matrix and ε_t is an $n \times 1$ error term. The VAR was advocated by Sim (1980) in order to estimate dynamic relationships between joint endogenous variables and imposing *a priori* restrictions. When the variables in the VAR are cointegrated, VECM is used. The VECM of the model in equation (3.17) is given as:

$$\Delta y_t = \mu + \prod y_{t-1} + \sum_{i=1}^{q-1} \Gamma_i \Delta y_{t-1} + \varepsilon_t \qquad (3.17)$$

where

$$\prod = \sum_{i=1}^{q} A_{i-1} - I_p \qquad (3.18)$$

and $$\Gamma_i = -\sum_{j-i+1}^{q} A_j \qquad (3.19)$$

There is an n×r matrices α and β if the coefficient matrix $\prod$ has a reduced rank, r×n. $\prod = \alpha\beta^I$ and $\beta^I Y_t$ are stationary, r is the number of cointegration relationship, α is the adjustment parameter in the vector error correction model and each column of β is the cointegrating vector. The Johansen cointegration test proposes two different likelihood ratio tests of the significance of these canonical corrections and thus, the reduced rank of the $\prod$ matrix.

There are two types of Johansen tests: the trace and the maximum eigenvalue with the inference being a little bit different. The trace and maximum eigenvalue tests are given as follows:

$$J_{\text{trace}} = -T\sum_{i-r+1}^{n} \text{In}(1-\bar{\lambda}_i) \qquad (3.20)$$

$$J_{\text{max Egen}} = -T\text{In}(1-\bar{\lambda}_{r+1}) \qquad (3.21)$$

where T is the sample size and $\bar{\lambda}$ is the i^{th} largest canonical correlation.

The null hypothesis of the trace test is r cointegrating vectors and the alternative hypothesis is n cointegrating vectors. The maximum eigenvalue test considers the null hypothesis of r cointegrating vectors while the alternative hypothesis is $r+1$ cointegrating vectors.

Johansen and Juselius's method tests more hypotheses about cointegrating relationships as follows:

- ❖ There are no cointegrating relationships; the regression is spurious;
- ❖ There is at most one cointegrating relationship;
- ❖ There are at most two cointegrating relationships and so on.

The number of such hypotheses tested gives the number of cointegrating variables. If none of the hypotheses are rejected, one must worry that the regression is spurious. If only the first hypothesis is rejected, it is assumed that there is only one cointegrating relationship. If the first and second hypotheses are rejected, it is assumed that there are two cointegrating relationships. If all hypotheses are rejected, it is concluded that none of the variables contain stochastic trends after all. This is because it is the only way that one can have as many cointegrating relationships as variables.

3.5.4.1 Order of integration

This test starts with the order of integration mentioned under stationary tests using ADF and PP tests (Sencicek & Upadhyaya, 2010). It is necessary that all variables in the model be integrated to the same order I(1). According to Harris (1995), a multivariate model can have variables that are stationary at I(0), I(1) and I(2) and still have cointegration. Variables that are stationary at I(0) may play a role in establishing a long-run relationship between nonstationary variables that are suggested by theory (Harris, 1995). The I(2) variables are complicated since they need to be cointegrated to I(1) and I(0) to obtain a cointegrating vector (Asteriou & Hall 2011).

3.5.4.2 Lag length selection

It is good if variables are all stationary at first difference in order to achieve excellent results. The second step is getting the appropriate lag length as explained in section 3.4.3. An appropriate lag length is necessary because the residuals will not suffer from autocorrelation, normality and heteroscedasticity.

3.5.4.3 Appropriate model regarding the deterministic components

The third step of the Johansen cointegration test is the choice of the appropriate model with respect to the deterministic components in the system of equations. This is to confirm whether an intercept and/or trend should be added to the short-run or long-run model. The VECM involves various cases that can exist in order to have a constant and/or a trend in the long-run estimates and a constant and/or trend in the short-run estimates (Asteriou and Hall 2011).

In general, five models are usually considered (Asteriou & Hall 2011) as follow:

- No intercept or trend in the cointegration equation or VAR. Here, the data has no deterministic components;
- Intercept (no trend) in cointegrating equation, no intercept or trend in VAR. Here, the data does not have a linear trend, hence first differenced series have zero mean;
- Intercept in cointegrating equation and VAR, no trends in cointegration equation and VAR. In this case, the data does not have a linear trend at level form but the specifications are allowed to drift around the intercept. Here, the trend is included in the cointegration equation as a trended stationarity variable for exogenous growth;
- Intercept in cointegrating equation and VAR, linear trend in cointegrating equation, no trend in VAR; and
- Intercept and quadratic trend in cointegrating equation intercept and linear trend in VAR.

The first and last models are not likely to occur in practice. In order to make a choice out of the remaining models, the Pantula principle is used to select the best model between model two, three and four above. This is obtained by estimating all the three models with the results presented from the most restrictive hypothesis to the least restrictive hypothesis. The trace statistics are compared with the critical value up to the point where the hypothesis of no cointegration is rejected.

3.5.4.4 Testing the reduced rank

The fourth step is to determine the number of cointegrating vectors. According to Harris (1995), for variables at first differenced in a model, there is a stationary long-run error correction relation which is stationary at level form. There are two methods of determining cointegration relationships in a model. They are the maximum eigen values and trace statistics. According to Asteriou and Hall (2011), for the maximum eigen values, the null hypothesis states the existence of r cointegrating relationships while the alternative hypothesis states the existence of r+1 vectors. They are estimated as follows:

$$J_{\max Egen} = -T\text{In}(1-\bar{\lambda}_{r+1}) \text{ .... (3.22)}$$

where T is the sample size and $\bar{\lambda}$ is the i^{th} largest canonical correlation. The test statistics estimated is based on the characteristic roots obtained by ordering the largest characteristic roots in descending order and testing their significance. For cointegration not to exist, the reduced rank has to be zero as well as all the characteristic roots.

The trace is based on the likelihood ratio test. It considers that there is an increase in the trace statistics by the addition of more eigen values beyond the *rth* eigen values (Asteriou & Hall 2011). The trace test for the null hypothesis states that there are r cointegrating vectors while the alternative hypothesis states n cointegrating vectors. The trace statistics is calculated as follows:

$$J_{trace} = -T\sum_{i-r+1}^{n} In(1-\bar{\lambda}_i) \text{ .... (3.23)}$$

In EViews, test statistics are compared to the displayed critical values and the hypothesis is accepted or rejected depending on the fact that one of this test is greater or less than the other.

3.5.4.5 Weak exogeneity test

The fifth step is the weak exogeneity test. The VAR model has large numbers of parameters and this can be addressed through the imposition of weak exogeneity test (Bonham, Gangnes & Zhou, 2009). When a variable is treated as weakly exogenous, then the equations in the system are reduced to one while the parameters are reduced as well. To assess the effect of weak exogeneity in a VAR system, variables z_t are integrated in the order I(1), hence to be divided into y_t and x_t vectors. y_t is then modelled structurally on its past values and on the current and past value of x_t. The different components of the VAR system of equation is partitioned, and the parameter of interest is added to the conditional model and the marginal model while the adjustment coefficients go to the covaraince matrix making the parameter of interest not to freely change. For weak exogeneity, the adjustment coefficient must be equal to zero. Its null hypothesis thus states that if the variable is not weakly exogenous, the chosen probability level is used to accept or reject this hypothesis. For endogenous variables, the probability values have to be less than the chosen significance level and for exogenous variables, the probability has to be more than the chosen significance level. After detecting that some variables are exogenous, it is always advisable to take them to the exogenous section when estimating the model. However, exogenous variable will still be found on the right hand side of the equation.

According to Bonham *et al.* (2009), this test addresses the problem of over parameterisation found in VECM, that is, many equations in the system will be reduced to one and the number of parameters by $(mk+d)$ where d is the number of deterministic components. VECM is transformed into a conditional model for y_t and a marginal model x_t as:

$$\Delta Y_t = (d_y - wd_x) + w\Delta X_t + (\alpha_y - w\alpha_x)\beta' Z_{t-1} + \sum_{i=1}^{k-1}(\Gamma_{yi} - w\Gamma_{xi})\Delta Z_{t-1} + (\varepsilon_{yt} - w\varepsilon_{xt}) \quad ..(3.24)$$

$$\Delta X_t = d_x + \alpha_x \beta' Z_{t-1} + \sum_{i=1}^{k-1}\Gamma_{xi}\Delta Z_{t-i} + \varepsilon_{xt}. \quad ......(3.25)$$

According to Johansen (1991), when β' are cointegrating vectors, x_t is weakly exogenous when $\alpha_x = 0$. This condition results in β not appearing in the conditional model. Since this model contains information about cointegrating relationships $\beta' z_{t-1}$ of the whole system, the analysis is sufficient. The null hypothesis states that variables are not weakly exogenous. If it is accepted, then the variables will be endogenous. After testing for weak exogeneity, one proceeds to impose theory-based restrictions on the cointegrating vector β.

3.5.4.6 Joint test of restrictions of α and β

The sixth step is testing for linear restrictions in the cointegrating vectors. This allows one to test specific hypotheses according to theories from an economic point of view in the long-run parameters. Some good models could be estimated by imposing restrictions on the long-run as well are short-run coefficients following economic theory (Greenslade, Hall & Henry, 2002).

3.5.5 VECTOR ERROR CORRECTION MODEL ESTIMATES

VECM is a good measure for correcting disequilibrium of the previous period and has very good economic implications. It also solves the problem of spurious regression by eliminating trends from variables when expressed at first differenced. Furthermore, the error correction model has an important feature in that the disequilibrium error term is a stationary variable. Hence, adjustments processes are involved that prevent the errors in the long-run relationship from becoming larger (Asterious & Hall, 2011). VECM is employed when nonstationary series are cointegrated. It involves differencing the variables of the study at first difference in an equation while adding a lagged error term to the equation. The VECM model for this study in the form $O * P$ of variables integrated to the order one is represented as follows:

$$\Delta y_{t+1} = -\prod y_t + \sum_{i}^{k} \Gamma_i \Delta y_t + \mu_t \text{ ....(3.26)}$$

Where $-\prod = \alpha\beta'$

where t+1=1, 2, 3, ...T., k stands for the number of lags included in the dependent variable (y_t). The long-run cointegrated coefficient matrix integrated to the order one is represented as y_{t+1}. $-\Pi$ stands for the cointegrating vector (β) and the adjustment parameters (α) in the vector error correction model. The error terms need to be negative and statistically in order to bring about equilibrium. The diagnostic and stability tests need to be in line with the classical assumptions of the linear regression model.

3.5.6 RESIDUAL DIAGNOSTIC AND STABILITY TESTS

Residual diagnostic and stability tests are carried out to verify if the estimated model meets the assumptions of the classical linear regression model. A stability test was first conducted followed by the autoregressive (AR) Root graph. For diagnostic tests, the following were tested: serial correlation, heteroskedasticity and normality tests. An Autocorrelation Lagrange Multiplier (LM) Test is used to test for Serial correlation, White Heteroskedasticity (no cross terms) for heteroskedasticity and the multivariate normality test for normality (Lazar and Denuit, 2009). The probability value is used to determine the level of significance of results.

3.5.6.1 Vector Error Correction (VEC) stability check

This test is used to confirm if the estimated model is reliable or not. The results are presented in an AR roots graph in this study. When the roots are all in the unit circle and/or some in the unit circle, it is concluded that the model is stable. When parts of the unit circle are outside the AR roots, the model is not, hence, the model is not good.

3.5.6.2 Autocorrelation Langrage Multiplier test

Autocorrelation is the correlation between members of observations in time series data. The classical linear regression model requires that there should be no autocorrelation in the residuals. Based on:

$$y_t = \alpha x_t + \mu_t \qquad \text{...(3.27)}$$

The n^th^ order of serial correlation is expressed as:

$$\mu_t = \alpha x_t + \delta_1 \mu_{t-1} + \delta \mu_{t-2} + \ldots + \delta_n \mu_{n-p} + \eta_t \qquad \text{...(3.28)}$$

The Langrage Multiplier (LM) autocorrelation null hypothesis states that there is no serial correlation in the residuals of the estimated model in this study. This null hypothesis is rejected if the probability value is less than 5%. When the probability value is greater than 5%, it is concluded that there is no serial correlation in the residuals of the model (Seddighi, Lawler & Katos, 2000).

3.5.6.3 Heteroskedasticity

Stock and Watson (2013) define heteroskedasticity as the variation in the regression's error term conditional on the regressor. Heteroskedasticity occurs when the error variance has a non-constant variance. The null hypothesis of this test states that there is no heteroskedasticity in the residuals of the estimated model. This hypothesis is rejected if the probability value is less than 5%. When the probability is more than 5%, it is concluded that there is no heteroskedasticity in the residuals of the model. For the estimated model to be good, no heteroskedascity is needed in order to meet the requirements of the classical linear regression assumptions.

3.5.6.4 Normality tests

Here, the Jarque-bera (JB) technique is used to test for normality. This test comprises of the skewness and kurtosis. The hull hypothesis states that residuals in the estimated model are normally distributed. This null hypothesis is rejected if the probability value is less than 5%. When the probability value is greater than 5%, it is concluded that the residuals are normally distributed (Asteriou & Hall, 2007). The residuals in the estimated models need to be normally distributed.

3.5.7 GRANGER CAUSALITY TEST

Asteriou and Hall (2011) consider causality as the ability of a variable to predict others. According to Gujarati and Porter (2009), causation does not mean the existence of a relationship among variables. The causal link between the dependent variable with the independent variables is obtained using granger causality test. This test, as explained by Granger (1969), starts by assuming the fact that two variables y_t and x_t affect each other with the distributed lag. Hence, y_t is said to cause x_t if x_t is predicted by the past values of y_t in a two variable case. According to Stock and Watson (2012), the fact that the present and lagged values of a variable helps to predict the future value of the other variable, implies that the two variable cases are extended in the same way to a VAR model. There are four possible outcomes of the result which could be uni-directional (Y to X or X to Y), bidirectional (in both directions) and no causality (no direction). The null hypothesis of this test states that y_t cannot Granger cause x_t. If the probability value is greater than the chosen significant level, then this null hypothesis is not rejected.

If cointegration exists in the estimated model, then the Granger causality test will be estimated using VECM and not with VAR. The same procedures in VAR are applied in VECM. The Vector Error Correction (VEC) Granger causality/block exogeneity Walt test is used. The null hypothesis is accepted or rejected based on the probability value of the Wald criterion (Bhattacharya & Bhattacharya, 2011).

The Granger causality in a VAR or VECM test is sensitive to lag length selection hence, an appropriate lag length has to be implemented. When the appropriate lag length is chosen, good results will be obtained, whereas if the appropriate lag length is not obtained, the results may be biased and inefficient.

3.5.8 GENERALISED IMPULSE RESPONSE FUNCTION

According to Asteriou and Hall (2011), the impulse response function was introduced to overcome the problem of interpretation of the VAR model since it lacks a theoretical background. An impulse response function identifies the responsiveness of a dependent variable in a VAR model to a shock in the error term. According to Sims (1980), impulse response allows one to trace out the effects of different shocks over time on variables in a system of equations in a VAR model. In this study, the Generalised Impulse Response Function (GIRF) was used in the place of the Impulse Response Function (IRF) since GIRF is not sensitive to the way variables are ordered in VAR. Furthermore, IRF gives distorted results if important variables are omitted.

Enders (2010) expressed an Autoregressive (AR) process up to p term as:

$$y_t = \alpha + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + \beta_p y_{t-p} + \varepsilon_t \qquad (3.29)$$

and is expressed as a moving average (MA) process as:

$$y_t = \frac{\alpha}{1-\beta} + \sum_{i=0}^{\infty} \beta^i \varepsilon_{t-1} \qquad (3.30)$$

A VAR model with two variables is written as:

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \alpha_1 \\ \alpha_2 \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} y_{t-1} \\ x_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{y,t} \\ \varepsilon_{y,t} \end{bmatrix} \quad \text{.....(3.31)}$$

and the vector moving average (VMA) written as:

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{x} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix}^i \begin{bmatrix} \varepsilon_{y,t-1} \\ \varepsilon_{x,t-1} \end{bmatrix} \quad \text{.....(3.32)}$$

After some manipulation, the VMA becomes a moving average representation of the structural formulation of VAR as:

$$\begin{bmatrix} y_t \\ x_t \end{bmatrix} = \begin{bmatrix} \bar{y} \\ \bar{x} \end{bmatrix} + \sum_{i=0}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix} \begin{bmatrix} \varepsilon^s{}_{y,t-1} \\ \varepsilon^s{}_{x,t-1} \end{bmatrix} \quad \text{.....(3.33)}$$

where $\phi_{jk}(i)$ is the impact multiplier and interpreted as $\phi_{11}(0)$. The instantaneous impact of a unit change in $\varepsilon^s{}_{y,t}$ on y_t and $\phi_{11}(1)$ is the instantaneous impact of a unit change in $\varepsilon^s{}_{y,t-1}$. The cumulative effect of $\varepsilon^s{}_{y,t}$ on y_t is $\sum_{i=0}^{\infty}\phi_{11}(i)$ with ϕ_{jk} being the impulse response function. Enders (2010) presents the GIRF of a VAR of variable y_t as:

$$y_t = \sigma V_t + \sum_{i-1}^{\infty}\Pi_i y_{t-1} + \varepsilon_t \quad \text{.....(3.34)}$$

where V_t stands for the deterministic vector of the variables and ε_t is the error term. Since y_t is forecast n steps ahead, the equation above is expressed as:

$y_{t+n} - E\{y_{t+n} \mid \lambda_t\} = \sum_{j=0}^{n-1} C_j \varepsilon_{t+n-j}$ with λ_t being the set of information of y_t and V_t the time path. C_j being the $C_j = \sum_{i=1}^{\min k,j} \Pi_i C_{j-i}$ and $C_0 = 1_p$ where $j \geq 1$.

The GIRF becomes:

$$GI_X(n,\sigma,\lambda_{t-1}) = E[y_{t+n} \mid \varepsilon_t = \sigma, \lambda_{t-1}] - E[y_{t+h} \mid \lambda_{t-1}] \quad \text{......(3.35)}$$

where σ is the known vector, $GI_x(h,\sigma,\lambda_{t-1}) = C_h\sigma$ represents a VAR that depends on the shock of σ.

The same procedure in a VAR is conducted in a VECM if there is cointegration in the estimated model. If there is cointegration, GIRF is estimated based on the VECM model.

3.5.9 VARIANCE DECOMPOSITION

Variance decomposition reveals shocks that are mostly explained by variation in a variable over time. The forecast error variance decomposition tells the proportion of movements in a sequence due to its own shocks versus shock to other variables (Enders, 2010). When the total forecast error variance is explained by shocks of other variables, then the variable is endogenous and if the total forecast error variance is explained by shocks in the variable itself, then the variable is exogenous.

Enders (2010) explains variance decomposition starting with a VAR model

$$x_t = A_0 + A_1 x_{t-1} + e_t \quad \text{......(3.36)}$$

where A_o and A_1 are known and have to forecast i time ahead. Forecasting one period ahead brings the equation to $x_{t+1} = A_0 + A_1 x_t + e_{t+1}$ and taking the conditional expectation of x_{t+1} to obtain $E_t x_{t+1} = A_o + A_1 x_t$ and the one step ahead forecast error is:

$$e_{t+1} = x_{t+1} - E_t x_{t+1}. \quad \text{......(3.37)}$$

The conditional expectation n-step forecast error ahead is:

$$E_t x_{t+n} = (I + A_1 + A_1^2 + \ldots + A_1^{n-1})A_o + A_1^{\,n} x_t \quad \text{......(3.38)}$$

and has its forecast error as:

$$e_{t+n} + A_1 e_{t+n-1} + A_1^2 e_{t+n-2} + \ldots + A_1^{\,n-1} e_{t+1} \quad \text{......(3.39)}$$

It is good to express them in error terms since VAR and VMA have similar information. The general form of expressing a conditional forecast is:

$$x_{t+n} = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t+n-i} \qquad (3.40)$$

with the n-period forecast error being:

$$x_{t+n} - E_t x_{t+n} = \sum_{i=0}^{n-1} \phi_i \varepsilon_{t+n-i} \qquad (3.41)$$

Forecast error n-step ahead for y_t sequences is given as:

$$\begin{aligned} y_{t+n} - E_t y_{t+n} &= \phi_{11}(0)\varepsilon_{yt+n} + \phi_{11}(1)\varepsilon_{yt+n-1} + \ldots + \phi_{11}(n-1)\varepsilon_{yt+1} \\ &\quad + \phi_{12}(0)\varepsilon_{zt+n} + \phi_{12}(1)\varepsilon_{zt+n-1} + \ldots + \phi_{12}(n-1)\varepsilon_{zt+1} \end{aligned} \qquad (3.42)$$

and the n-step ahead forecast error variance of y_{t+n} as $\sigma_y(n)^2$ is:

$$\begin{aligned} \sigma_y(n)^2 &= \sigma^2{}_y \left\{ \phi_{11}(0)^2 + \phi_{11}(1)^2 + \ldots + \phi_{11}(n-1)^2 \right\} \\ &\quad + \sigma_z^2 \left\{ \phi_{12}(0)^2 + \phi_{12}(1)^2 + \ldots + \phi_{12}(n-1)^2 \right\} \end{aligned} \qquad (3.43)$$

This n-step-ahead forecast can be broken down into proportions resulting from each shock whereby, the shock in ε_{yt} and ε_{zt} respectively on $\sigma_y(n)^2$ is expressed as:

$$\frac{\sigma_y^2 \left\{ \phi_{11}(0)^2 + \phi_{11}(1)^2 + \ldots + \phi_{11}(n-1)^2 \right\}}{\sigma_y(n)^2} \qquad (3.44)$$

and $$\frac{\sigma_z^2 \left\{ \phi_{12}(0)^2 + \phi_{12}(1)^2 + \ldots + \phi_{12}(n-1)^2 \right\}}{\sigma_y(n)^2} \qquad (3.45)$$

Forecast error variance decomposition expresses the proportion of movement in a sequence due to its own shocks against those other variables. If for example, ε_{zt} shocks explain none of the forecast error variance of y_t over the estimated time path, then a conclusion can be drawn that y_t sequence is exogenous. Also, ε_{zt} shock could, in certain occasions, explain all the forecast variance in the y_t sequence over the estimated time path, and it is concluded that y_t sequence is endogenous. When it is exogenous, then the evolution of y_t is independent from the ε_{zt} shocks as well as the z_t sequence. In practice, it is possible for a variable to explain most of the forecast error variance at short time path while for long time path, only smaller proportions are explained. Also, it is advisable to carry out variance decomposition is various time paths. As the time path increases, variance decomposition will converge.

If cointegration is revealed in the estimated model, then variance decomposition will be estimated in VECM based on the same steps as VAR.

3.5.10 COMPARATIVE MODEL ANALYSIS

For the comparative model for the USA and Greece, the same techniques and steps followed above were employed for each country.

3.6 SUMMARY OF CHAPTER

This chapter has stated the hypotheses tested in this study, described the data, presented and explained the various steps involved in estimating determinants of government debt in the USA and debt reduction models for the USA and Greece.

Quarterly and annual time series data was used in this study. Seasonally adjusted quarterly data was used to estimate the determinants of real federal debt reduction for the USA only. Data was collected from the Federal Reserve Bank of St Louise for the first quarter of 1980 to the third quarter of 2013. Annual data used for the comparative analysis for the USA and Greece to reduce debt was obtained from AMECO and the World Data Bank from 1970 to 2012.

Three different models were estimated. The first model was estimated such that real federal debt represented the dependent variable while consumer price index, federal interest payment, federal government current tax receipts and government spending on goods and services were the independent variables for the USA model using quarterly data. The second model was the USA using yearly data while the third model was Greece using annual data as well. Variables for the second and third models were general government debt, inflation, gross domestic product growth, primary balance and net current transfers from abroad.

Two different hypotheses were stated and detailed explanations of the various techniques provided such as Johansen cointegration followed by VECM, Granger causality test, GIRF and lastly, variance decomposition. The first test performed was the stationarity test, followed by the Johansen cointegration which reveals the long-run relationship and VECM which shows the short-run and lastly, the diagnostic and stability tests to check and confirm if the estimated model is good. The Granger causality shows the direction of causation among variables while GIRF and variance decomposition reveal shocks on variables over time.

CHAPTER FOUR

EMPIRICAL ANALYSIS AND INTERPRETATION OF RESULTS FOR THE USA

"The ultimate goal of scientific research is to cover the greatest number of empirical facts by logical deduction from the smallest number of hypotheses or axioms."

Albert Einstein

4.1 INTRODUCTION

This chapter presents the empirical analysis and interpretation of results relating to the objectives of the study. Eviews 8 was used as the statistical package for the analysis. A 5% probability value is chosen for significance level and the analysis is based on the techniques discussed in Chapter 3. The results are presented in graphs and tables with values in three decimal places. As stated earlier, this study investigates if real federal debt as a percentage of GDP (FDEBT) is significantly determined by consumer price index (CPI), real federal interest payment as a percentage of GDP (RFINTPG), real federal government constant tax receipts as a percentage of GDP (FRTAXG) and real government spending as a percentage of GDP (RGSPENG) for the USA using quarterly data.

4.2 INITIAL DATA ANALYSIS

This section provides initial results on the data and information on the suitability of data for further analysis. This involves descriptive statistics and visual inspection.

4.2.1 Descriptive statistics of variables for the USA

Table 4.1 presents results of the descriptive statistics. From the Table, it is clear that the mean, median, mode, minimum and maximum values of the variables are close to each other.

The mean value of federal debt for the USA is 81% of GDP, with a maximum value of 96% federal debt to GDP and a minimum of 64% federal debt to GDP, hence the federal debt for the USA is higher compared to the debt to GDP ratio of 60% Growth and Stability Pact. The average of the consumer price index is 0.7, the maximum value is 1.06 while the minimum is 0.3. This shows a high inflation rate since 0.7 consumer price index is close to the base index of 1. The minimum value of real interest payment is 2.2 billion dollars while the maximum is 10.3. The mean of real government spending is 200 million dollars and 12.4 billion dollars is the average amount of real federal government constant tax receipts.

The second observation made is that the probability values of the Jarque-Bera test for real federal debt, consumer price index, real interest payment, real government spending and real federal government constant tax receipts are below the 5% level of significance. As a result, the null hypothesis (that residuals are normally distributed) is rejected. There is, therefore, a need to test for stationarity in these variables. The implication is that this variable is not normally distributed and requires a stationarity test to be carried out.

Table 4.1: Results of descriptive statistics of variables at level form for the USA

VARIABLES	RFDEBT (Percentage of Gross Domestic Product)	CPI (Index 2010=1)	RINTPG (Billions of dollars)	RGSPENG (Billions of dollars)	RTAXG (Billions of dollars)
MEAN	81.916	0.716	6.076	0.201	12.477
MEDIAN	83.838	0.719	6.157	0.202	12.231
MAXIMUM	96.425	1.061	10.340	0.220	26.974
MINIMUM	64.810	0.362	2.178	0.178	4.181
STD. DEV.	10.285	0.196	2.865	0.012	5.093
SKEWNESS	-0.287	0.042	0.117	-0.274	0.693
KURTOSIS	1.628	1.858	1.482	1.863	3.377
JARQUE-BERA	12.170	7.211	12.982	8.762	11.332
PROBABILITY	0.002	0.027	0.002	0.013	0.003
SUM	10812.94	94.550	802.097	26.523	1646.929
SUM SQ. DEV	13857.93	5.041	1074.932	0.018	3398.300
OBSERVA-TIONS	132	132	132	132	132
Conclusion at level	Residuals are not normally distributed	Residuals are not normally distributed	Residuals are not normally distributed	Residuals are not normally distributed	Residuals are not normally distributed

4.2.2 Graphical analysis

Figure 4.1 shows the visual inspection of the time series data of variables in this study. These variables are in logarithms as justified in Chapter 3. The graphs indicate how the natural logarithms of real federal government debt and consumer price index for the USA are increasing while those of real federal interest payment, real government spending and real federal government constant tax receipts are decreasing over time. This implies that their mean are changing over time and it is therefore concluded that the variables are nonstationary at level, hence, need to be differenced (Gujarati and Porter, 2009).

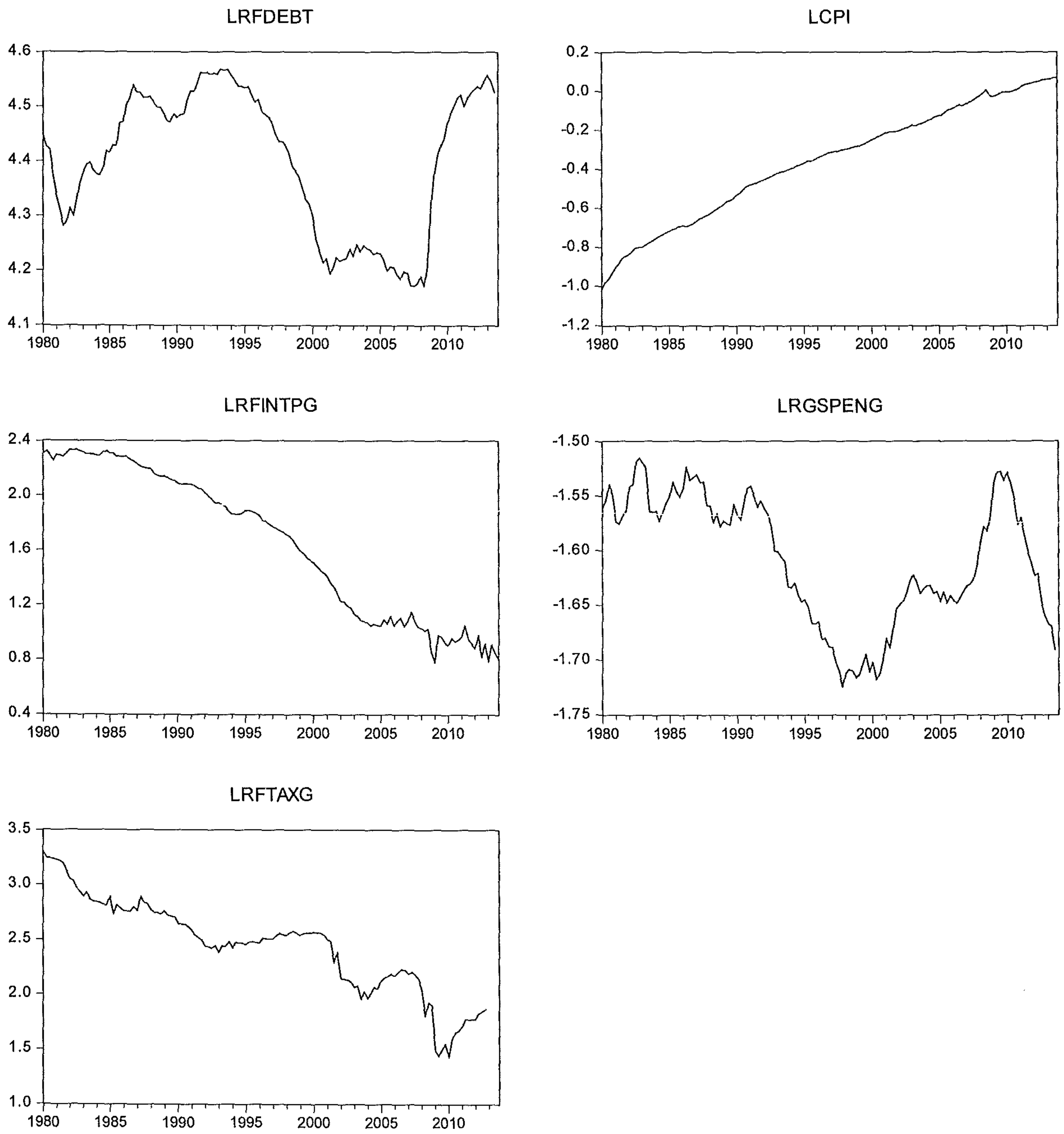

Figure 4.1: Selected variables of the study at level form

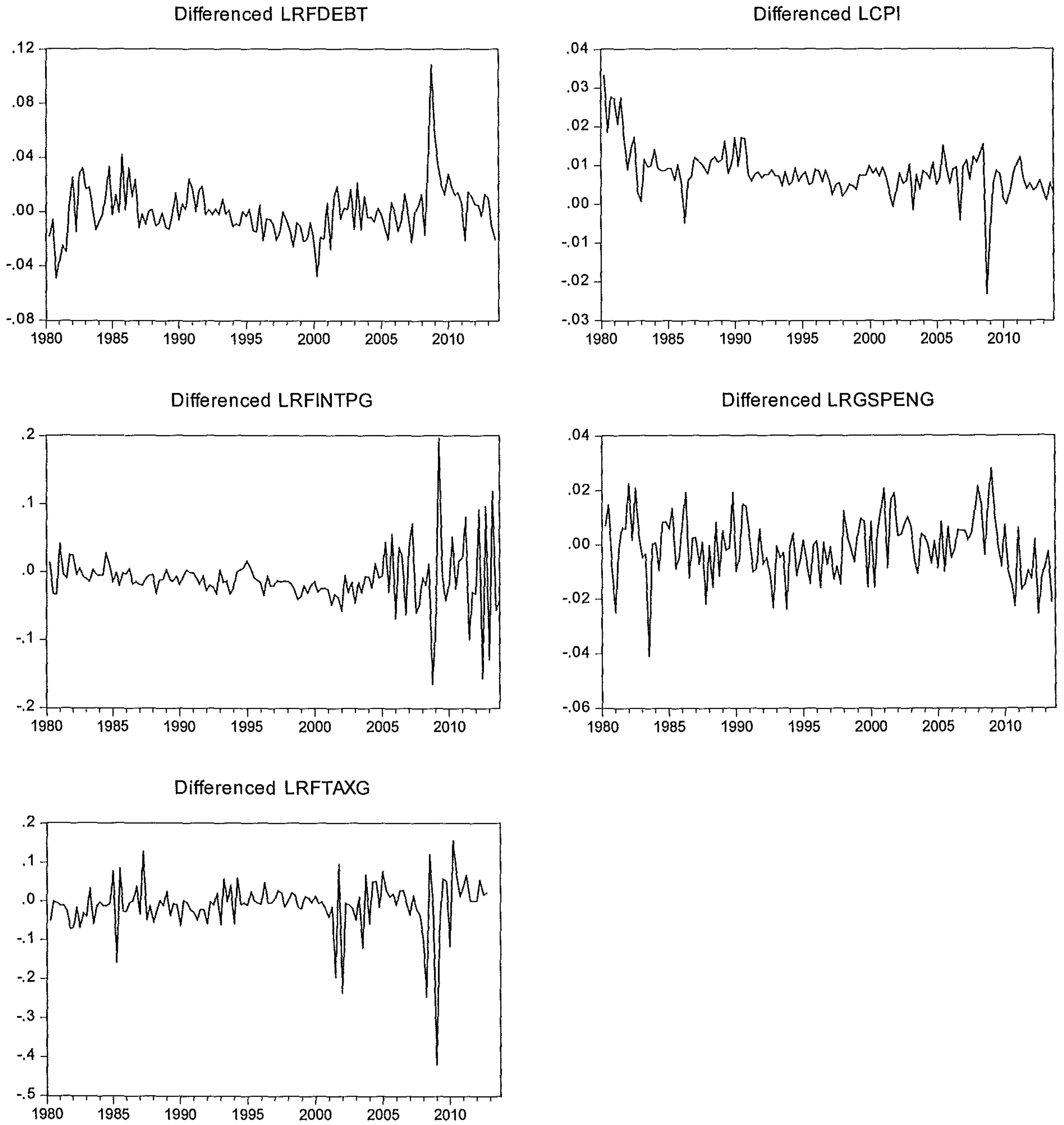

Figure 4.2: Selected variables of the study at differenced

Figure 4.2 shows that when the variables are differenced, they become stationary indicating that the mean, variance and covaraince become constant over the periods. There is no longer a trending behaviour in the white noise process and the variation from the mean is constant. The visual inspection in Figures 4.1 and 4.2 only give an indication that variables are stationary when differenced without stating if they are stationary at first differenced or second differenced. As such, there is a need to conduct the unit roots test in order to establish the exact order of integration.

4.3 UNIT ROOT TEST

A good regression model is obtained when variables in the regression equation are stationary. When a variable is nonstationarity, the regression procedure can easily lead to an incorrect conclusion. It may also have a very high R squared (above 0.95) and very high t-ratios even if the variables have no interrelationships (Asteriou & Hall, 2006). The study analysed the unit root results using ADF, PP and NP tests techniques. Tables 4.2 and 4.3 show results of the three techniques as well as their conclusions. The decision made when the probability values is less than the 5% significance level (or when ADF, PP, and NP test statistics are less than the 5% test critical value) is that, the null hypothesis is rejected and it is concluded that the variable is stationary. The NP unit root test results are used to draw the final conclusion from the three unit root tests.

Table 4.2: Results of ADF, PP and NP tests at level form for the USA

		ADF TEST	PP TEST	NP TEST		CONCLUSION
VARIA-BLES	MODEL SPECIFI-CATION	T-VALUES (LAGS)	T-VALUES (BANDWIDH)	MZA (LAGS)	MZT	
LRFDEBT	Intercept	-1.338(1)	-1.435(8)	-3.846(1)	-1.347	Non stationary
	Trend and Intercept	-1.232(1)	-1.265(8)	-4.021(1)	-1.317	Non stationary
	None	0.218(1)	0.160(8)			Non stationary
LCPI	Intercept	-3.635(1)	-4.675**(6)	1.255(5)	2.562	Non stationary
	Trend and Intercept	-3.125(1)	-4.355**(5)	-0.342(1)	-0.202	Non stationary
	None	-5.377**(1)	-8.416*(8)			Stationary
LRINTPG	Intercept	0.3742(1)	0.373(8)	1.506(4)	2.067	Non stationary
	Trend and Intercept	-2.214(1)	-2.568(8)	-2.885(1)	-1.196	Non stationary
	None	-3.908(1)	-3.416**(8)			Non stationary
LRSPENG	Intercept	-0.824(0)	-1.390(7)	-0.588(0)	-0.289	Non stationary
	Trend and Intercept	-1.161(0)	-1.733(7)	-15.563(4)	-2.776	Non stationary
	None	0.944(0)	0.641(7)			Non stationary
LRFTAXG	Intercept	-1.926(4)	-1.572(8)	-0.543(4)	-0.283	Non stationary
	Trend and Intercept	-4.193**(4)	-3.032(8)	-66.999** (4)	-5.773**	Stationary
	None	-1.305(4)	-1.941(8)			Non stationary

** Reject H0: non-stationarity at a 5% level*
*** Reject H0: non-stationarity at a 1% level*

From Table 4.2, it is concluded that all variables are non-stationary at level form therefore, they should be differenced. On the other hand, the results in Table 4.3 reveal that all variables become stationary at first differenced I(1). For economic variables, if there are contradictions in the results of stationarity in the model specification at intercept, intercept and trend and none, then the results of intercept should be the best since it is the form to which a model is expressed (Gujarati & Porter, 2010).

Table 4.3: Results of ADF, PP and NP test at first differenced for the USA

		ADF TEST	PP TEST	NP TEST		CONCLUSION
VARIA-BLES	MODEL SPECIFI-CATION	T-VALUES (LAGS)	T-VALUES (BANDWIDTH)	MZA (LAGS)	MZT	
LFDEBT	Intercept	-6.767**(0)	-7.097**(7)	-9.676*(3)	-2.194*	Stationary, I(1)
	Trend and Intercept	-6.761**(0)	-7.116**(7)	-48.421**(0)	-4.883**	Stationary, I(1)
	None	-6.786**(0)	-7.122**(7)			Stationary, I(1)
LCPI	Intercept	-7.378**(0)	-7.329**(1)	-0.096(4)	-0.074	Stationary, I(1)
	Trend and Intercept	-8.259**(0)	-8.207**(3)	-3.487(4)	-1.285	Stationary, I(1)
	None	-2.830**(4)	-4.148**(4)			Stationary, I(1)
LRINTPG	Intercept	-16.232**(0)	-16.080**(7)	-0.876(7)	-0.510	Stationary, I(1)
	Trend and Intercept	-16.235**(0)	-16.154**(7)	-11.706(3)	-2.411	Stationary, I(1)
	None	-3.707**(3)	-14.354**(8)			Stationary, I(1)
LGSPENG	Intercept	-9.495**(0)	-10.038**(7)	-9.999*(3)	-2.035	Stationary, I(1)
	Trend and Intercept	-9.467**(0)	-10.018**(7)	-13.509(3)	-2.539(3)	Stationary, I(1)
	None	-9.462**(0)	-10.025**(7)			Stationary, I(1)
LRFTAXG	Intercept	-3.415*(3)	-12.910**(8)	-6.154(3)	-1.709	Stationary, I(1)
	Trend and Intercept	-3.438(3)	-12.896**(9)	-8.503(3)	-2.060	Non Stationary
	None	-3.275**(3)	-12.756**(8)			Stationary, I(1)

* *Reject Ho: non-stationarity at a 5% level*
** *Reject Ho: non-stationarity at a 1% level*

4.4 VAR LAG ORDER SELECTION CRITERIA

Table 4.4 shows results of different lag length selection methods with the chosen optimal lag length of the various criteria. The LR, FPE, AIC, SC and HQ criteria with the best lag length is marked with an asterisk and they appear on the model with the lowest values for FPE, AIC, SC and HQ as follows: LR (5 lags), FPE (5 lags), AIC (5 lags), SC (1 lags) and HQ (2 lags). It is observed that all the criteria are good but lag 5 was selected for this study as suggested by at least three of the criteria. According to Liew (2004), AIC and FPE criteria results are recommended for estimation of the autoregressive lag length hence, Lag 5 was chosen and used in subsequent tests.

Table 4.4: Results of Lag length

LAG	LOGL	LR	FPE	AIC	SC	HQ	CONCLUSION
0	543.382	NA	1.17e-10	-8.684	-8.570	-8.637	Not chosen
1	1693.224	2188.409	1.54e-18	-26.826	-26.144*	-26.549	Not chosen
2	1750.882	105.086	9.11e-19	-27.353	-26.102	-26.845*	Not chosen
3	1777.036	45.559	8.98e-19	-27.372	-25.552	-26.632	Not chosen
4	1802.463	42.242	9.00e-19	-27.378	-24.990	-26.408	Not chosen
5	1840.955	60.842*	7.35e-19*	-27.596*	-24.639	-26.395	Chosen
6	1858.213	25.887	8.52e-19	-27.471	-23.946	-26.039	Not chosen
7	1875.592	24.667	9.95e-19	-27.348	-23.254	-25.685	Not chosen
8	1896.070	27.414	1.12e-18	-27.275	-22.613	-25.381	Not chosen

*It should be noted that * indicates the best lag order selected by each criterion*

4.5 JOHANSEN COINTEGRATION

This is a multivariate technique used to estimate and test the presence of multiple cointegrating equations. The test was used to verify economic theories by placing, where possible, restrictions on the magnitude of estimated coefficients. It also tests restricted versions of cointegration as well as the speed of adjustment of parameters. The existence of cointegration among variables illustrates the presence of a common trend and long-run equilibrium. For a good model to be estimated, the appropriate model in relation to the deterministic component in the system of equations is chosen. Table 4.5 shows the various models and the number of cointegrating equations involved.

Table 4.5: Results of the summarised sets of the five different models with lag five

DATA TREND	NONE	NONE	LINEAR	LINEAR	QUADRATIC
TEST TYPE	NO INTERCEPT NO TREND	INTERCEPT NO TREND	INTERCEPT NO TREND	INTERCEPT TREND	INTERCEPT TREND
TRACE	2	3	2	1	1
MAX-EIG	2	3	0	1	1
CONCLUSION	Not chosen	Not chosen	Not chosen	chosen	Not chosen

According to Asteriou and Hall (2011), the first and last models are not likely to occur in practice, hence the fourth model which has intercept and trend in the linear regression is selected. Subsequently, the Johansen cointegration technique is estimated based on five lags and model four (intercept and trend). The number of cointegrating equations is determined using the Trace and Maximal Eigen statistics as shown in Table 4.6.

Table 4.6: Results of Trace and Maximal eigen values

HYPOTHESIZED NO OF CE(S)	EIGEN VALUE	TRACE STATISTICS	5% CRITICAL VALUE	PROB	MAX-EIGEN STATISTICS	5% CRITICAL VALUE	PROB	CONCLUSION
None *	0.330	112.285	88.804	0.000***	50.469	38.331	0.000***	Reject H_0
At most 1	0.193	61.816	63.876	0.074	27.068	32.118	0.074	Do not Reject H_0
At most 2	0.140	34.748	42.915	0.256	19.047	25.823	0.256	Do not Reject H_0
At most 3	0.077	15.701	25.872	0.517	10.087	19.387	0.517	Do not Reject H_0
At most 4	0.044	5.614	12.518	0.511	5.614	12.518	0.511	Do not Reject H_0

Note: H_0 stands for the null hypothesis

The results for cointegration show that there is one cointegration equation in both the Trace and Max-eigenvalue tests. The null hypothesis of the Trace test states that the number of distinct cointegrating vectors is at most equal to r against the alternative and is rejected if the probability value is less than 5% significance level. At none cointegrating vector, the trace null hypothesis is rejected since the probability value is less than 5% significance level. Also, the test statistics of 112.285 is greater than the 5% critical value of 88.804. This shows the existence of one cointegrating vector at none. The null hypothesis of at most 1 cointegrating vector is rejected since the probability value is greater than the 5% significance level and also because the Trace statistics of 61.816 is less than the 0.05 critical values of 63.876.

The Max-eigen value tests the null hypothesis that the number of cointegrating vectors is r against the alternative $r+1$. In this case, the Max-eigen value test for the null hypothesis is rejected at none, hence there is one cointegrating vector since the probability value is less than 5% significance level. This is supported by the fact that the statistics of 50.469 is greater than the 5% critical value of 38.331 and this indicates the existence of cointegration at none. The null hypothesis of at most one cointegrating vector is rejected since the probability value is greater than 5% significance level and the statistics of 27.068 is less than the 0.05 critical values of 32.118. The existence of one cointegrating equation indicates a unique long-run relationship among the variables. This long-run relationship is explained in detail under VECM since the signs of the coefficients and the significance of the coefficients are revealed in VECM results.

Since cointegration was established, the study proceeded by testing the long-run restrictions implied by economic theory in order to estimate a good model for the USA. This was done by considering different proposals such as: Is the USA data consistent with the budget constraint of Blanchard (2011)? The underlying purpose was to identify the debt determinant function, which is a function of real federal interest, real government spending and real federal government constant tax receipts. The cointegration vector was therefore normalised on federal debt of the USA and the restrictions imposed on the debt function, excluding inflation variables in the model as proposed by Blanchard (2011). The following results in Table 4.7 were obtained.

Table 4.7: Results of long-run restrictions test for the USA model without CPI

RESTRICTIONS	HYPOTHESIZED NO. OF CE(S)	RESTRICTED LOG-LIKEHOOD	LR STATISTIC	DEGREES OF FREEDOM	PROBABILITY	CONCLUSION
b(1,2)=0, b(1,1)=1	1	1868.389	0.048	1	0.827	Consistent data with the estimated debt function

Note b = long-run cointegrated vector. In the brackets, the first columns are the cointegrating equations and the second columns are the positions of the variables in the regression. After the equal sign are the restrictions imposed.

The null hypothesis is not rejected since the probability value is more than 5% significance level. Hence, it is concluded that data for the USA is consistent with the government budget constraint of Blanchard (2011).

After comparing the estimated model with the restricted model, the next step was to conduct the weak exogeneity test. The value of α indicates the speed of adjustment which measures the degree to which the variable in an equation responds to the deviation from the long-run equilibrium relationship. The null hypothesis states that if the variables are exogenous, it will be rejected if the probability value is less than the 5% significance level. The results are presented in Table 4.8. When there is disturbance in the equilibrium, a variable is able to correct equilibrium if it is endogenous. On the contrary, exogenous variables cannot correct disequilibrium in the long-run. The null hypothesis for exogeneity for most variables in this study cannot be rejected implying that they play no role in the adjustment towards equilibrium and towards the long-run as well.

Table 4.8: Results of exogeniety test

Variables	RESTRICTIONS	RESTRICTED LOG-LIKEHOOD	LR STATISTICS	PROBABILITY	CONCLUSION
LCPI	B(1,1)=1, A(2,1)=0	1871.815	0.607	0.436	LCPI is exogenous
LRFINTPG	B(1,1)=1, A(3,1)=0	1866.271	4.283	0.038	LRFINTPG is endogenous
LRSPENG	B(1,1)=1, A(4,1)=0	1867.595	1.636	0.201	LRSPENG is exogenous
LRFTAX	B(1,1)=1, A(5,1)=0	1868.346	0.135	0.714	LRFTAX is exogenous

Note: b = long-run cointegrated vector and a= short-run adjustment coefficient. In the brackets, the first columns are the cointegrating equations and the second columns are the positions of the variable in the regression. After the equal sign, are the restrictions imposed.

4.6 RESULTS FOR VECM

VECM is a restricted VAR designed for use with non-stationary series known to be cointegrated. VECM has cointegration relations built into the specification. It restricts the long-run behaviour of the variables to converge in their cointegrating relationships while allowing for short-run adjustment dynamics. The error correction term, also referred to as the cointegrating term, deviates from the long-run equilibrium to gradually correct through a series of partial short-run adjustments. The results for VECM are presented in Table 4.9.

The long-run relationship for the USA using quarterly data, shows that there is a negative and significant relationship between consumer price index and real federal debt. The implication is that a one unit increase in consumer price index will cause real federal debt to decrease by 1.077 units. These results are consistent with the economic theory and are also in line with Bildirica and Ersin (2007) and Sbrancia (2011) who obtained a negative relationship between the cost of domestic debt and inflation. For the US government to reduce its federal debt, it has to increase consumer price index to a sustainable level since this determines federal debt. Even though the government aims at having a low and stable inflation, this increase will be caused by other economic activities. Since consumer price index is exogenous, this means that it cannot correct any dis equilibrium in the long-run.

Furthermore, the results in Table 4.9 show that there is a positive and significant relationship between real federal interest payment and real federal debt. A one unit increase in real federal interest payment will cause real federal debt in the USA to increase by 1.254 units. This finding is consistent with that of Amo-Yartey *et al.* (2012) and the government budget constraint theory which states that when interest increases, federal debt increases as well. The US government can reduce its federal debt by decreasing federal interest payment. When federal interest payments are lower, the debtor country experiences a decrease in the cost of its debt which may lead to an increase in investment as well as a rise in government expenditure and income.

Table 4.9: Results of VECM for the US model

RESULTS OF THE VECM LONG RUN FOR THE USA MODEL						
VARIABLE	LRFDEBT (-1)	LCPI (-1)	LRFINTPG (-1)	LRGSPENG (-1)	LRFTAXG (-1)	@TREND (80Q1)
COINTEGRATING EQUATION	1.000	-1.077	+1.254	+0.822	-0.743	+0.017
T-STATISTICS		3.208	-13.368	-2.144	6.828	-5.769
CONSTANT	+3.864					
CONCLUSION		Negative and significant	Positive and significant	Positive and significant	Negative and significant	Positive and significant

RESULTS OF VECM SHORT RUN FOR THE US MODEL						
ERROR CORREC-TION	ΔLRFDEBT	ΔLCPI	ΔLRFINTPG	ΔLRGSPENG	ΔLRFTAXG	CONCLUSION
COINTEQ1	-0.175	0.0154	0.136	-0.03-	-0.049	Negative error term (-0.175)
T-STATISTICS	-5.808	1.440	2.094	-1.298	-0.422	Significant error term (-5.808)
R^2	0.617					61.7% of change in real federal debt is explained by the independents variables
ADJUSTED R^2	0.516					Good adjusted r^2
F-STATISTICS	6.130					Significant model

A positive and significant relationship is also found between real government spending and real federal debt. This empirical result is in line with the government budget constraint theory that relates government debt to government spending. A unit increase in government spending will cause federal debt to increase by 0.822 units. Similar results were obtained by Heylen *et al.* (2013). They found that both permanent cuts in expenditure and increase in tax contribute significantly to the reduction of debt in the long-run. The more the US government spends, the more debt it will incur. Hence, the government has to ensure that it reduces or keeps spending at a sustainable level. It is of interest for the US government to cut down spending on consumption and investment that are not necessities and increase income-generating projects respectively. This will help reduce spending and consequently, federal government debt. This result confirms the decision to reduce government spending in 2013 during the fiscal cliff.

Finally, a negative and statistically significant relationship exists between federal tax receipts and federal debt. A one unit increase in federal tax receipts will cause federal debt to reduce by 0.743 units. These signs are in accordance with the economic theory (the government budget constraint) and the study of Heylen *et al.* (2013). This result suggests that the US government can reduce its debt by increasing federal tax receipts. This result encouraged recent increases in taxes in the USA from 2013.

A comparison between federal tax receipts and government spending shows that government spending has a greater impact than tax receipts on federal debt. Alesina and Ardagna (2009) argue that when there is fiscal adjustment, spending cuts are more effective than tax increase in stabilising debt and avoiding economic downturns.

From the results obtained in Table 4.9, the following variables reduce federal debt in the USA in ascending order of magnitude: federal interest payment; consumer price index; government spending; and federal tax receipts. Hence, the US government can reduce debt by negotiating for a decrease in interest payment and government spending while increasing tax receipts to a sustainable level. At the same time, consumer price index will increase but it should not be kept too low since this may reduce real federal debt.

The coefficient of the constant is positive and the coefficient of the trend is positive and significant as well. This is in accordance with the theory which requires that the constant be positive and statistically significant.

The short-run results reveal that the error term is negative (-0.175) and statistically significant (-5.808) with t-statistics greater than 2, hence restoring equilibrium. This is a confirmation that cointegration exists in the long-run since coefficient carries the correct sign and is statistically significant. When there is a shock in the system, real federal debt will take 17.5 percent to adjust to equilibrium of the first quarter deviation from equilibrium. The R^2 value of 0.617 shows that the independent variables explained 61.7% change in the dependent variable. Adjusted R square of 0.516 confirms that even though there are several variables, the variation in the dependent variables is still high.

Table 4.10 shows the long-run relationship of the estimated Blanchard model using quarterly data for the USA. In this estimated model, consumer price was excluded in order to have the model as stated in the government budget constraint. The results show a positive and statistical significant relationship between federal interest payment and federal debt. A positive and statistical significant relationship is found between government spending and federal debt. Finally, a negative statistical significant relationship exists between federal tax receipts and real federal debt. This relationship is the same as that of the estimated model in Table 4.9 and as the original Blanchard model (see budget constraint in Chapter Two). Since this estimated Blanchard model is in line with theory, this confirms the fact that the estimated debt reduction model for the USA is good.

Table 4.10: Results of VECM test for the budget constraint of Blanchard (2011)

LONG-RUN VECM RESTRICTED DEBT REDUCTION MODEL FOR THE USA						
Variable	LRFDEBT (-1)	LCPI (-1)	LRFINTPG (-1)	LRGSPENG (-1)	LRFTAXG (-1)	@TREND (80Q1
COINTEGRATING EQUATION	1.000	0.000	+1.096	+1.759	-0.491	+0.010
T-STATISTICS			-12.006	-3.949	4.065	-5.886
CONSTANT	+5.882					
Conclusion			Positive and significant	Positive and significant	Negative and significant	Positive and significant

SHORT-RUN RESTRICTED DEBT REDUCTION MODEL FOR THE USA						
ERROR CORRECTION	ΔLRFDEBT	ΔLCPI	ΔLRFINTPG	ΔLRGSPENG	ΔLRFTAXG	CONCLUSION
COINTEQ1	-0.134	0.010	0.117	-0.025	0.100	Negative error term
T-STATISTICS	-4.951	1.074	2.079	-1.249	0.987	Significant error term
R^2	0.588					Good r^2
ADJUSTED R^2	0.480					48% of variation in federal debt is explained by the independent variables
F-STATISTICS	5.440					Significant model

From the results (as shown in Table 4.10), the following variables reduce federal debt in the USA: federal interest payment; government spending; and federal tax receipts. Hence, the US government can reduce debt by negotiating for a decrease in interest payment and government spending while increasing tax receipts to a sustainable level. The short-run results reveal that the error correction term is negative (-0.134) and statistically significant (-4.951) with t-statistics greater than 2, hence restoring equilibrium. This confirms that cointegration exists in the long-run. When there is a shock in the system, it will take 13.4

percent speed for the system of equations to adjust to equilibrium. The R^2 is 0.588, which shows that variation in the dependent variable is mostly explained by the independent variables.

4.7 RESULTS OF STABILITY AND DIAGNOSTIC TESTS

Stability and diagnostic tests were conducted in order to determine whether the estimated model is good and in line with the classical linear regression model assumptions. A probability value of 5% was used to accept or reject the null hypothesis of these tests.

4.7.1 Results of the Stability test

Figure 4.3 shows the VEC stability condition check for the VEC model. The unit roots lie in the unit of the circle for the US model indicating that the estimated model is stable. This test is good because it shows that the estimated model is stable and can be used for further analysis.

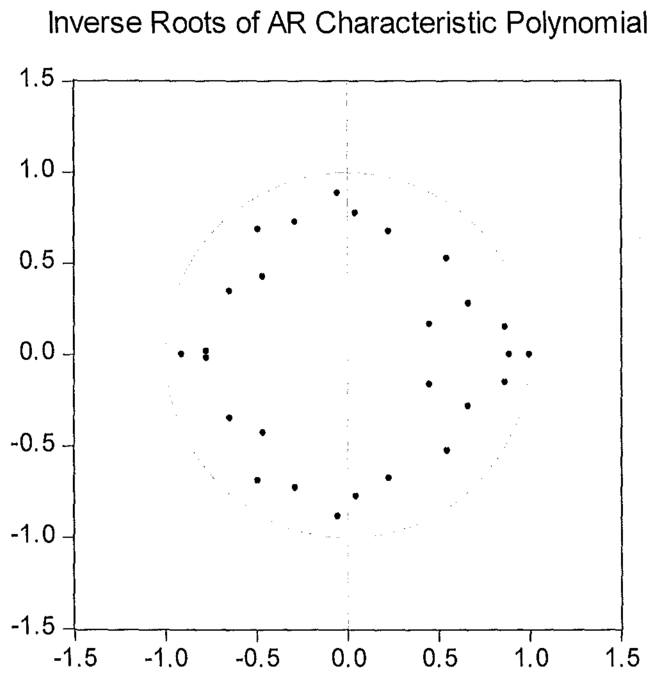

Figure 4.3: VEC stability condition check for the VEC model

4.7.2 Results of LM Autocorrelation test

Table 4.11 presents results of the serial correlation test. The classical linear regression assumptions require that there should be no serial correlation in residuals of the estimated model. The null hypothesis of no serial correlation is accepted when the probability value is greater than the 5% significance level. The probability values of the LM test in Table 4.11 are all greater than 5% significance level, hence there is no serial correlation in residuals of the model from lags one to twelve.

Table 4.11: Results of the Serial correlation LM test

LAGS	LM-STAT	PROB	CONCLUSION OF SERIAL CORRELATION
1	23.026	0.576	No serial correlation
2	14.167	0.959	No serial correlation
3	23.661	0.539	No serial correlation
4	27.337	0.339	No serial correlation
5	18.002	0.842	No serial correlation
6	21.829	0.646	No serial correlation
7	32.163	0.153	No serial correlation
8	15.349	0.933	No serial correlation
9	23.544	0.546	No serial correlation
10	26.827	0.365	No serial correlation
11	25.304	0.445	No serial correlation
12	26.510	0.381	No serial correlation

4.7.3 Results of White Heteroskedasticity

Table 4.12 presents results of heteroskedasticity of residuals of the model. The null hypothesis of no heteroskedasticity is accepted when the probability value is greater than the 5% significance level. If the probability value is greater than 5%, it is concluded that there is no heteroskedasticity in residuals. This result is good since it is in line with classical linear regression model assumptions.

Table 4.12: Results of VEC residual Heteroskedasticity test: no cross

CHI-SQ	DF	PROB.	CONCLUSION OF HETEROSKEDASTICITY
844.657	780	0.054	No heteroskedasticity

VEC stands for vector error correction

4.7.4 Results of Normality test

Table 4.13 shows results of normality of residuals in the estimated model. This is revealed by the probability value of the skewness and results of kurtosis. For residuals to be normally distributed, the probability values should be more than 5% significance level. The skewness shows that residuals are not normally distributed while the kurtosis shows that residuals are normally distributed. According to Paruolo (1997), when there is a difference in the results of skewness and kurtosis, the results of Kurtosis are used. Based on the results in Table 4.13, it is concluded that residuals in the estimated model are normally distributed, hence it is as requested for a good model by the classical linear regression model assumptions.

Table 4.13: Results of VEC residual normality test

COMPONENT		CHI-SQ	DF	PROB.	CONCLUSION
JOINT	SKEWNESS	28.552	5	0.000	Residuals are not normally distributed
JOINT	KURTOSIS	8.626	5	0.125	Residuals are normally distributed
JOINT	JARQUE-BERA	37.178	10	0.000	Residuals are not normally distributed

VEC stands for vector error correction

Table 4:14: Results summary of diagnostics and stability tests

TEST	Null hypothesis	Test statistics	P-Value	Conclusion
AR roots graph	Stable model	$\sum_{i=1}^{n} a_i < 1$		The model is stable
Autocorrelation LM test	No serial correlation	At lag 5, LM stat =18.002	P = 0.842	There is no serial correlation
White	No heteroskedasticity	Chi square = 844.657	P = 0.054	There is no heteroskedasticity
Kurtosis	Residuals are normally distributed	Chi square = 8.626	P = 0.125	The model is normally distributed

4.8 RESULT OF THE VEC MODEL AND CAUSALITY TEST

Results of the VEC Granger causality test are presented in Table 4.14. The null hypothesis states that the independent variables do not Granger cause the dependent variable when all of them are stationary at first differenced. Even though there is a relationship between variables in this study, it does not show the direction of causality, hence the need for the Granger causality test.

If the chosen significance level is 5%, any value above it is insignificant, hence the null hypothesis is accepted. When the probability value is less than 5%, then it is significant. The null hypothesis is therefore rejected and it is concluded that the independent variables can Granger cause the dependent variable in the matrix. VEC Granger causality is used since there is cointegration in the estimated model.

Changes in consumer price index, changes in real federal interest payment, changes in real government spending and changes in real federal government constant tax receipts jointly Granger cause real federal debt as a percentage in the USA. This implies that policies implemented by targeting these variables together, will Granger cause real federal debt. Hence, these variables jointly impact real federal debt in the USA as stipulated by the government budget constraint.

Individually, only changes in consumer price index and real federal interest payment Granger cause real federal debt while changes in real federal government constant tax receipts and real government spending do not Granger cause real federal debt. This means that if the US government wants to reduce real federal debt in the country, then consumer price index and real federal interest payment need to be targeted first. If they are targeted first, it will affect real federal debt.

On the other hand, changes in real federal debt Granger cause changes in consumer price index, real federal interest payment and real government spending. However, real federal debt does not Granger cause real federal government constant tax receipts. This implies that if the government targets real federal debt as the first variable, real federal debt will affect consumer price index, real federal interest payment and real government spending.

Granger causality is bidirectional from consumer price index and real federal debt, also from real federal interest payment and real federal debt, hence which ever variables the government targets first, will have an effect on the other variable. A unidirectional Granger causality relationship from real federal debt Granger cause changes in real government spending. There is causality established between real federal government constant tax receipts and real federal debt.

Table 4.15: Results of VEC Granger causality test at lag five

NULL HYPOTHESIS	CHI-SQ	PROBABILITY	CONCLUSION
D(LCPI) does not Granger cause D(LRFDEBT)	16.526	0.006	Causality
D(LRFINTPG) does not Granger cause D(LRFDEBT)	19.761	0.001	Causality
D(LRGSPENG) does not Granger cause D(LRFDEBT)	4.570	0.470	No causality
D(LRFTAXG) does not Granger cause D(LRFDEBT)	5.410	0.368	No causality
ALL does not Granger cause D(LRFDEBT)	63.516	0.000	Causality
D(LRFDEBT) does not Granger cause D(LCPI)	13.158	0.021	Causality
D(LRFINTPG) does not Granger cause D(LCPI)	2.980	0.703	No causality
D(LRGSPENG) does not Granger cause D(LCPI)	5.204	0.392	No causality
D(LRFTAXG) does not Granger cause D(LCPI)	2.506	0.776	No causality
ALL does not Granger cause D(LCPI)	27.552	0.120	No causality
D(LRFDEBT) does not Granger cause D(LRFINTPG)	21.751	0.001	Causality
D(LCPI) does not Granger cause D(LRFINTPG)	14.770	0.011	Causality
D(LRGSPENG) does not Granger cause D(LRFINTPG)	5.384	0.371	No causality
D(LRFTAXG) does not Granger cause D(LRFINTPG)	25.598	0.000	Causality
ALL does not Granger cause D(LRFINTPG)	101.721	0.000	Causality
D(LRFDEBT) does not Granger cause D(LRGSPENG)	14.644	0.012	Causality
D(LCPI) does not Granger cause D(LRGSPENG)	7.442	0.189	No causality
D(LRFINTPG) does not Granger cause D(LRGSPENG)	6.056	0.301	No causality
D(LRFTAXG) does not Granger cause D(LRGSPENG)	7.075	0.215	No causality
ALL does not Granger cause D(LRGSPENG)	41.155	0.004	Causality
D(LRFDEBT) does not Granger cause D(LRFTAXG)	5.174	0.395	No causality
D(LCPI) does not Granger cause D(LRFTAXG)	20.358	0.001	Causality
D(LRFINTPG) does not Granger cause D(LRFTAXG)	12.334	0.030	Causality
D(LRGSPENG) does not Granger cause D(LRFTAXG)	5.849	0.321	No causality
ALL does not Granger cause D(LRFTAXG)	73.904	0.000	Causality

Note: D stands for change in variables of the study

4.9 RESULTS OF GENERALISED IMPULSE RESPONSE FUNCTION (GIRF)

The GIRF shows the shock applied to each variable and its effect on the VECM system. GIRF is employed to show how federal debt responds to shocks from the variables in this study, GIRF is estimated on VECM since cointegration exists in the estimated debt reduction model. For this study, one to eight quarters is considered as the short-term, nine to eighteen quarters, as the medium-term and more than eighteen quarters as the long-term.

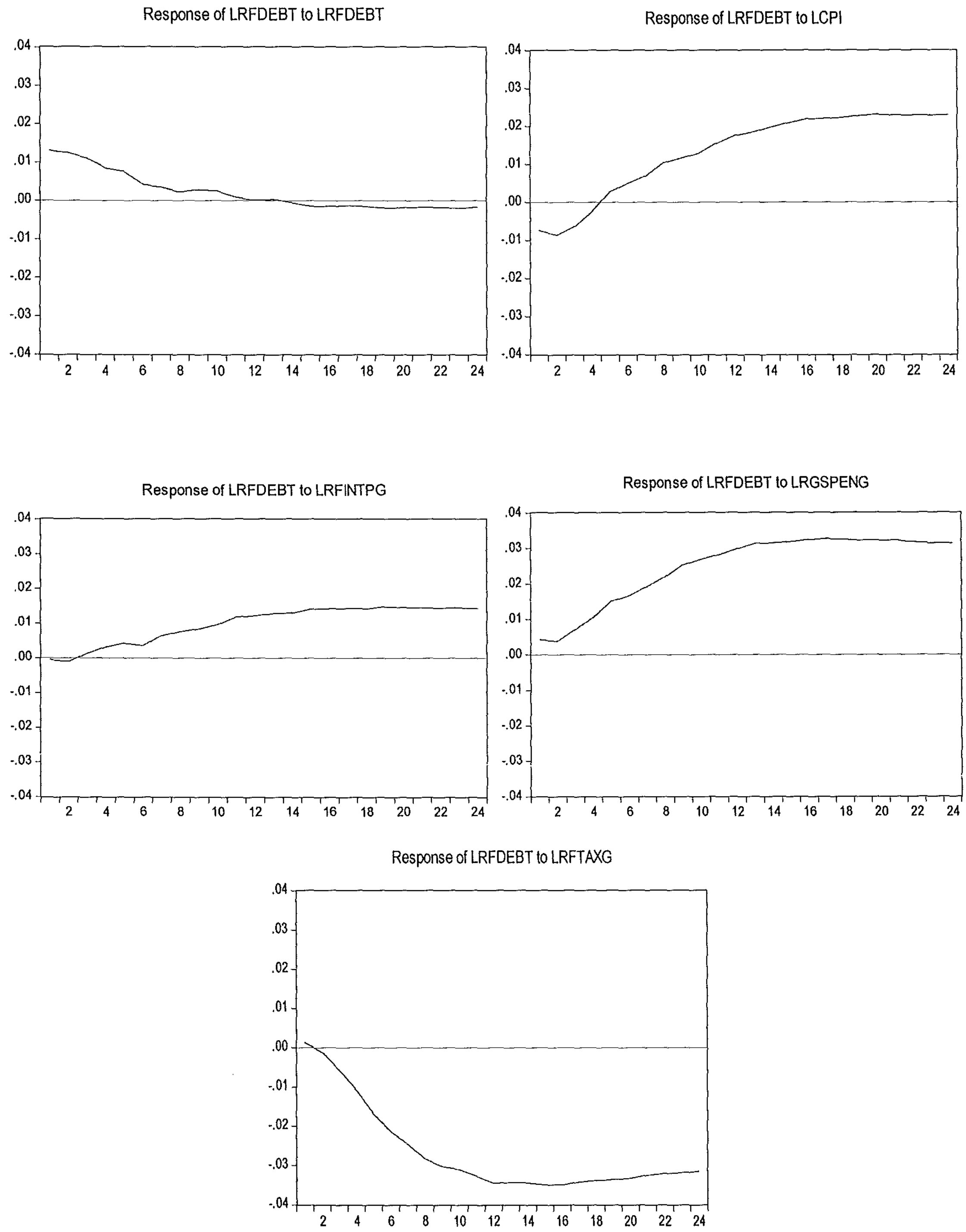

Figure 4.4: Response of LFDEBT to shocks

Figure 4.4 shows the response of variables to shocks in the VECM model (twenty four quarters ahead). The movement above the zero line has a positive effect while below the zero line are the negative effects. The response of real federal debt to the independent variables was first analysed in this study. In the short-run, a positive shock on real federal government debt will cause real federal debt to respond positively in a decreasing order, in the medium-term, it responds negatively as well as in the long-term. If a positive shock is given to consumer price index, real federal debt reacts negatively from the 1st to the 4th period, then it becomes negative in the short-term but in the medium and long-term, it is negative. Real federal interest payments do not respond in the first period but respond positively in the second period until the 12th period to real federal debt in the short-term, in the medium and long-term, the response is positive. Furthermore, a positive shock on real government spending will cause real federal debt to be positive and increase over time in the short, medium and long-term. While that of real federal tax receipts is zero, during the first period, it becomes negative during the second period until the 12th period in the short-term and negative in the medium and long-term.

From Figure 4.5, consumer price index responds negatively to a shock in real federal debt up to the 24th period. On the other hand, real federal interest payment responds negatively from the 1st to the 2nd period, becomes positive over time until the 20th period and zero from the 21st to 24th period. Real government spending responds positively to shocks from real federal debt from the 1st period up till the 5th period. It becomes zero until the 7th period and reverts negative again until the 14th period and later on it becomes positive until the 24th period. Real federal government tax receipts respond to shocks from federal government debt by being positive in the first period and turn to the negative side in the 2nd up to the 3rd period. Later, after the 4th period, it becomes positive until the 24th period.

For the 24 quarters, it is also shown that real federal debt responds positively to its shock. The response of real federal debt to consumer price index is negative, then later, positive while the response of consumer price index to real federal debt remains negative throughout. The response of real federal debt to real federal interest payment is negative, then positive and vice-versa. Meanwhile, real federal debt to real government spending is positive while the response of real government spending to real federal debt is positive, then changes to negative and again changes to positive. The response of real federal debt to real federal tax receipts and vice-versa is positive, followed by a negative response and back to positive.

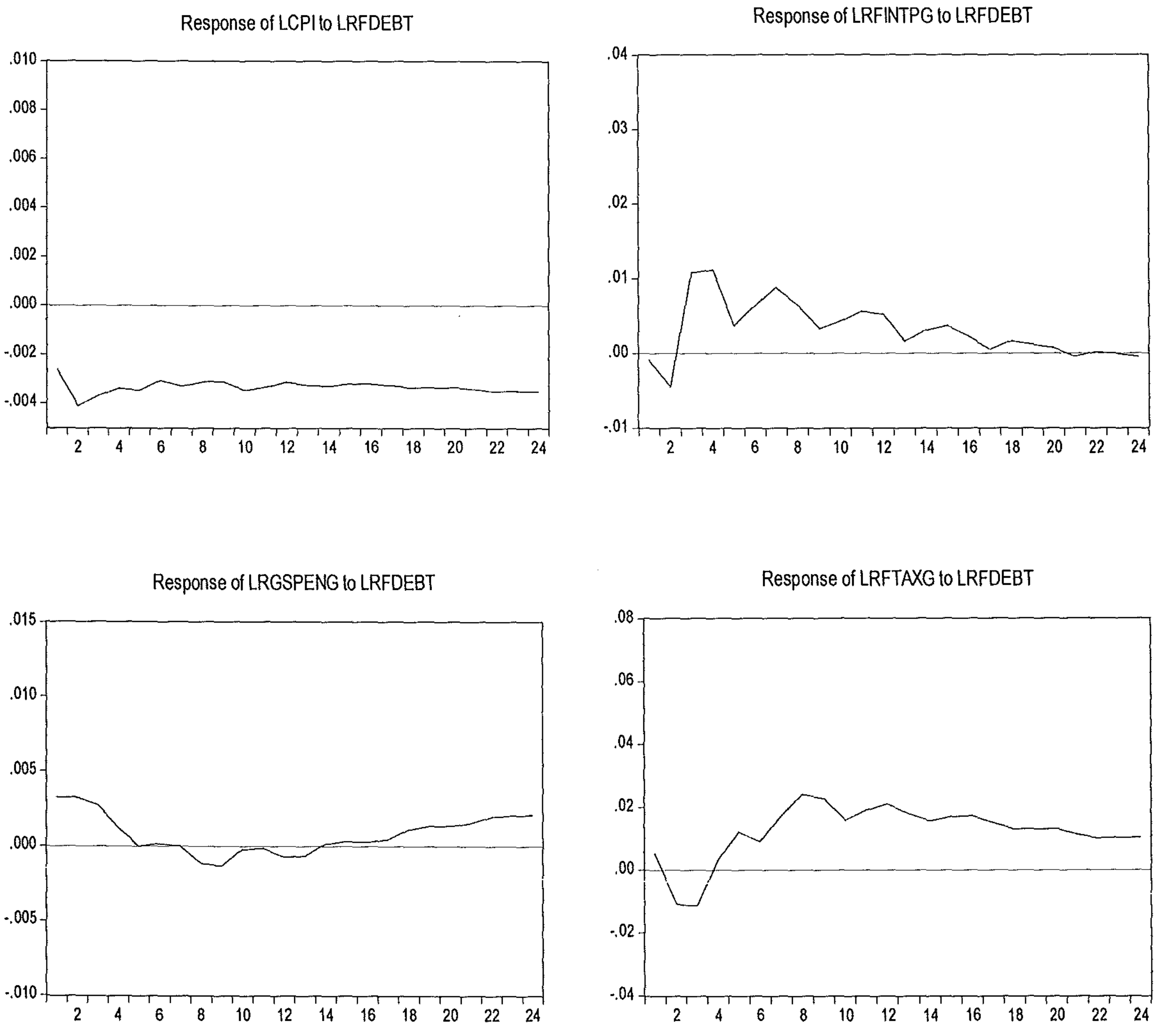

Figure 4.5: Response of shocks from LFDEBT

The results as summarised in Table 4.15 for the short-run imply the following as real federal debt responds to shocks: If real federal debt increases out of a sudden, the present real federal debt will increase as well, and when consumer price index increases, real federal debt will decrease for one year (four quarters) and after a year, it will increase. This shows that consumer price index should be increased for just a year; this is in line with results of VECM presented in Table 4.10. If consumer price index continues to increase after a year, real federal debt will instead increase. This could be due to the fact that when prices increase up to a certain level, it will get to a point where it will no longer increase. Also, if real federal interest payment increases, real federal debt will respond positively. This relationship is similar to results of VECM in Table 10, hence real interest payment needs to be increased since this might discourage government from borrowing and thus, reducing federal debt. Real federal government debt will respond by increasing when real government spending increases all through the 24 quarters. This response to shock is the same as the relationship revealed in the estimated determinant of real federal debt. This means that as soon as government increases spending, debt will increase, hence a good justification for the recent spending cut in the USA. Furthermore, when real federal government tax receipts increase, real federal debt will not respond for the first two periods but from the third period, it will decrease. This result confirms the relationship in Table 4.10. The decrease in government spending and an increase is taxes as implemented by the USA and other countries are a good measure to cut down on rising government debt.

The long-run implies the following as real federal debt responds to shocks: If real federal debt increases out of a sudden, in the long-run, consumer price index will increase as real federal debt increases. This reveals that consumer price index should be decreased in the long-run; this is contrary to results of VECM presented in Table 4.10. This is good because the more inflation is kept low, the more real federal debt will reduce. Also, if real federal interest payment increases for the first two quarters, real federal debt will not respond, but as from the third period, it will respond positively. This relationship is similar to results of VECM in Table 10, hence real interest payment needs to be increased since this might discourage government from borrowing thus, reducing federal debt. Real federal government debt will respond by increasing when real government spending increases all through the 10 quarters. This response to shock is the same as the relationship revealed in the estimated determinant of real federal debt. This means that as soon as government starts to increase spending, debt will increase, hence a good justification for the recent spending cut in the USA. Furthermore, when real federal government tax receipts increase, real federal debt increases as well. This result contradicts the relationship in Table 4.10.

Table 4.16 Response and signs of variables in a VEC model for Figures 4.4 and 4.5

SHOCK	RESPONSE		
	Short-term	Medium-term	Long-term
LRFDEBT to LRFDEBT	Positive	Negative then zero and negative	Negative
LRFDEBT to LCPI	Negative followed by positive	Positive	Positive
LRFDEBT to LRFINTPG	Zero followed by positive	Positive	Positive
LRFDEBT to LRGSPENG	Positive	Positive	Positive
LRFDEBT to LRFTAXG	Zero followed by negative	Negative	Negative
LCPI to LRFDEBT	Negative	Negative	Negative
LRINTPG to LRFDEBT	Negative followed by positive and zero	Positive	Positive then zero
LRGSPENG to LGFDEBT	Positive followed by zero then negative	Positive followed by zero then negative	Positive
LGFTAXG to LGFDEBT	Positive followed by negative and then positive	Positive	Positive

4.10 RESULTS OF VARIANCE DECOMPOSITION

The results of variance decomposition of real federal debt are presented in Table 4.16 while all the results are shown in Appendix H. The focus of this study was on the dependent variable (real federal debt). Variance decomposition was estimated on VECM because of the cointegrated relationship in the estimated debt reduction model.

The results in Table 4.16 show the variation effect of real federal debt over twenty four quarters. The 6^{th} quarter will stand for the short-run, 12^{th} quarter for medium-term and the 18^{th} quarter for long-term. High variation of shocks in the short-run is explained by real government spending with 39.067% followed by real federal debt with 30.892%. Real federal government tax receipts follows with 20.640%, consumer price index and lastly, real federal interest payment in the short-run. In the medium-term, high variation of shock is explained by real federal government tax receipts with 44.106% followed by real government spending with 31.139%. This is followed by consumer price index, real federal debt and lastly, real federal interest payment. In the long-run, variation in real federal debt is again explained by real federal government tax receipts with 38.801% followed by real government spending with 33.636%. This is followed by consumer price index with 23.834%, real federal debt and lastly, by real federal interest payment.

It is revealed that the impact of real government spending and real federal government tax receipts have been the major variables explaining the variation of shocks. The implication is that the US government needs to adopt a twin-policy, one that focuses on addressing government spending and the other looking at increasing tax revenues.

Table 4.17: Results of variance decomposition based on LFDEBT

PERIODS	STANDARD ERROR	LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG
1	0.013	100.000	0.000	0.000	0.000	0.000
2	0.018	96.487	1.009	0.003	0.045	2.457
3	0.023	85.164	0.655	0.783	2.598	10.800
4	0.028	65.980	1.507	1.358	8.618	22.537
5	0.036	45.271	6.865	0.991	15.120	31.752
6	0.044	30.892	8.738	0.663	20.640	39.067
7	0.053	21.715	10.270	0.717	23.754	43.544
8	0.063	15.493	12.302	0.678	25.801	45.725
9	0.073	11.609	13.939	0.638	27.950	45.865
10	0.083	9.130	15.287	0.668	29.514	45.402
11	0.092	7.308	16.663	0.809	30.386	44.834
12	0.103	5.965	17.934	0.856	31.139	44.106
13	0.112	5.008	19.136	0.896	31.915	43.045
14	0.121	4.303	20.263	0.909	32.468	42.058
15	0.130	3.763	21.217	0.959	32.810	41.250
16	0.138	3.338	22.181	0.978	33.099	40.403
17	0.145	3.002	23.063	0.989	33.4007	39.545
18	0.153	2.734	23.834	0.996	33.636	38.801
19	0.160	2.518	24.542	1.022	33.779	38.139
20	0.166	2.336	25.235	1.027	33.903	37.500
21	0.173	2.180	25.844	1.032	34.039	36.904
22	0.178	2.050	26.403	1.036	34.137	36.375
23	0.184	1.938	26.908	1.046	34.199	35.909
24	0.189	1.839	27.384	1.046	34.257	35.474

From the results, real federal government tax receipts impact on real federal debt the most followed by real government spending and consumer price index with real federal interest payment not having an effect. This is contrary to Alesina and Ardagna (2009) who maintain that spending cuts are more effective than tax increase in stabilising debt. This could be due to the fact that the US government has been lowering its taxes in the past years through various Acts as explained in section 2.3.3. Thus, an increase in these taxes has far-reaching effects on real federal debt.

Appendix H shows various results of effects of variance decomposition of the variables up to the 24th period. A high proportion of a shock on consumer price index is mostly explained by innovations in consumer price index followed by real federal tax receipts and real federal debt. Variance decomposition of real federal interest payment is mostly explained by consumer price index followed by itself. Variation in real government spending is also explained by itself. Similarly, variance decomposition of real federal tax receipts is mostly explained by itself, followed by real government spending and consumer price index.

4.11 SUMMARY OF CHAPTER

The empirical results of determinants of real federal debt in the USA using quarterly data revealed negative and significant relationships between real federal debt and consumer price index as well as real federal debt and real federal government constant tax receipts. Positive and significant relationships exist between real federal debt and real interest payment as well as real federal debt and real government spending. Restrictions were imposed on the estimated model for the USA in order to obtain a model with the exclusion of consumer price index. The results show that there is a positive and significant relationship between real federal interest payment and real federal debt which is same as results for the unrestricted model. A positive significant relationship was found between real government spending and real federal debt. A negative significant relationship exists between real federal tax receipts and real federal debt. The same relationship and significance were revealed between the unrestricted US model and the restricted model for the USA.

VEC Granger causality results revealed that real federal debt is jointly Granger caused by changes in consumer price index, changes in real federal interest payment, changes in real government spending and changes in real federal government constant tax receipts in the USA. Bidirectional Granger causality exists between consumer price index and real federal debt and between real federal interest payment and real federal debt while a unidirectional causality exists from real federal debt to real government spending.

GIRF results revealed that real federal debt responds positively to shock from itself as well as shock from real government spending. At the beginning of the period, real federal debt responds negatively to consumer price index and there is no response from real interest payment and real federal government constant tax receipts. These GIRF results are the same as the estimated relationship of results of VECM. Results of Variance decomposition revealed that real federal government tax receipts and real government spending explain most of the variations in real federal debt over ten quarters with real federal government tax receipts being the key determinant.

CHAPTER FIVE

COMPARATIVE EMPIRICAL ANALYSIS FOR THE USA AND GREECE

"We should listen to data but know when to tell the data to shut up."

Peter Kennedy

5.1 INTRODUCTION

This chapter focuses on the comparative analysis of the USA and Greece using quarterly data relating to one of the objectives mentioned in Chapter 1. The techniques discussed in the methodology are employed in the analysis and test the following hypothesis: general government debt (GDEBT) is significantly reduced by inflation (INF), gross domestic product growth (GDPG), primary balance (PB) and net current transfers from abroad (RNTRA) in the USA and in Greece. The results are presented in graphs and tables with values in three decimal places. 5% is used as the level of significance. The letters U and G are attached behind each and every variable to represent the USA and Greece respectively. The purpose is to distinguish between the two countries with the same variables in the table as well as in the graphical analysis.

5.2 RESULTS OF INITIAL DATA ANALYSIS FOR THE USA AND GREECE

The section presents the results in order to confirm if the data is good for comparative analysis. It involves descriptive statistics and visual inspection.

5.2.1 Descriptive statistics

Tables 5.1 and 5.2 show results of the comparative data for the USA and Greece respectively. The values of the mode, median, minimum and maximum are closed to one another. Looking at the probability value of the Jarque-bera, the residuals do not all meet normality conditions. The probability value of gross domestic product growth, primary balance and net transfer from abroad for the USA is greater than the 5% probability value;

hence, the null hypothesis is accepted that residuals are normally distributed. On the other hand, residuals of government debt and inflation are less than the 5% level of significance in the USA, hence residuals are not normally distributed. There is, therefore, a need to carry out unit roots tests.

Table 5.1 Results of descriptive statistics of variables for the USA at level form

NAME OF VARIABLES	UDEBT	UINF	UGDPG	UPB	RUNTRA
MEAN	58.995	4.397	2.897	1.62E+12	2.18E+08
MEDIAN	58.878	3.377	3.292	1.42E+12	1.69E+08
MAXIMUM	102.854	13.509	7.259	2.61E+12	2.66E+09
MINIMUM	40.238	-0.356	-2.802	7.88E+11	-2.07E+09
STD. DEV.	15.806	2.923	2.097	6.18E+11	1.15E+09
SKEWNESS	1.006	1.424	-0.733	0.283	0.057
KURTOSIS	3.837	4.621	3.419	1.523	2.396
JARQUE-BERA	8.512	19.232	4.168	4.482	0.677
PROBABILITY	0.014	0.001	0.124	0.106	0.713
SUM	2536.800	189.086	124.570	6.95E+13	9.39E+09
SUM SQ. DEV	10492.33	358.865	184.608	1.61E+25	5.55E+19
OBSERVATIONS	43	43	43	43	43
CONCLUSION	N.N.D	N.N.D	N.D	N.D	N.D

N.D. stands for residuals are normally distributed while N.N.D stands for residuals are not normally distributed

Table 5.2 shows that data for Greece is close to each from the mean, median, mode, minimum and maximum values. In general, residuals of general government debt, inflation, gross domestic product growth and primary balance are normally distributed since the probability values are more than 5% significance level whereby the null hypothesis is not rejected. Net current transfer from abroad is not normally distributed. For variables that are not normally distributed, there is a need to test for unit roots.

From Tables 5.1 and 5.2, the mean value of government debt as a share of GDP is 58.9% in the USA while in Greece, it is 71.6% revealing that average general government debt in Greece is higher than that of the USA by about 13%. The maximum amount of general government debt in the USA is 102.9% and in Greece, it is 170.3%. The level of general government debt in Greece is by far greater than that of the USA. Average inflation rate in the USA (4.4%) is less than that of Greece (10.9%). This rate is more than double that of the USA. This could be because of government activities that lead to increase in inflation even though studies such as (Abedian and Biggs (1998) have been conducted and recommend an increase in inflation as a measure of reducing rising government debt. On average, gross domestic product growth in the USA (2.9%) is more than that of Greece (2.2%) even though Greece has a higher maximum value of 10.2% while the USA has 7.2%. Since 2008, Greece has been experiencing a sovereign debt crisis, hence a decrease in the country's gross domestic product growth rate compared to the USA. The mean primary balance for the USA (1620 billion) is more than that of Greece (201 billion) but the mean net transfer from abroad in the USA (218 million) is less than that of Greece (241 million). These two variables are based on the fact that the economy of the USA is by far greater than that of Greece, thus the high values.

Table 5.2: Results of descriptive statistics of variables in Greece at level form

NAME OF VARIABLES	GDEBT	GINF	GGDPG	GBP	RGNTRA
MEAN	71.613	10.943	2.166	2.01E+10	2.41E+08
MEDIAN	74.022	10.923	2.941	1.84E+10	52391061
MAXIMUM	170.306	26.869	10.160	3.36E+10	1.03E+09
MINIMUM	15.740	1.210	-7.106	8.98E+09	-62390872
STD. DEV.	43.179	7.783	4.044	5.35E+09	3.57E+08
SKEWNESS	0.256	0.391	-0.476	0.329	1.135
KURTOSIS	2.115	1.795	2.917	2.778	2.687
JARQUE-BERA	1.873	3.698	1.636	0.868	9.416
PROBABILITY	0.392	0.157	0.441	0.648	0.009
SUM	3079.359	470.543	93.131	8.65E+11	1.03E+10
SUM SQ. DEV	78305.40	2544.348	686.738	1.20E+21	5.34E+18
OBSERVATIONS	43	43	43	43	43
CONCLUSION	N.D	N.D	N.D	N.D	N.N.D

N.D. stands for residuals are normally distributed while N.N.D stands for residuals are not normally distributed

5.2.2 Graphical results for the USA and Greece

Figures 5.1 and 5.2 show the variation of comparative data over time. Results of the visual inspection indicate that the natural logarithms of variables from 1970 to 2012 for the USA and Greece are nonstationary and some stationary at level form. Government net current transfer from abroad and gross domestic product growth are stationary for both countries while all the other variables are nonstationary.

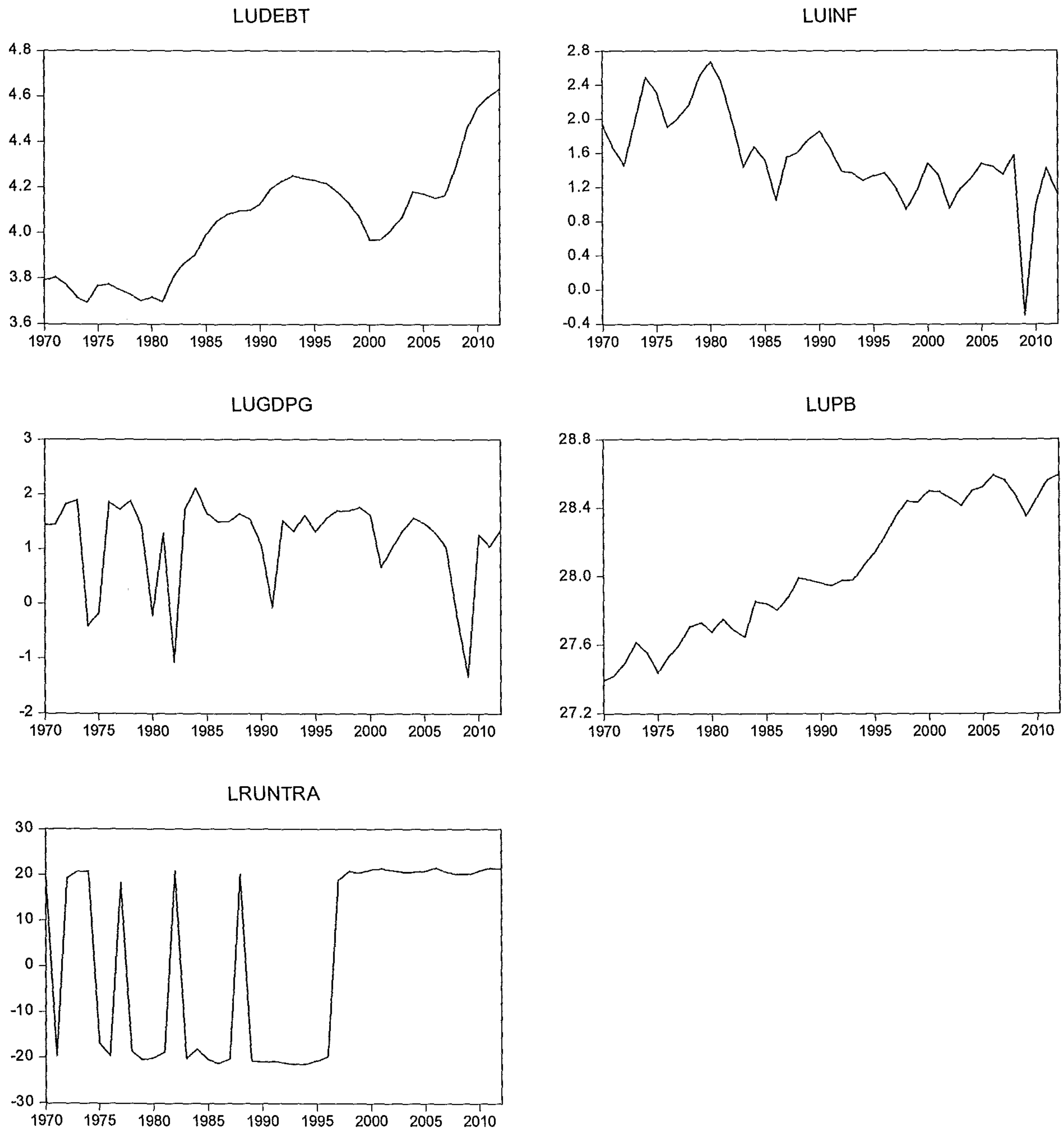

Figure 5.1: Selected variables of study at level form for the USA

The overall impression from Figures 5.1 and 5.2 is that in both countries, variables are either trending upwards with fluctuations, downwards with fluctuations or having a constant mean and variance. These figures reveal that over time, all the variables are either increasing or decreasing; hence the mean has not been constant over time. When the mean is not constant over time, variables are nonstationary. Since the variables appeared to be nonstationary, the study proceeded to the next step of differencing the data.

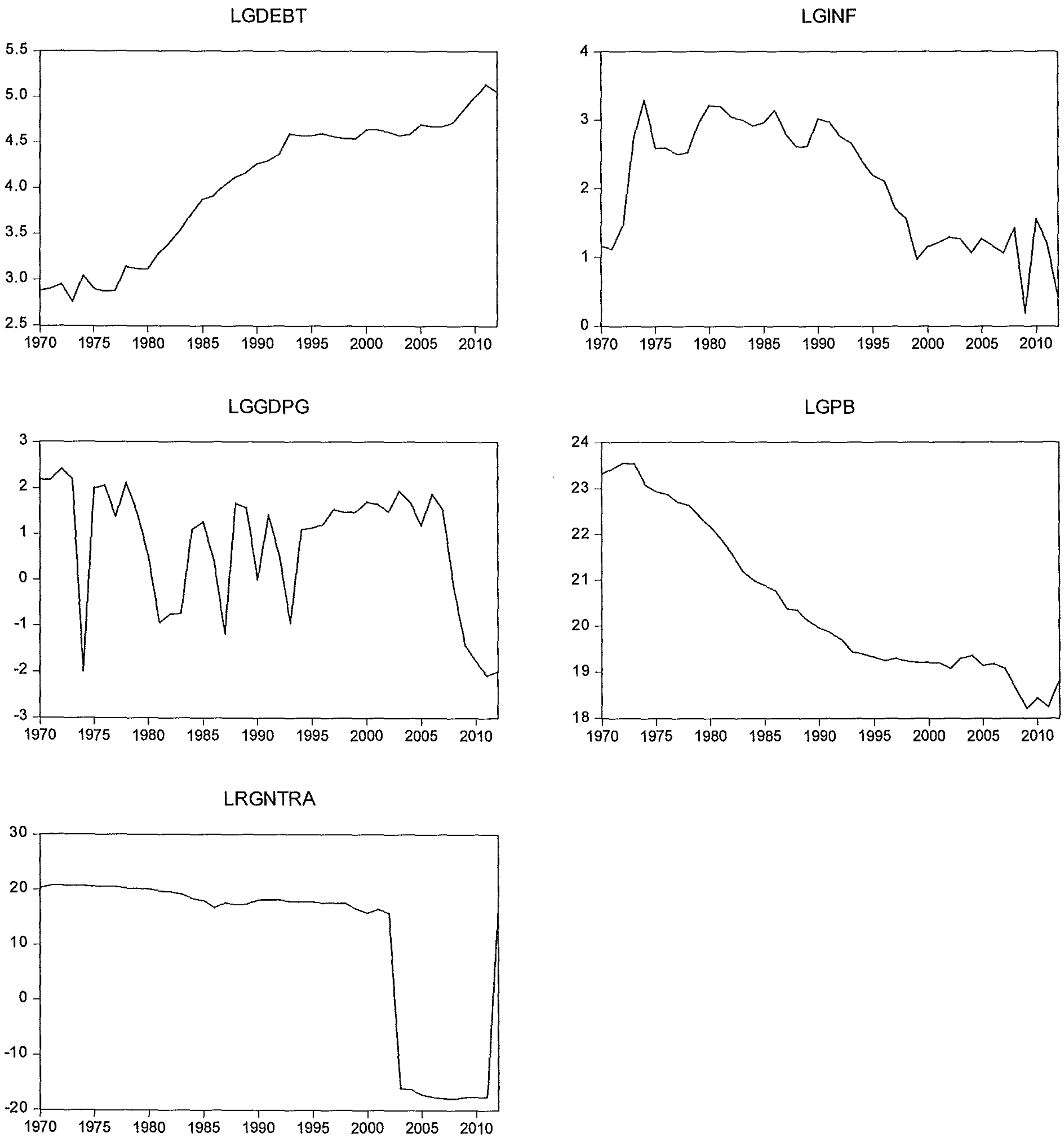

Figure 5.2: Selected variables of study at level form for Greece

Figure 5.3 shows results of visual inspection at first differenced for the USA while Figure 5.4 presents results for Greece. Differencing removes the trend component from the time series hence, the data appears to be stationary. The mean, variance and covariance become constant over time and there is no longer a trending behaviour in the white noise process. The next step is to proceed to the unit roots tests in order to confirm if variables are indeed stationary and also to determine the order of integration (I(d)).

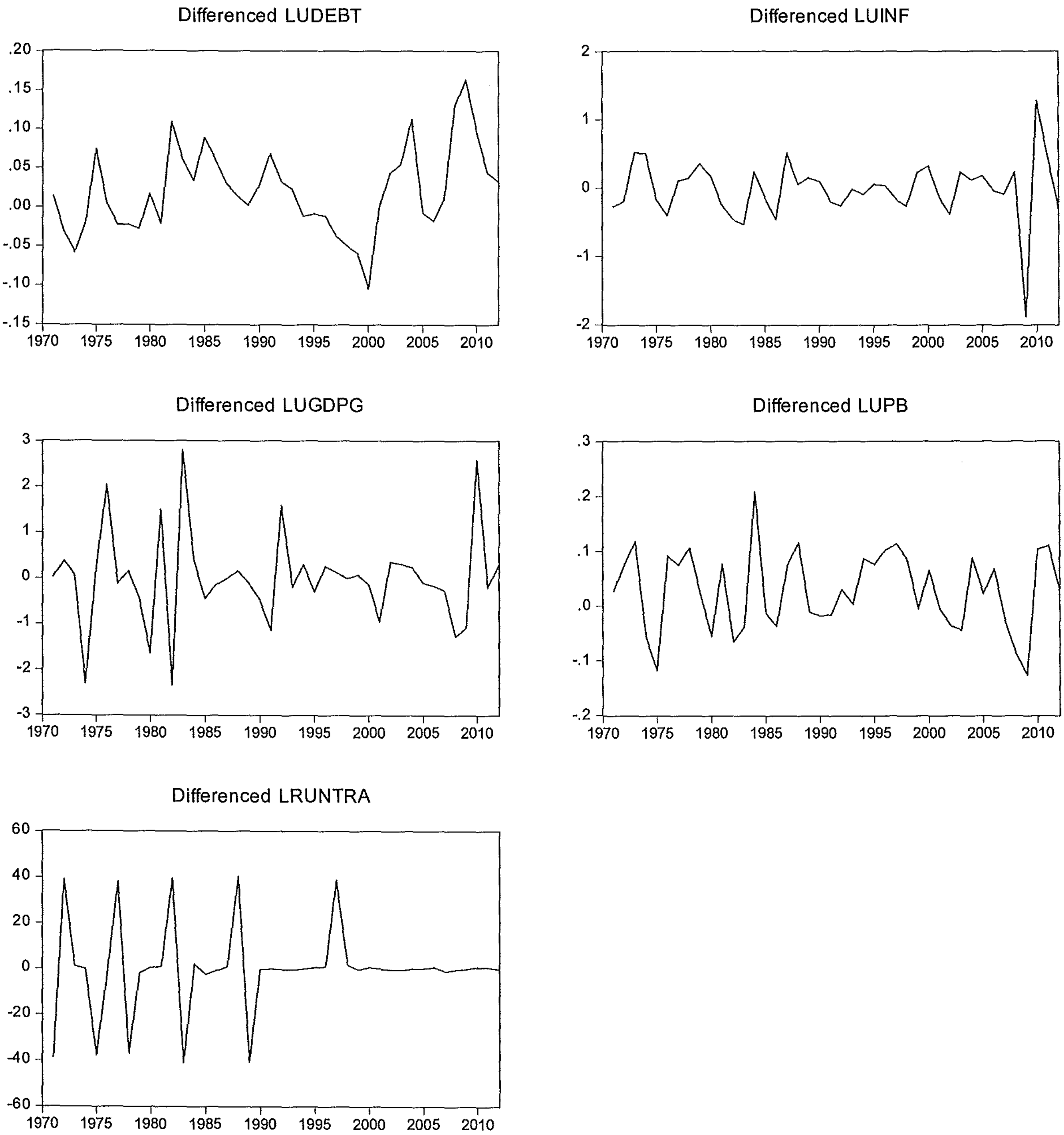

Figure 5.3: Selected variables of study at differenced for the USA

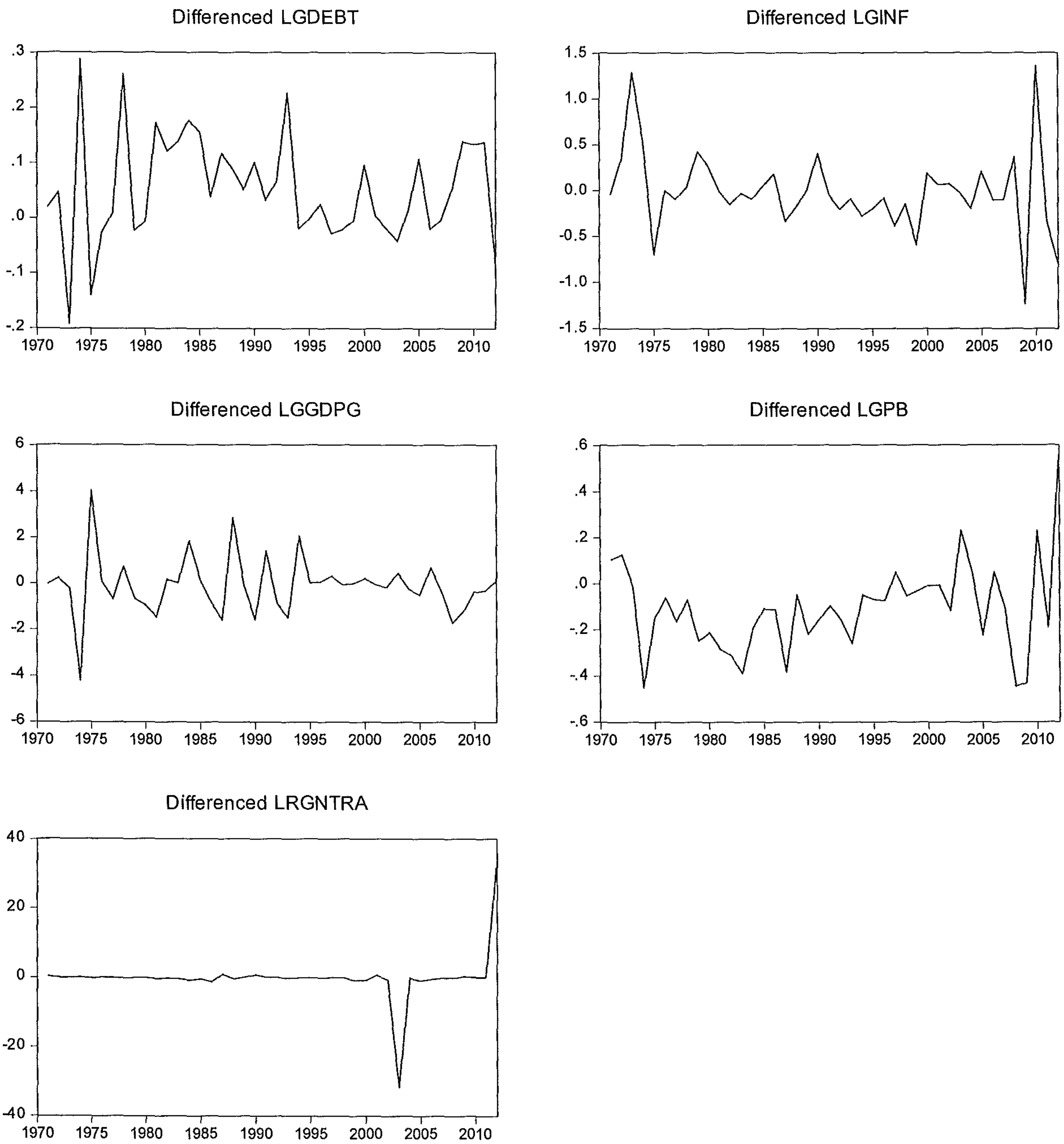

Figure 5.4: Selected variables of study at differenced for Greece

5.3 RESULTS OF UNIT ROOT TESTS FOR THE USA AND GREECE

Just like in Chapter 4, ADF, PP and NP unit roots tests were used to test for stationarity for both the USA and Greece. Tables 5.3 and 5.4 present results of tests using the three techniques as well as conclusions drawn for the USA and Greece respectively. The conclusions are based on NP unit roots tests and the focus is more on intercept and trend and intercept.

Table 5.3 shows that general government debt and primary balance have unit roots at level form for the USA at 5% significance level. Hence, they need to be differenced while inflation, gross domestic product growth and net transfer from abroad do not have unit roots at level form.

Table 5.4 shows results of the unit roots tests for Greece at 5% significance level. General government debt, inflation and primary balance in Greece are all nonstationary at level form. Gross domestic product growth and net transfer from abroad in Greece are the only stationary variables at level form. Since the variables for both countries are nonstationary at level form, there is a need to proceed to first differenced.

Results of the unit roots tests are in line with those of visual inspection with the exception of inflation in Greece which becomes stationary at level form. Since some of the variables are nonstationary at level form, there was a need to proceed to first differenced.

Tables 5.5 and 5.6 present results of the unit roots tests for the USA and Greece respectively. All the variables are stationary at first differenced for both countries, hence the need to proceed to results of the lag length selection test.

Table 5.3: ADF, PP and NP tests at level form for the USA

		ADF TEST	PP TEST	NP TEST		CONCLUSION
VARIABLES	MODEL SPECIFICATION	T-VALUES (LAGS)	T-VALUES (BANDWIDTH)	MZA (LAGS)	MZT	
LUDEBT	Intercept	-0.494(1)	0.263(2)	-2.313(1)	-0.670	Non stationary
	Trend & Intercept	-2.466(1)	-1.557(3)	-17.584(1)	-2.862	Non stationary
	None	1.136(1)	1.663(3)			Non stationary
LUINF	Intercept	-2.968*(1)	-2.850(2)	-11.748*(0)	-2.369*	Stationary, I(0)
	Trend & Intercept	-4.502**(0)	-4.299**(5)	-18.603*(0)	-3.047	Stationary, I(0)
	None	-1.136(0)	-0.976(13)			Non stationary
LUGDPG	Intercept	-5.109**(0)	-4.964**(7)	19.884**(0)	-3.153	Stationary, I(0)
	Trend & Intercept	-5.0771**(0)	-4.914**(7)	-20.121*(0)	-3.167*	Stationary, I(0)
	None	-1.833(1)	-2.285*(2)			Stationary, I(0)
LUPB	Intercept	-0.904(0)	-0.850(9)	0.909(0)	0.786	Non stationary
	Trend & Intercept	-2.461(0)	-2.589(2)	-10.095(0)	-2.217	Non stationary
	None	2.507(0)	3.707(9)			Non stationary
LRUNTRA	Intercept	-3.351*(0)	-3.259*(2)	-12.677*(0)		Stationary, I(0)
	Trend & Intercept	-4.162*(0)	-4.132*(1)	-15.057*(0)	-2.733	Stationary, I(0)
	None	-3.384**(0)	-3.293**(2)			Stationary, I(0)

* Reject Ho: non-stationarity at a 5% level
** Reject Ho: non-stationarity at a 1% level

Table 5.4: ADF, PP and NP tests at level form for Greece

		ADF TEST	PP TEST	NP TEST		CONCLUSION
VARIABLES	MODEL SPECIFICATION	T-VALUES (LAGS)	T-VALUES (BANDWIDTH)	MZA (LAGS)	MZT	
LGDEBT	Intercept	-0.733(0)	-0.726708(1)	1.00848(1)	1.04528(1)	Non stationary
	Trend & Intercept	-1.333(0)	-1.296(2)	-3.894(0)	-1.356(0)	Non stationary
	None	3.075(1)	3.336(2)			Non stationary
LGINF	Intercept	-1.074(1)	-1.117(2)	-2.512(1)	-0.984	Non stationary
	Trend & Intercept	-3.153(0)	-3.140(5)	-4.837(1)	-1.447	Non stationary
	None	-0.609(1)	-0.680(1)			Non stationary
LGGDPG	Intercept	-3.330*(0)	-3.299*(0)	-13.805*(0)	-2.389	Stationary, I(0)
	Trend & Intercept	-3.517(0)	-3.537*(3)	-15.479(0)	-2.712	Non stationary
	None	-3.049**(0)	-2.936**(3)			Stationary, I(0)
LGPB	Intercept	-1.651(0)	-1.651(0)	-0.698(2)	-0.381(2)	Non stationary
	Trend & Intercept	-0.322(0)	-0.322(0)	-1.760(0)	-0.678(0)	Non stationary
	None	-3.721(0)	-3.587**(1)			Non stationary
LRGNTRA	Intercept	-1.618(0)	-1.688(2)	-4.263(0)	-1.460	Non stationary
	Trend & Intercept	-5.857**(8)	-2.025(2)	-7.830(0)	-1.815	Non stationary
	None	-1.365(0)	-1.380(1)			Non stationary

** Reject H0: non-stationarity at a 5% level*
*** Reject H0: non-stationarity at a 1% level*

Table 5.5: ADF, PP and NP tests at first differenced for the USA

		ADF TEST	PP TEST	NP TEST		CONCLUSION
VARIABLES	MODEL SPECIFICATION	T-VALUES (LAGS)	T-VALUES (BANDWIDTH)	MZA(LAGS)	MZT	
D (LUDEBT)	Intercept	-3.288**(1)	-3.159*(4)	-13.931*(0)	-2.636**	Stationary, I(1)
	Trend & Intercept	-3.407(0)	-3.266(5)	-14.591(0)	-2.700(0)	Non stationary
	None	-3.407**(0)	-3.067**(3)			Stationary, I(1)
D (LUINF)	Intercept	-6.707**(1)	-13.155**(18)	-19.930**(0)	-3.152	Stationary, I(1)
	Trend & Intercept	-6.637**(1)	-13.261**(19)	-36.001**(1)	-4.232	Stationary, I(1)
	None	-8.132**(1)	-12.348**(16)			Stationary, I(1)
D (LUGDPG)	Intercept	-8.856**(0)	-27.661**(40)	-18.193**(0)	-3.013	Stationary, I(1)
	Trend & Intercept	-8.745(0)	-27.116**(40)	-18.184(0)	-3.013	Stationary, I(1)
	None	-8.969**(0)	-27.784**(40)			Stationary, I(1)
D (LUPB)	Intercept	-5.735**(0)	-6.145**(11)	-20.351**(0)	-3.189	Stationary, I(1)
	Trend & Intercept	-5.676**(0)	-6.109**(11)	-20.357*(1)	-3.190	Stationary, I(1)
	None	-5.134**(0)	-5.059**(3)			Stationary, I(1)
D (LRUNTRA)	Intercept	-10.019**(0)	-15.772**(18)	-0.092**(5)	-0.125**	Stationary, I(1)
	Trend & Intercept	-9.880**(0)	-18.448**(21)	-18.956*(0)	-3.072	Stationary, I(1)
	None	-10.127**(0)	-14.518**(17)			Stationary, I(1)

** Reject H0: non-stationarity at a 5% level*
*** Reject H0: non-stationarity at a 1% level*

Table 5.6: ADF, PP and NP tests at first differenced for Greece

		ADF TEST	PP TEST	NP TEST		CONCLUSION
VARIABLES	MODEL SPECIFICATION	T-VALUES (LAGS)	T-VALUES (BANDWIDTH)	MZA(LAGS)	MZT	
D (LGDEBT)	Intercept	-7.068**(0)	-7.046**(3)	-20.3546**(3)	-3.141	Stationary, I(1)
	Trend & Intercept	-6.996**(0)	-6.990**(2)	-20.122*(0)	-3.122	Stationary, I(1)
	None	-5.549**(0)	-5.849**(4)			Stationary, I(1)
D(LGINF)	Intercept	-7.139**(0)	-7.145**(1)	-20.074**(0)	-3.067	Stationary, I(1)
	Trend & Intercept	-7.603**(0)	-7.958**(4)	-19.587*(0)	-3.070**	Stationary, I(1)
	None	-7.225**(0)	-7.232**(1)			Stationary, I(1)
D (LGGDPG)	Intercept	-8.528**(0)	-9.652**(4)	-18.653**(0)	-3.053**	Stationary, I(1)
	Trend & Intercept	-5.059**(0)	-5.059**(0)	-18.838*(1)	-2.761	Stationary, I(1)
	None	-2.305*8(1)	-3.995**(4)			Stationary, I(1)
D (RGNTRA)	Intercept	-4.135**(0)	-4.135**(1)	-19.268**(0)	-2.358*	Stationary, I(1)
	Trend & Intercept	-3.501(8)	-3.939*(1)	-18.622*(0)	-2.492	Stationary, I(1)
	None	-4.246**(0)	-4.245**(1)			Stationary, I(1)

** Reject H0: non-stationarity at a 5% level*
*** Reject H0: non-stationarity at a 1% level*

5.4 RESULTS OF VAR LAG CRITERIA FOR THE USA AND GREECE

Table 5.7 shows results of the various lag length selection methods with their chosen optimal lag length for the USA and Greece respectively. The lag length of 1 is chosen for both countries as suggested by the asterisk. The choice of SC was due to its effectiveness in many model estimations and because of its accuracy (Rust, Simester, Brodie & Nilikant, 1995). Furthermore, most of the criteria suggest lag one as the best lag length.

Table 5.7: Selection of the lag length for the USA and Greece

SELECTION OF THE LAG LENGTH FOR THE USA							
LAG	LOGL	LR	FPE	AIC	SC	HQ	CONCLUSION
0	-228.646	NA	0.082	11.682	11.893	11.758	Not chosen
1	-69.181	271.089*	9.91e-05*	4.959	6.226*	5.417*	Chosen
2	-43.338	37.473	0.000	4.917*	7.239	5.757	Not chosen
3	-24.920	22.10175	0.000	5.246001	8.624	6.467	Not chosen
SELECTION OF THE LAG LENGTH FOR GREECE							
LAG		LR	FPE	AIC	SC	HQ	CONCLUSION
0	-288.078	NA	1.59134	14.653	14.865	14.730	Not chosen
1	-122.997	280.638*	0.001*	7.649*	8.917*	8.108*	Chosen
2	-101.941	30.531	0.002	7.847	10.169	8.687	Not chosen
3	-73.206	34.482	0.002	7.660	11.038	8.882	Not chosen

*The * indicates the best lag selected by each criterion*

5.5 RESULTS OF JOHANSEN COINTEGRATION FOR THE USA AND GREECE

The cointegration results in Table 5.8 show clearly, the number of cointegration based on the different model specifications for the USA and Greece respectively. This model was selected for this study because it allows for linear intercept and trends in each variable and in cointegration relations. From Table 5.8, for both countries, one (1) represents the trace statistics while zero (0), the maximum Eigen statistics. According to Harris (1995), cointegration can be done with variables that are stationary at I(0) and I(1) since I(0) plays a role in establishing a long-run relationship between nonstationary variables. This justifies the reason why I(0) and I(1) variables were used in the Johansen cointegration for this comparative study.

Table 5.8: Summarised sets of the model specifications with lag one for the USA and Greece

SUMMARISED SETS OF THE MODEL SPECIFICATIONS WITH LAG ONE FOR THE USA					
DATA TREND	NONE	NONE	LINEAR	LINEAR	QUADRATIC
TEST TYPE	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
TRACE	1	1	0	1	1
MAX-EIG	0	0	0	0	1
CONCLUSION	Not selected	Not selected	Not selected	Selected	Not selected
SUMMARISED SETS OF THE MODEL SPECIFICATIONS WITH LAG ONE FOR GREECE					
DATA TREND	NONE	NONE	LINEAR	LINEAR	QUADRATIC
TEST TYPE	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
TRACE	2	2	5	1	1
MAX-EIG	0	1	0	0	1
CONCLUSION	Not selected	Not selected	Not selected	Selected	Not selected

Table 5.9 shows results of cointegration based on Trace statistics and Max eigen statistics for the USA. The probability value of Trace statistics at none cointegrating vector until at most 4 is less than the 5% significance level. This shows that there is one cointegration equation at none with trace test for the USA based on trace statistics since the null hypothesis is not rejected. Also, Trace statistics is greater than the 5% critical value at none, hence the conclusion of one cointegrating equation is drawn. The probability values of the max-eigen statistics are greater than the 5% significance level at no cointegration until at most four cointegrating equations. Also, Max-eigen statistics are less than the 5% critical value at none up to at most four cointegrating equations, hence the null hypotheses are not rejected and it is concluded that that there is no cointegrating equation. The trace tests

indicate that there one cointegrating equations while the Max-eigen reveals no cointegrating equation for the US model. According to Lutkepohl and Trenkler (2000), the Trace test is better than the Max-eigen value test even though the trace test maybe highly distorted in small sample sizes. Gujarati and Porter (2009) also maintain that the Trace test is better than the Max-eigen test since the Trace test precedes the Max-eigen test.

Table 5.9: Results of Cointegration for the USA and Greece

RESULTS OF COINTEGRATION OF TRACE AND MAXIMAL EIGEN VALUES FOR THE USA								
HYPOTHESIZED NO OF CE(S)	EIGEN VALUE	TRACE STATISTICS	0.05 CRITICAL VALUE	PROB	MAX-EIGEN STATISTICS	0.05 CRITICAL VALUE	PROB	CONCLUSION
None *	0.601	91.226	88.804	0.033*	37.635	38.331	0.060	Reject H_0
At most 1 *	0.472	53.591	63.876	0.269	26.212	32.118	0.221	Do not reject H_o
At most 2 *	0.288	27.380	42.915	0.659	13.921	25.823	0.729	Do not reject H_o
At most 3 *	0.209	13.459	25.872	0.702	9.634	19.387	0.658	Do not reject H_o
At most 4 *	0.089	3.825	12.518	0.767	3.825	12.518	0.767	Do not reject H_o
RESULTS OF COINTEGRATION OF TRACE AND MAXIMAL EIGEN VALUES FOR GREECE								
HYPOTHESIZED NO OF CE(S)	EIGEN VALUE	TRACE STATISTICS	0.05 CRITICAL VALUE	PROB	MAX-EIGEN STATISTICS	0.05 CRITICAL VALUE	PROB	CONCLUSION
None *	0.598	98.990	88.804	0.008*	37.405	38.331	0.064	Reject H_0
At most 1 *	0.433	61.585	63.876	0.077	23.271	32.118	0.399	Do not reject H_o
At most 2 *	0.347	38.314	42.915	0.134	17.444	25.823	0.421	Do not reject H_o
At most 3	0.309473	20.870	25.872	0.185	15.182	19.387	0.184	Do not reject H_o
At most 4	0.130	5.687	12.518	0.501	5.687	12.518	0.501	Do not reject H_o

Table 5.9 shows results of cointegration based on Trace statistics and Max eigen statistics for Greece as well. The probability value at none cointegrating vector is less than the 5% significance level. Also, trace statistics at none cointegrating vector is greater than the 5% critical value. This shows that there is cointegration at no cointegrating vector, hence one cointegrating equation is found with the Trace test for Greece based on the Trace statistics.

The probability value of Max-eigen statistics is greater than the 5% significance at none until at most four. Also, the Max-eigen statistics is less than the 5% critical value at none up till at most four, hence the null hypotheses are not rejected and it is concluded that there is no cointegrating equation with the Max-eigen test. The Trace test shows one cointegrating equation while the Max eigen reveals zero cointegrating equations in Greece.

In both countries, the Trace test shows one cointegrating equation while the Max-eigen test shows no cointegrating equations. It is concluded that there is one cointegrating equation in the USA and Greece.

Restrictions were imposed on general government debt function and the following results were obtained:

Table 5.10: Results of long-run restrictions test for the USA and Greece

RESULTS OF LONG-RUN RESTRICTIONS TEST FOR THE USA			
COINTEGRATION RESTRICTIONS	CHI SQUARE	PROBABILITY	CONCLUSION
B(1,2)=-1, B(1,3)=-1, B(1,4)=1, B(1,5)=-1	25.782	0.000	Correct imposition signs
RESULTS OF LONG-RUN RESTRICTIONS TEST FOR GREECE			
COINTEGRATION RESTRICTIONS	CHI SQUARE	PROBABILITY	CONCLUSION
B(1,2)=-1, B(1,3)=-1, B(1,4)=1, B(1,5)-1	17.313	0.001	Correct imposition signs

b = long-run cointegrated vector. In the brackets, the first column is the cointegrating equation and the second columns are the positions of the variables in the regression. After the equal to sign, are the restrictions imposed

The null hypothesis is not rejected since the probability value is more than the 5% significant level. Hence, it is concluded that data for both the USA and Greece are consistent with economic theory signs of debt function. After imposing long-run restrictions, the next step was to study the weak exogeneity tests.

α is the speed of adjustment which measures the degree to which the variable in an equation responds to the deviation from the long-run equilibrium relationship. The null hypothesis that variables are exogenous will be rejected if the probability value is less than the 5% significant level. Exogenous variables cannot correct disequilibrium in the long- run. The null hypothesis for exogeneity of most variables cannot be rejected implying that they play no role in adjustment with respect to equilibrium and towards the long-run.

From Table 5.11, when there is disturbance in equilibrium, a variable is able to correct equilibrium if it is endogenous.

Table 5.11: Results of exogeniety test for the USA and Greece

	RESULTS OF EXOGENIETY TEST FOR THE USA			
	RESTRICTIONS	CHI SQUARE	PROBABILITY	CONCLUSION
LUDEBT	B(1,1)=1, A(1,1)=0	0.079	0.778	LUDEBT is exogenous
LUINF	B(1,1)=1, A(2,1)=0	7.534	0.006	LINF is endogenous
LUGDPG	B(1,1)=1, A(3,1)=0	0.364	0.546	LUGDPG is exogenous
LUPB	B(1,1)=1, A(4,1)=0	8.442	0.004	LUPB is endogenous
LRUNTRA	B(1,1)=1, A(5,1)=0	0.041	0.840	LRUNTRA is exogenous
	RESULTS OF EXOGENIETY TEST FOR GREECE			
	RESTRICTIONS	CHI SQUARE	PROBABILITY	CONCLUSION
LGDEBT	B(1,1)=1, A(1,1)=0	14.006	0.000	LGDEBT is endogenous
LGINF	B(1,1)=1, A(2,1)=0	0.047	0.828	LGINF is exogenous
LGGDPG	B(1,1)=1, A(3,1)=0	2.104	0.148	LGGDPG is exogenous
LGPB	B(1,1)=1, A(4,1)=0	3.710	0.054	LGPB is exogenous
LRGNTRA	B(1,1)=1, A(5,1)=0	0.404	0.525	LRGNTRA is exogenous

a= short run adjustment coefficient. In the brackets, the first column is the cointegrating equations and the second columns are the positions of variables in the regression. After the equal to sign, are the restrictions imposed

5.6 RESULTS OF VECM FOR THE USA AND GREECE

Table 5.12 shows results of the long and short-run model for the USA and Greece. There is a significance and negative relationship between general government debt and inflation in the USA while in Greece, there is an insignificance and negative relationship. If inflation increases by one unit, general government debt will decrease by 0.312 units in the USA. In Greece, if inflation increases by one unit, general government debt will decrease by 0.018 units. The relationship in the USA is in line with empirical studies conducted by Bildirica and Ersin (2007) and Sbrancia (2011) who found a significant relationship. These results could be due to the fact that inflation rate in the USA is low (below 2%). In Greece, the relationship is insignificant and similar to the study conducted by Sinha *et al.* (2011). For governments of these countries to reduce their debts, the US government has to increase inflation while the Greek government does not have to increase it. Inflation is a variable which the government of the USA can work on in order to reduce general government debt. A significance and positive relationship was found between general government debt and constant in the USA and Greece.

The relationship between general government debt and gross domestic product growth is positive and insignificant in the USA while in Greece, it is a negative and insignificant relationship as well. The relationships show that if gross domestic product growth increases by one unit in the USA, general government debt will increase by 0.077 units while in Greece, when gross domestic product growth increases by one unit, general government debt will decrease by 0.003 units. The variables are insignificant in both countries and have opposite relationships. The positive relationship in the USA is contrary to economic theory probably because the country might have attained its full growth point such that for growth to take place, the country has to invest more, thus incurring debt. The negative relationship in Greece is in line with theory and consistent with studies conducted by Dinca and Dinca (2013) and Sheihk *et al*. (2010) who also found a negative relationship. Greece needs growth in order to reduce its debts but these studies show that gross domestic product growth is not a variable to be used to reduce government debt in both countries.

The relationship between general government debt and primary balance in the USA and Greece are not similar even though they are significant in both countries. For the USA, there is a negative and significant relationship while in Greece, there is a positive and significant relationship between general government debt and primary balance. A one unit increase in primary balance will cause general government debt in the USA to decrease by 0.295 units while that of Greece will increase by 0.596 units. The negative and significant relationship in the USA is due to the fact that the USA has a surplus in its primary balance. That is, gross national income is more than gross national government spending in the USA. Thus, as this surplus increases, general government debt will decrease. In Greece, the primary balance is a deficit, that is, gross national expenditure is more than gross national income. Hence, as the deficit increases, general government debt will increase. Also, studies conducted by Amo-Yartey *et al* (2012) and Nikel *et al* (2010) confirmed that fiscal consolidation reduces government debt. The results revealed that the USA can spend more on gross capital formation which is a component of primary balance. It is suggested that government should maintain the positive primary balance. As for Greece, it confirms the implementation of the various austerity measures. The Greek government has to take all necessary measures in order to reduce expenditure while increasing income.

There are similarities in the relationship between general government debt and net current transfer from abroad in the USA and Greece. These relationships are negative but insignificant in the USA while significant in Greece. If the net current transfer from abroad increases by one unit, the general government debt of the USA will decrease by 0.001 units and in Greece, by 0.007. These relationships are in line with economic theory. This negative relationship could be due to the fact that these economies (which are already indebted) need greater assistance.

Table 5.12: Results of long-run VECM for models of the USA and Greece

	USA				GREECE		
VARIA-BLES	COINTE RGRATI NG EQUA-TION	TEST STATI S-TICS	CONCLU-SION	VARIA-BLES	COINTE RGRATI NG EQUA-TION	TEST STATISTI CS	CONCLU-SION
LUDEBT (-1)							
LINF (-1)	- 0.312	5.067	Negative, significant	LINF(-1)	-0.018	0.603	Negative, insignificant
LUGDPG (-1)	0.079	-1.689	Positive and insignificant	LGGDPG (-1)	0.003	-0.192	Negative and insignificant
LUPB (-1)	-2.495	7.140	Negative and significant	LGPB (-1)	-0.596	12.020	Positive and significant
LRUNTRA(-1)	-0.001	0.245	Negative and insignificant	LRGNTRA(-1)	-0.007	3.189	Negative and significant
TREND	0.088	-7.665	Positive and significant	TREND	-0.028	3.196	Negative and significant
CONSTANT	72.468		Positive	CONSTANT	16.970		Positive

SHORT-RUN ESTIMATES FOR USA AND GREECE				
ERROR CORRECTION	D LUDEBT	CONCLUSION	D LGDEBT	CONCLUSION
COINTEQ1	-0.021	Negative error term	-0.910	Negative error term
TEST STATISTICS	-0.294	Insignificant error term	-6.783	Significant error term
R-SQUARED	0.365	36.5% variation is explained by the independent variables in USA	0.630	63% variation is explained by the independent variables in Greece

The coefficient of the error correction term of general government debt is 91 percent (-0.910) in the USA while in Greece, the speed of adjustment is 2 percent (-0.021). These signs are correct. Speed of adjustment refers to the share of deviation from equilibrium corrected in a single period. These adjustment speeds are both negative, but that of Greece is statistically significant. In case of disequilibrium in the system in the short run, general government debt in the US model will take 91 percent speed to adjust back to equilibrium of the year's deviation while the Greek model will take 2 percent speed to adjust back to equilibrium of the year's deviation. As shown by large absolute values of the coefficient on the error correction term, equilibrium agents remove a large percentage of disequilibrium in each period, that is, the speed of adjustment is very rapid while low absolute values are indicative of a slow speed of adjustment towards equilibrium. The speed of adjustment is higher and better in the system of equations as in Greece. This great difference between the USA and Greece could be due to the fact that most of the estimated variables have an effect on Greece and also that the estimated model for the USA is not good. Variations on the dependent variable are explained by 36.5% on the independent variables in the USA while in Greece, it is 63%.

5.7 RESULTS OF STABILITY AND DIAGNOSTIC TESTS

These tests are conducted to confirm if the estimated model is good and in line with classical linear regression model assumptions. The probability value of 5% is used to accept or reject the null hypothesis of these tests. The first is the stability test.

5.7.1 Results of stability tests for the USA and Greece

Figures 5.5 and 5.6 present results of stability tests in the USA and Greece respectively. The unit roots lie in the unit of the circle of the models for the USA and Greece indicating that the estimated models are stable.

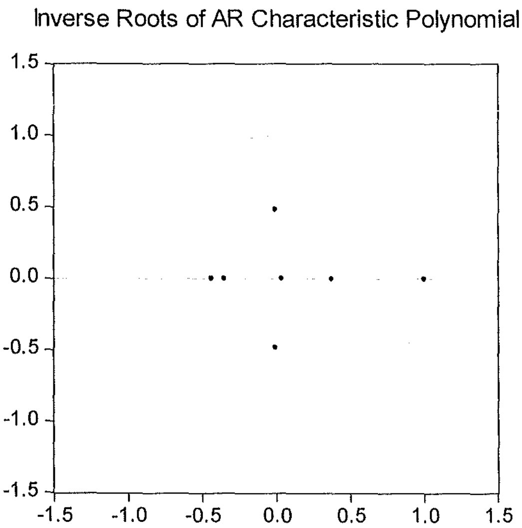

Figure 5.5

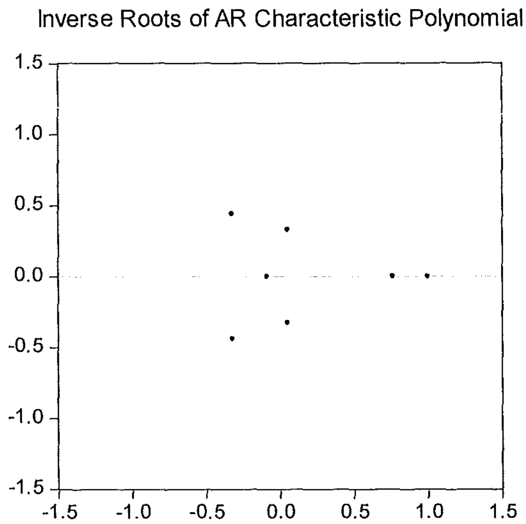

Figure 5.6

Figures 5.5 and 5.6: VEC stability condition check

5.7.2 Results of serial correlation LM tes for the USA and Greece

The null hypothesis for this test states that there is no serial correlation in residuals. If the probability value is greater than 5% significance level, then the null hypothesis is rejected and it is concluded that there is no serial correlation. At the chosen lag one, the probability values are greater than 5% for both countries. It is concluded that there is no serial correlation.

Table 5.13: Results of serial correlation LM test for the USA and Greece

USA				GREECE			
LAGS	LM-STAT	PROB	CONCLUSION ON SERIAL CORRELATION	LAGS	LM-STAT	PROB	CONCLUSION ON SERIAL CORRELATION
1	14.249	0.957	No serial correlation	1	25.260	0.448	No serial correlation
2	18.203	0.834	No serial correlation	2	18.336	0.828	No serial correlation
3	18.526	0.819	No serial correlation	3	17.135	0.877	No serial correlation
4	33.555	0.118	No serial correlation	4	30.112	0.220	No serial correlation
5	36.694	0.062	No serial correlation	5	19.071	0.794	No serial correlation
6	34.849	0.091	No serial correlation	6	28.499	0.285	No serial correlation
7	16.061	0.913	No serial correlation	7	33.262	0.125	No serial correlation
8	28.915	0.268	No serial correlation	8	10.627	0.995	No serial correlation
9	15.438	0.931	No serial correlation	9	51.791	0.001	Serial correlation
10	27.504	0.331	No serial correlation	10	24.517	0.489	No serial correlation
11	27.064	0.353	No serial correlation	11	16.761	0.890	No serial correlation
12	21.489	0.665	No serial correlation	12	10.878	0.994	No serial correlation

5.7.3 VEC Residual normality test for the USA and Greece

The null hypothesis for this test states that residuals are normally distributed. If the probability value is greater than 5%, then the null hypothesis is not rejected and it is concluded that residuals are normally distributed. Table 5.14 presents results of normality test for the USA and Greece respectively. This is good since residuals are in line with classical linear regression assumptions.

Table 5.14: VEC residual normality test for the USA and Greece

		USA				GREECE			
COMPONENT		CHI-SQ	DF	PROB.	CONCLUSION	CHI-SQ	DF	PROB.	CONCLUSION OF NORMALITY
JOINT	SKEWNESS	7.768	5	0.170	Not normally distributed	68.662	5	0.000	Normally distributed
JOINT	KURTOSIS	7.191	5	0.207	Not normally distributed	439.402	5	0.000	Normally distributed

5.7.4: VEC residual Heteroskedasticity test: no cross for the USA and Greece

The null hypothesis of no heteroskedasticity is accepted if the probability value is greater than 5% significance level. Results for the USA and Greece are presented in Table 5.15.

Table 5.15: VEC residual Heteroskedasticity test: no cross for the USA and Greece

USA			CONCLUSION	GREECE			CONCLUSION
CHI-SQ	DF	PROB.		CHI-SQ	DF	PROB.	
456.9926	405	0.038	Heteroskedasticity	432.517	405	0.166	No heteroskedasticity

These results conclude that residuals in the US model are heteroskedastic while in Greece, they are not. Hence, those for the USA are not in line with classical linear regression assumptions while those of Greece are.

Table 5:16: Results summary of diagnostics and stability tests for the USA and Greece

TEST	Null hypothesis	Conclusion (USA)	Conclusion (Greece)
AR roots graph	Stable model	The model is stable	The model is stable
Autocorrelation LM test	No serial correlation	There is no serial correlation	There is no serial correlation
VEC residual normality test	Residuals are normally distributed	Not normally distributed	Normally distributed
VEC residual heteroscedasticity test	No heteroskedasticity	There is heteroskedasticity	There is no heteroskedasticity

5. 8 RESULTS OF CAUSALITY TEST FOR THE USA AND GREECE

Results of VEC Granger causality test are shown in Table 5.16 for the USA and Greece respectively. The null hypothesis states that independent variables at lag 1 do not Granger cause dependent variables. The chosen significance level is 5%; any probability value above the 5% significance level is insignificant. When it is insignificant, then the null hypothesis is not rejected and it is concluded in the study that the independent variables do not Granger cause dependent variables.

When the probability value is less than 5%, then it is significant. The null hypothesis is rejected and it is concluded that independent variables can Granger cause the dependent variable. Table 5.16 presents results of VEC Granger causality test for the USA and Greece respectively.

In the USA, inflation, gross domestic product growth, primary balance and net current transfer from abroad do not jointly Granger cause general government debt. Individually, Granger causality is unidirectional between general government debt and inflation and no causality among other variables. When a variable Granger causes the other, it shows that if government targets such variables first, they will have an effect on the other. From the VECM results above, the relationship between general government debt and inflation is significant and the results of the Granger causality test show that government debt Granger causes inflation and not the other way round. This reveals that inflation is not a variable to be targeted in order to reduce government debt. If general government debt decreases, inflation will increase.

In Greece, inflation, gross domestic product growth, primary balance and net current transfer from abroad jointly Granger cause general government debt. Causality is unidirectional from inflation to general government debt, from general government debt to gross domestic product growth and from primary balance to general government debt. No causality existed between net transfer from abroad and general government debt.

When there is Granger causality between variables, this means that change in the short-run of one variable is revealed in the movement of the other variable, hence policy makers need to first target variables that Granger cause others.

Table 5.17: VEC Granger causality test for the USA and Greece

VAR GRANGER CAUSALITY TEST FOR USA			
NULL HYPOTHESIS	CHI-SQ	PROBABILITY	CONCLUSION
D(LUINF) does not Granger cause D(LUDEBT)	0.996	0.318	No causality
D(LUGDPG) does not Granger cause D(LUDEBT)	0.163	0.687	No causality
D(LUPB) does not Granger cause D(LUDEBT)	0.833	0.361	No causality
D(LRUNTRA) does not Granger cause D(LUDEBT)	0.005	0.942	No causality
ALL does not Granger cause D(LUDEBT)	2.284	0.684	No causality
D(LUDEBT) does not Granger cause D(LUINF)	8.399	0.004	Causality
D(LUDEBT) does not Granger cause D(LUGDPG)	1.832	0.176	No causality
D(LUDEBT) does not Granger cause D(LUPB)	3.254	0.071	No causality
D(LUDEBT) does not Granger cause D(LRUNTRA)	0.011	0.915	No causality
VAR GRANGER CAUSALITY TEST FOR GREECE			
NULL HYPOTHESIS	CHI-SQ	PROBABILITY	CONCLUSION
D(LGINF) does not Granger cause D(LGDEBT)	7.856	0.005	Causality
D(LGGDPG) does not Granger cause D(LGDEBT)	1.709	0.191	No causality
D(LGPB) does not Granger cause D(LGDEBT)	4.243	0.039	Causality
D(LRGNTRA) does not Granger cause D(LGDEBT)	3.036	0.081	No causality
All	18.288	0.001	Causality
D(LGDEBT) does not Granger cause D(LUINF)	0.005	0.942	No causality
D(LGDEBT) does not Granger cause D(LGGDPG)	7.792	0.005	Causality
D(LGDEBT) does not Granger cause D(LGPB)	0.387	0.534	No causality
D(LGDEBT) does not Granger cause D(LRGNTRA)	0.843	0.358	No Causality

D stands for change in the variables of the study

5. 9 RESULTS OF GENERALISED IMPULSE RESPONSE FUNCTION

GIRF shows shock applied to each variable (general government gross debt, inflation, gross domestic product growth, primary balance and net current transfers from abroad). Appendices U and V show the response of variables to shocks from other variables estimated on a VECM. Ten years ahead was chosen, above the zero line is a positive effect while below the zero line are the negative effects. From one to three years is short-term, above three to six years is medium-term and above six years to ten years is long-term.

The response of general government debt to debt itself is positive in the USA over the ten years period while in Greece, it is positive in the short-run and later on becomes negative in the medium and long-term. The response of government debt to a shock from inflation is negative in the USA all through the 10 years while positive in Greece over the 10 years period. This negative response in the USA is the same with the long-run relationship above. The response of general government debt to gross domestic product growth is negative in the USA and Greece over the 10 year period. This is the same as the long-run relationship in Greece but different to that of the USA. The responses of general government debt to primary balance are negative in both countries over the 10 years period. This is same with the negative relationship revealed in the long-run relationship in the USA but different to that of Greece. The response of general government debt to net current transfer is zero in the USA but negative in Greece over the ten years. The summarised results of GIRF are shown in Table 5.17.

Table 5.18: Response signs of variables for the USA and Greece in Appendices U and V

SHOCKS	RESPONSE IN THE USA	RESPONSE IN GREECE	SHOCKS	RESPONSE IN THE USA	RESPONSE IN GREECE
LGDEBT TO LGDEBT	Positive	Positive then negative			
LGDEBT TO LINF	Negative	Positive	LINF TO LGDEBT	Negative	Positive
LGDEBT TO LGDPG	Negative	Negative	LGDPG TO LGDEBT	Negative then positive	Negative
LGDEBT TO LUPB	Negative	Negative	LGPB TO LGDEBT	Negative	Negative, zero then positive
LGDEBT TO LRNTRA	Zero	Negative	LRNTRA TO GDEBT	Negative	Positive

5.10 RESULTS OF VARIANCE DECOMPOSITION FOR THE USA AND GREECE

Results of variance decomposition for the USA and Greece are shown in Table 5.18. The focus of this comparative study was on the dependent variable (general government debt). The variation effect of general government debt over ten years is revealed.

Table 5.18 shows that variation in general government debt in the USA is mostly explained by itself in the long-run with about 96.574% followed by 1.515% inflation and the remaining variables in this study explain just 1.911%.

In the short-run, government debt in the USA is mostly explained by itself while in the medium-term, it is still government debt and slightly by inflation and proceeds until 10 years. The key determinant of government debt in the USA is general government debt.

Table 5.18: Results of variance decomposition of DEBT for the USA and Greece on independent variables

RESULTS OF VARIANCE DECOMPOSITION OF DEBT FOR THE USA						
Period	S.E.	LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA
1	0.048	100.000	0.000	0.000	0.000	0.000
2	0.093	98.484	0.612	0.409	0.493	0.002
3	0.133	97.723	0.928	0.662	0.685	0.001
4	0.167	97.255	1.179	0.797	0.768	0.001
5	0.195	96.981	1.318	0.877	0.824	0.001
6	0.220	96.818	1.396	0.925	0.860	0.000
7	0.243	96.710	1.448	0.957	0.884	0.000
8	0.264	96.632	1.487	0.981	0.900	0.000
9	0.283	96.574	1.515	0.998	0.912	0.000
10	0.301	96.530	1.537	1.010	0.922	0.000
RESULTS OF VARIANCE DECOMPOSITION OF DEBT FOR GREECE						
Period	S.E	LGDEBT	LGINF	LRGGDPG	LGGPB	LGNTRA
1	0.066	100.000	0.000	0.000	0.000	0.000
2	0.098	48.723	14.647	4.016	30.820	1.793
3	0.159	18.597	11.898	1.785	62.581	5.139
4	0.236	8.404	13.279	0.941	71.562	5.813
5	0.314	5.002	14.481	0.633	74.373	5.510
6	0.389	3.542	14.577	0.458	76.072	5.350
7	0.462	2.786	14.758	0.360	76.862	5.233
8	0.532	2.387	14.890	0.298	77.301	5.123
9	0.599	2.149	14.948	0.254	77.605	5.044
10	0.663	1.999	15.002	0.224	77.794	4.979

As shown in Table 5.18, variation in Greece at the beginning of the periods is mostly explained by primary balance with 77.795%. This is followed by 15.002% inflation over the 10^{th} period. In the USA, inflation, which also explains variation on general government debt, has a significant relationship with general government debt. Primary balance is also significant in Greece in explaining the relationship with gnarl government debt.

During the second year, general government debt is mostly determined by general government debt followed by primary balance and then inflation. In the fifth year, key determinants of general government debt is primary balance followed by inflation, then net transfer abroad and proceeds until the tenth year.

5.11 SUMMARY OF CHAPTER

The comparative results for the USA revealed a negative and significant relationship between general government debt and inflation, insignificant positive relationship with gross domestic product growth, negative significance with primary balance and an insignificant negative relationship with net transfer. In Greece, the relationship between general government debts with inflation is negative and insignificant, with gross domestic product growth, it is negative as well but insignificant, positive and significant with primary balance and negative and significant with net transfer from abroad.

All the variables of this study do not jointly granger cause government debt in the USA while they jointly Granger cause it in Greece. Unidirectional Granger causality exists between general government debt and inflation in the USA. In Greece, it is from inflation to general government debt, from general government debt to gross domestic product growth and from primary balance to general government debt.

In the USA, government debt responds to shock from itself positively and negatively from inflation, gross domestic product growth, primary balance and there is no response from net transfer from abroad. In Greece, general government debt responds positively to itself and inflation but negatively to gross domestic product growth and primary balance. In the USA, variations in general government debt are mostly explained over time by primary balance in Greece.

CHAPTER SIX

CONCLUSION, RECOMMENDATIONS AND AREAS FOR FUTURE RESEARCH

"Research is never completed... Around the corner, lurks another possibility of interview, another book to read, a courthouse to explore, a document to verify."

Catherine Drinker Bowen

6.1 RESEARCH SUMMARY

Sovereign debt reduction has proven to be a challenging economic policy which even developed countries are battling with. Many developed economies are battling with how to reduce debts with some countries implementing contractionary fiscal policies while others are using different measures.

The objectives of this study were to: evaluate various methods of reducing government debt, analyse reduction in government spending and increase in taxes in the USA and Greece respectively and assess the consequences of fiscal consolidation; empirically investigate determinants of government debt in the USA and shocks of variables on others; empirically undertake a comparative analysis of government debt reduction strategies in the USA and Greece using variables not used in the analysis above; and make policy recommendations for reducing government debt in the USA and Greece.

The Government budget constraint theory was used as the framework for this study. Other theories also led to the choice of some variables in this study. Literature review revealed various strategies that have impacted on government debt. These are: inflation, fiscal consolidation, debt restructuring, debt default, growth and financial repression. Fiscal consolidation has been widely used by cut in spending and increase taxes. Despite this, it has had a negative impact on domestic economy such as reduction in employment, balance of trade, consumption, disposable income, investment, savings, remittances and economic growth resulting in the collapse of businesses across countries.

The study used quarterly and annual time series data. Seasonally-adjusted quarterly data was obtained from the Federal Reserve Bank of St Louise. Annual data used for the comparative analysis was obtained from AMECO and the World Bank's World development indicator database. A variable for both the USA and Greece were obtained from the same source. VECM, Granger causality testing, GIRF and variance decomposition were used to examine relationships among variables, the direction of causation, the response of government debt to shocks and variations respectively.

The estimated debt reduction models were estimated using three models. The first model was estimated where federal debt was the dependent variable and consumer price index, real federal interest payment, real federal government current tax receipts and real government spending on goods and services were the independent variables for the USA model using quarterly data. The second model was the USA using yearly data and the third model was that of Greece using yearly data as well. The second and third models both used yearly data for the comparative analysis with the same variables for each country and collected from the same source. Variables for the second and third models were: general government gross debt, inflation, gross domestic product growth, primary balance and net current transfers from abroad which used for the comparative analysis.

Results of the determinant in the USA revealed that all variables significantly determine real federal debt in the USA. Real federal debt has a negative relationship with consumer price index, a positive relationship with real federal interest payment, a positive relationship with real government spending and a negative relationship with real federal tax receipts. These signs are in accordance with economic theory.

VEC Granger causality test revealed that CPI, real federal interest payment, real federal government constant tax receipts and real government spending jointly Granger cause real federal debt in the USA. Granger causality is bidirectional from CPI and real federal debt, also from real federal interest payment to real federal debt. A unidirectional Granger causality relationship exists from real federal debt and Granger cause changes in real government spending. There is no Granger causality between real federal government constant tax receipts and real federal debt.

The response of real federal debt to consumer price index is negative, then positive while the response of CPI to federal debt remains negative throughout. The response of real federal debt to real federal interest payment is negative and then positive and vice-versa. Meanwhile, federal debt to real government spending is positive while the response of real government spending to real federal debt is positive then changes to negative and again to positive. The response of real federal debt to real federal tax receipts and vice-versa is positive, followed by a negative response and back to positive. This means in the short-run, with the exception of shocks from real federal tax receipts, real federal debt responded positively to shocks other variables.

In the USA, high variation of shocks of federal debt is explained by real federal government tax receipts over the period followed by real government spending. It is then followed by CPI, real federal debt and real federal interest payment. A high proportion of a shock on federal debt is mostly explained by innovations in CPI and federal debt while real federal interest payment is mostly explained by itself and consumer price index. Variation in government spending is also explained by itself and federal tax receipts. Similarly, the variance decomposition of real federal tax receipts is mostly explained by itself and real government spending.

Results of the comparative analysis presented in Chapter 5 revealed that in the long-run in the USA, there is a significant and negative relationship between general government debt and inflation. On the other hand, there is a positive and insignificant relationship between general government debt and gross domestic product growth. There is a significant and negative relationship between general government debt and primary balance. A negative and insignificant relationship was also observed between general government debt and net current transfer. In Greece, a negative and significant relationship was also obtained between general government debt and inflation and there is a negative and insignificant relationship between general government debt and gross domestic product growth. Similarly, a positive and significant relationship exists between general government debt and primary balance. Lastly, a negative significant relationship between general government debt and net current transfer also exists.

The study found that in the USA, inflation, GDP growth, primary balance and net current transfer from abroad do not jointly Granger cause general government debt. These variables jointly Granger cause the general government debt in Greece. The response of general government debt to debt itself is positive in the USA and negative with other variables until the 10th year with the exception of net transfer from abroad which is zero. As far as Greece is concerned, general government debt responds positively to itself and negatively to other variables in this study. Variation in general government debt is mostly explained by general government debt itself in the USA and by primary balance in Greece.

6.3 POLICY IMPLICATIONS OF EMPIRICAL RESULTS

This analysis has provided results that could help policy makers in the USA and Greece to reduce government debt. The fourth objective of this study was to make policy recommendations to reduce government debt in the USA and Greece. The recommendations are done based on the empirical results for the USA and Greece. As far as the USA is concerned, government debt can be reduced by increasing consumer price index and the inflation rate. The model with quarterly data as well as with annual data for the USA shows a negative and significant relationship with government debt and inflation.

Consumer price index has a significant negative relationship with real federal debt but real federal debt Granger causes consumer price index in the USA, hence reduced real deferral debt will cause consumer price index to increase, hence the government should not stop the rise in consumer price index because it reduces real federal debt. Real government spending significantly affects real federal debt positively. Policy makers in the USA can thus, reduce debts by decreasing government spending. Therefore, reduction of government spending from 2013 fiscal consolidation is a good policy for debt reduction in the USA. Real federal government constant tax receipts in the USA significantly affect federal debt negatively. Policy makers should thus, increase government revenue in order to reduce government debt. Increase in taxation in the USA is a good measure in order to reduce rising government debt in the country thus, confirming that the recent increase in taxes in the USA is a good measure. Real federal interest payments significantly affect debts negatively in the USA. The government can therefore reduce debt by decreasing federal interest payment. The government can also reduce government debt in the USA by increasing primary balance. Primary balance is the difference between gross national income and gross national expenditure. The more positive the primary balance is, the more debt will be reduced in the USA. When policy makers target consumer price index, federal interest payment, government spending and federal government current tax receipts, federal debt in the USA will be affected. In Greece, government debt could be reduced by increasing the inflation rate which is expected to reduce government debt since the relationship is negative. A positive relationship exists between general government debt and primary balance. The Greek government can also reduce general government debt by decreasing primary balance and increasing net current transfer since the relationship is negative.

6.4 AREAS FOR FUTURE RESEARCH

This study could not cover all other variables that can be used to reduce government debt in developed economies. Based on the findings of this study, the research raises the following areas for future research:

Countries in the Eurozone have experienced rising government debt in the past. There is a need to determine the relationship among inflation, GDP growth, primary balance and net transfer from abroad for these countries.

There is also a need to estimate a comparative debt reduction model for developed countries that have experienced debt crises and developed countries that have not experience debt crises in order to determine the similarities and differences between these countries.

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LIST OF APPENDICES

Appendix A: Results of Johansen cointegration for the USA

Date: 08/01/14 Time: 13:49
Sample (adjusted): 1981Q3 2012Q4
Included observations: 126 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: LRFDEBT LCPI LRFINTPG LRGSPENG LRFTAXG
Lags interval (in first differences): 1 to 5

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.330046	112.2847	88.80380	0.0004
At most 1	0.193317	61.81583	63.87610	0.0736
At most 2	0.140294	34.74797	42.91525	0.2556
At most 3	0.076938	15.70121	25.87211	0.5167
At most 4	0.043576	5.613826	12.51798	0.5108

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.330046	50.46886	38.33101	0.0013
At most 1	0.193317	27.06786	32.11832	0.1828
At most 2	0.140294	19.04676	25.82321	0.3021
At most 3	0.076938	10.08738	19.38704	0.6095
At most 4	0.043576	5.613826	12.51798	0.5108

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG	@TREND(80Q2)
-25.86843	-27.87226	32.43319	21.25941	-19.20970	0.446452
15.88811	-13.27534	-11.97768	5.427001	-7.330467	-0.136485
9.326767	20.95413	-11.74834	60.13292	15.20906	-0.139344
3.020949	-6.971968	9.729062	-9.492170	0.277704	0.182513
-16.12448	-42.29553	17.36835	-24.60603	-9.129693	0.402793

Unrestricted Adjustment Coefficients (alpha):

D(LRFDEBT)	0.006766	-0.001197	-0.001946	-0.000699	-0.000174
D(LCPI)	-0.000594	0.000764	0.001233	-0.000385	0.000126
D(LRFINTPG)	-0.005250	0.002780	-0.001529	-0.006237	-0.000437
D(LRGSPENG)	0.001156	-0.001670	-4.25E-05	-0.001302	0.001309
D(LRFTAXG)	0.001913	0.014150	-0.010285	0.001938	0.002844

1 Cointegrating Equation(s):		Log likelihood	1868.413		

Normalized cointegrating coefficients (standard error in parentheses)

LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG	@TREND(80Q2)
1.000000	1.077462	-1.253775	-0.821828	0.742593	-0.017259
	(0.33589)	(0.09379)	(0.38329)	(0.10876)	(0.00299)

Adjustment coefficients (standard error in parentheses)

D(LRFDEBT)	-0.175036
	(0.03014)
D(LCPI)	0.015376
	(0.01068)
D(LRFINTPG)	0.135813
	(0.06487)
D(LRGSPENG)	-0.029894
	(0.02304)
D(LRFTAXG)	-0.049486
	(0.11718)

2 Cointegrating Equation(s):		Log likelihood	1881.947		

Normalized cointegrating coefficients (standard error in parentheses)

LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG	@TREND(80Q2)
1.000000	0.000000	-0.972219	-0.166567	0.064482	-0.012376
		(0.09860)	(0.48120)	(0.13044)	(0.00190)
0.000000	1.000000	-0.261314	-0.608153	0.629359	-0.004531
		(0.09448)	(0.46108)	(0.12499)	(0.00182)

Adjustment coefficients (standard error in parentheses)

D(LRFDEBT)	-0.194051	-0.172706
	(0.03518)	(0.03577)
D(LCPI)	0.027517	0.006422
	(0.01231)	(0.01252)
D(LRFINTPG)	0.179982	0.109428
	(0.07565)	(0.07694)
D(LRGSPENG)	-0.056424	-0.010043
	(0.02655)	(0.02700)
D(LRFTAXG)	0.175323	-0.241159
	(0.13056)	(0.13278)

3 Cointegrating Equation(s):		Log likelihood	1891.470		

Normalized cointegrating coefficients (standard error in parentheses)

LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG	@TREND(80Q2)
1.000000	0.000000	0.000000	25.72391	0.558423	0.012333
			(5.97667)	(1.62457)	(0.01753)
0.000000	1.000000	0.000000	6.350722	0.762122	0.002110
			(1.47502)	(0.40094)	(0.00433)
0.000000	0.000000	1.000000	26.63029	0.508056	0.025416
			(6.04996)	(1.64449)	(0.01774)

Adjustment coefficients (standard error in parentheses)

D(LRFDEBT)	-0.212197	-0.213474	0.256648
	(0.03627)	(0.04262)	(0.04171)
D(LCPI)	0.039016	0.032257	-0.042916
	(0.01226)	(0.01441)	(0.01410)
D(LRFINTPG)	0.165721	0.077387	-0.185613
	(0.07899)	(0.09281)	(0.09083)

D(LRGSPENG)	-0.056820	-0.010933	0.057979
	(0.02777)	(0.03263)	(0.03193)
D(LRFTAXG)	0.079402	-0.456662	0.013392
	(0.13258)	(0.15577)	(0.15244)

4 Cointegrating Equation(s): Log likelihood 1896.514

Normalized cointegrating coefficients (standard error in parentheses)

LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG	@TREND(80Q2)
1.000000	0.000000	0.000000	0.000000	0.469953	0.004897
				(0.50191)	(0.00529)
0.000000	1.000000	0.000000	0.000000	0.740280	0.000275
				(0.18295)	(0.00193)
0.000000	0.000000	1.000000	0.000000	0.416469	0.017718
				(0.52154)	(0.00550)
0.000000	0.000000	0.000000	1.000000	0.003439	0.000289
				(0.06263)	(0.00066)

Adjustment coefficients (standard error in parentheses)

D(LRFDEBT)	-0.214307	-0.208603	0.249851	0.026993
	(0.03637)	(0.04327)	(0.04308)	(0.07377)
D(LCPI)	0.037853	0.034942	-0.046662	0.069305
	(0.01226)	(0.01458)	(0.01452)	(0.02486)
D(LRFINTPG)	0.146879	0.120871	-0.246292	-0.129276
	(0.07679)	(0.09137)	(0.09096)	(0.15576)
D(LRGSPENG)	-0.060753	-0.001854	0.045311	0.025314
	(0.02759)	(0.03282)	(0.03268)	(0.05596)
D(LRFTAXG)	0.085256	-0.470172	0.032245	-0.519373
	(0.13304)	(0.15829)	(0.15759)	(0.26986)

Appendix B: Results of VECM for the USA

Vector Error Correction Estimates
Date: 08/01/14 Time: 13:51
Sample (adjusted): 1981Q3 2012Q4
Included observations: 126 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LRFDEBT(-1)	1.000000
LCPI(-1)	1.077462 (0.33589) [3.20779]
LRFINTPG(-1)	-1.253775 (0.09379) [-13.3684]
LRGSPENG(-1)	-0.821828 (0.38329) [-2.14416]
LRFTAXG(-1)	0.742593 (0.10876) [6.82791]
@TREND(80Q1)	-0.017259 (0.00299) [-5.76926]
C	-3.864662

Error Correction:	D(LRFDEBT)	D(LCPI)	D(LRFINTPG)	D(LRGSPENG)	D(LRFTAXG)
CointEq1	-0.175036 (0.03014) [-5.80813]	0.015376 (0.01068) [1.44017]	0.135813 (0.06487) [2.09361]	-0.029894 (0.02304) [-1.29772]	-0.049486 (0.11718) [-0.42231]
D(LRFDEBT(-1))	0.019724 (0.11957) [0.16496]	-0.107864 (0.04236) [-2.54636]	-0.079446 (0.25738) [-0.30867]	0.031344 (0.09140) [0.34294]	-0.192453 (0.46492) [-0.41394]
D(LRFDEBT(-2))	-0.112224 (0.11204) [-1.00160]	0.036098 (0.03969) [0.90941]	0.670744 (0.24118) [2.78108]	0.029300 (0.08565) [0.34211]	-0.844706 (0.43566) [-1.93890]
D(LRFDEBT(-3))	-0.163464 (0.11518) [-1.41919]	0.054917 (0.04081) [1.34582]	0.370125 (0.24793) [1.49283]	-0.211885 (0.08804) [-2.40658]	0.305019 (0.44786) [0.68105]
D(LRFDEBT(-4))	0.063806 (0.11850) [0.53844]	0.025982 (0.04198) [0.61889]	-0.061746 (0.25508) [-0.24206]	-0.270983 (0.09058) [-2.99156]	0.249657 (0.46077) [0.54182]
D(LRFDEBT(-5))	-0.216639 (0.12237) [-1.77039]	0.096255 (0.04335) [2.22034]	0.704377 (0.26340) [2.67413]	-0.072008 (0.09354) [-0.76983]	-0.219345 (0.47581) [-0.46100]

D(LCPI(-1))	-0.498913	0.209183	1.596959	-0.150674	2.635822
	(0.37442)	(0.13265)	(0.80596)	(0.28621)	(1.45587)
	[-1.33249]	[1.57698]	[1.98143]	[-0.52645]	[1.81048]
D(LCPI(-2))	0.120712	-0.030788	-1.894013	0.424711	-4.663142
	(0.36052)	(0.12772)	(0.77605)	(0.27558)	(1.40183)
	[0.33482]	[-0.24105]	[-2.44059]	[1.54113]	[-3.32646]
D(LCPI(-3))	0.258213	0.177171	0.514377	-0.389548	2.225504
	(0.34688)	(0.12289)	(0.74667)	(0.26515)	(1.34876)
	[0.74440]	[1.44172]	[0.68889]	[-1.46916]	[1.65003]
D(LCPI(-4))	1.261584	-0.011870	-0.120214	-0.302814	-2.894897
	(0.36953)	(0.13091)	(0.79543)	(0.28247)	(1.43684)
	[3.41404]	[-0.09067]	[-0.15113]	[-1.07204]	[-2.01476]
D(LCPI(-5))	-0.074328	0.263780	1.569127	0.204447	-1.301443
	(0.38089)	(0.13494)	(0.81989)	(0.29115)	(1.48103)
	[-0.19514]	[1.95480]	[1.91382]	[0.70220]	[-0.87874]
D(LRFINTPG(-1))	-0.192984	0.007576	-0.217171	-0.015871	0.505924
	(0.05444)	(0.01929)	(0.11718)	(0.04161)	(0.21167)
	[-3.54504]	[0.39281]	[-1.85330]	[-0.38140]	[2.39013]
D(LRFINTPG(-2))	-0.092098	0.008818	0.270191	-0.002856	0.593900
	(0.05855)	(0.02074)	(0.12603)	(0.04475)	(0.22765)
	[-1.57305]	[0.42512]	[2.14392]	[-0.06382]	[2.60882]
D(LRFINTPG(-3))	-0.061580	0.013403	0.063164	0.036382	-0.119612
	(0.05446)	(0.01929)	(0.11723)	(0.04163)	(0.21177)
	[-1.13068]	[0.69467]	[0.53879]	[0.87390]	[-0.56483]
D(LRFINTPG(-4))	-0.115645	-0.010458	0.159090	0.033446	0.000107
	(0.05188)	(0.01838)	(0.11168)	(0.03966)	(0.20173)
	[-2.22900]	[-0.56898]	[1.42452]	[0.84335]	[0.00053]
D(LRFINTPG(-5))	-0.133063	0.021897	-0.037528	-0.063511	0.236389
	(0.05197)	(0.01841)	(0.11187)	(0.03973)	(0.20208)
	[-2.56037]	[1.18930]	[-0.33546]	[-1.59874]	[1.16980]
D(LRGSPENG(-1))	-0.164998	0.110747	0.182967	-0.113599	-1.056111
	(0.14709)	(0.05211)	(0.31662)	(0.11243)	(0.57192)
	[-1.12176]	[2.12529]	[0.57788]	[-1.01037]	[-1.84659]
D(LRGSPENG(-2))	0.134842	-0.023269	0.110767	0.018160	-0.497084
	(0.13627)	(0.04828)	(0.29333)	(0.10416)	(0.52986)
	[0.98952]	[-0.48200]	[0.37762]	[0.17434]	[-0.93814]
D(LRGSPENG(-3))	0.125436	-0.011145	-0.228960	0.048657	-0.136780
	(0.12869)	(0.04559)	(0.27702)	(0.09837)	(0.50040)
	[0.97469]	[-0.24445]	[-0.82651]	[0.49462]	[-0.27334]
D(LRGSPENG(-4))	0.129168	-0.007076	-0.562322	0.175330	-0.625473
	(0.12655)	(0.04483)	(0.27240)	(0.09673)	(0.49205)
	[1.02072]	[-0.15784]	[-2.06434]	[1.81254]	[-1.27115]
D(LRGSPENG(-5))	0.033020	-0.016459	-0.070485	0.176053	0.106286
	(0.13020)	(0.04613)	(0.28026)	(0.09952)	(0.50625)
	[0.25362]	[-0.35683]	[-0.25150]	[1.76899]	[0.20995]
D(LRFTAXG(-1))	0.069836	-0.011092	-0.167783	-0.011327	-0.381744
	(0.03265)	(0.01157)	(0.07029)	(0.02496)	(0.12696)

	[2.13876]	[-0.95887]	[-2.38712]	[-0.45383]	[-3.00671]
D(LRFTAXG(-2))	0.011593	-0.000870	-0.011879	-0.039722	0.025729
	(0.03022)	(0.01070)	(0.06504)	(0.02310)	(0.11749)
	[0.38366]	[-0.08123]	[-0.18263]	[-1.71978]	[0.21899]
D(LRFTAXG(-3))	-0.001408	0.006553	0.196486	-0.018270	0.236782
	(0.02892)	(0.01024)	(0.06224)	(0.02210)	(0.11244)
	[-0.04870]	[0.63972]	[3.15673]	[-0.82658]	[2.10595]
D(LRFTAXG(-4))	-0.004382	0.010618	0.035751	-0.025677	0.086437
	(0.02842)	(0.01007)	(0.06119)	(0.02173)	(0.11052)
	[-0.15416]	[1.05441]	[0.58431]	[-1.18176]	[0.78207]
D(LRFTAXG(-5))	0.002340	-0.001295	-0.110945	0.020388	-0.194589
	(0.02586)	(0.00916)	(0.05567)	(0.01977)	(0.10056)
	[0.09049]	[-0.14137]	[-1.99291]	[1.03131]	[-1.93504]
C	-0.012248	0.003172	-0.024593	0.000542	0.032693
	(0.00457)	(0.00162)	(0.00983)	(0.00349)	(0.01775)
	[-2.68307]	[1.96136]	[-2.50269]	[0.15528]	[1.84177]
R-squared	0.616855	0.394814	0.589117	0.385284	0.558508
Adj. R-squared	0.516232	0.235877	0.481208	0.223843	0.442560
Sum sq. resids	0.016930	0.002125	0.078443	0.009892	0.255959
S.E. equation	0.013077	0.004633	0.028149	0.009996	0.050847
F-statistic	6.130313	2.484083	5.459393	2.386537	4.816902
Log likelihood	382.8571	513.6057	286.2583	416.7093	211.7519
Akaike AIC	-5.648525	-7.723900	-4.115211	-6.185862	-2.932569
Schwarz SC	-5.040751	-7.116125	-3.507436	-5.578087	-2.324795
Mean dependent	0.001875	0.007512	-0.010962	-0.000664	-0.010725
S.D. dependent	0.018801	0.005300	0.039081	0.011346	0.068103

Determinant resid covariance (dof adj.)	3.03E-19
Determinant resid covariance	9.07E-20
Log likelihood	1868.413
Akaike information criterion	-27.41925
Schwarz criterion	-24.24532

Appendix C: Results of Serial correlation Lagrange Multiplier for the USA

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 08/01/14 Time: 14:00
Sample: 1980Q1 2013Q4
Included observations: 126

Lags	LM-Stat	Prob
1	23.02615	0.5760
2	14.16734	0.9587
3	23.66104	0.5390
4	27.33720	0.3393
5	18.00200	0.8423
6	21.82891	0.6456
7	32.16306	0.1533
8	15.34932	0.9328
9	23.54396	0.5458
10	26.82660	0.3646
11	25.30408	0.4454
12	26.51019	0.3808

Probs from chi-square with 25 df.

Appendix D: Results of Heteroscedasticity test with no cross terms for the USA

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 08/01/14 Time: 14:01
Sample: 1980Q1 2013Q4
Included observations: 126

Joint test:

Chi-sq	df	Prob.
844.6574	780	0.0536

Individual components:

Dependent	R-squared	F(52,73)	Prob.	Chi-sq(52)	Prob.
res1*res1	0.613621	2.229489	0.0008	77.31619	0.0129
res2*res2	0.602687	2.129502	0.0015	75.93852	0.0168
res3*res3	0.475005	1.270174	0.1716	59.85067	0.2122
res4*res4	0.456017	1.176836	0.2582	57.45818	0.2801
res5*res5	0.413574	0.990057	0.5097	52.11038	0.4696
res2*res1	0.594771	2.060479	0.0022	74.94110	0.0203
res3*res1	0.568111	1.846632	0.0078	71.58197	0.0371
res3*res2	0.565534	1.827355	0.0087	71.25731	0.0393
res4*res1	0.363771	0.802664	0.7975	45.83513	0.7137
res4*res2	0.392584	0.907331	0.6413	49.46557	0.5742
res4*res3	0.543268	1.669831	0.0216	68.45179	0.0627
res5*res1	0.502216	1.416345	0.0845	63.27921	0.1358
res5*res2	0.460137	1.196530	0.2377	57.97730	0.2644
res5*res3	0.478181	1.286448	0.1592	60.25083	0.2020
res5*res4	0.401448	0.941559	0.5866	50.58250	0.5298

Appendix E: Results of Normality tests for the USA

VEC Residual Normality Tests
Orthogonalization: Residual Correlation (Doornik-Hansen)
Null Hypothesis: residuals are multivariate normal
Date: 08/01/14 Time: 14:02
Sample: 1980Q1 2013Q4
Included observations: 126

Component	Skewness	Chi-sq	Df	Prob.
1	0.107132	0.265727	1	0.6062
2	-0.669871	8.903601	1	0.0028
3	0.091681	0.194858	1	0.6589
4	-0.619210	7.762427	1	0.0053
5	-0.775762	11.42497	1	0.0007
Joint		28.55158	5	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	3.085683	0.398812	1	0.5277
2	4.857348	3.789245	1	0.0516
3	3.026603	0.251922	1	0.6157
4	3.831824	0.023359	1	0.8785
5	5.325975	4.162574	1	0.0413
Joint		8.625913	5	0.1249

Component	Jarque-Bera	df	Prob.
1	0.664539	2	0.7173
2	12.69285	2	0.0018
3	0.446781	2	0.7998
4	7.785786	2	0.0204
5	15.58754	2	0.0004
Joint	37.17750	10	0.0001

Appendix F: VEC Granger Causality Test

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 10/20/14 Time: 13:55
Sample: 1980Q1 2013Q4
Included observations: 126

Dependent variable: D(LRFDEBT)

Excluded	Chi-sq	df	Prob.
D(LCPI)	16.52612	5	0.0055
D(LRFINTPG)	19.76090	5	0.0014
D(LRGSPENG)	4.570140	5	0.4706
D(LRFTAXG)	5.410175	5	0.3679
All	63.51570	20	0.0000

Dependent variable: D(LCPI)

Excluded	Chi-sq	df	Prob.
D(LRFDEBT)	13.15791	5	0.0219
D(LRFINTPG)	2.979861	5	0.7031
D(LRGSPENG)	5.203975	5	0.3915
D(LRFTAXG)	2.506124	5	0.7756
All	27.55218	20	0.1204

Dependent variable: D(LRFINTPG)

Excluded	Chi-sq	df	Prob.
D(LRFDEBT)	21.75076	5	0.0006
D(LCPI)	14.77015	5	0.0114
D(LRGSPENG)	5.383973	5	0.3708
D(LRFTAXG)	25.59844	5	0.0001
All	101.7214	20	0.0000

Dependent variable: D(LRGSPENG)

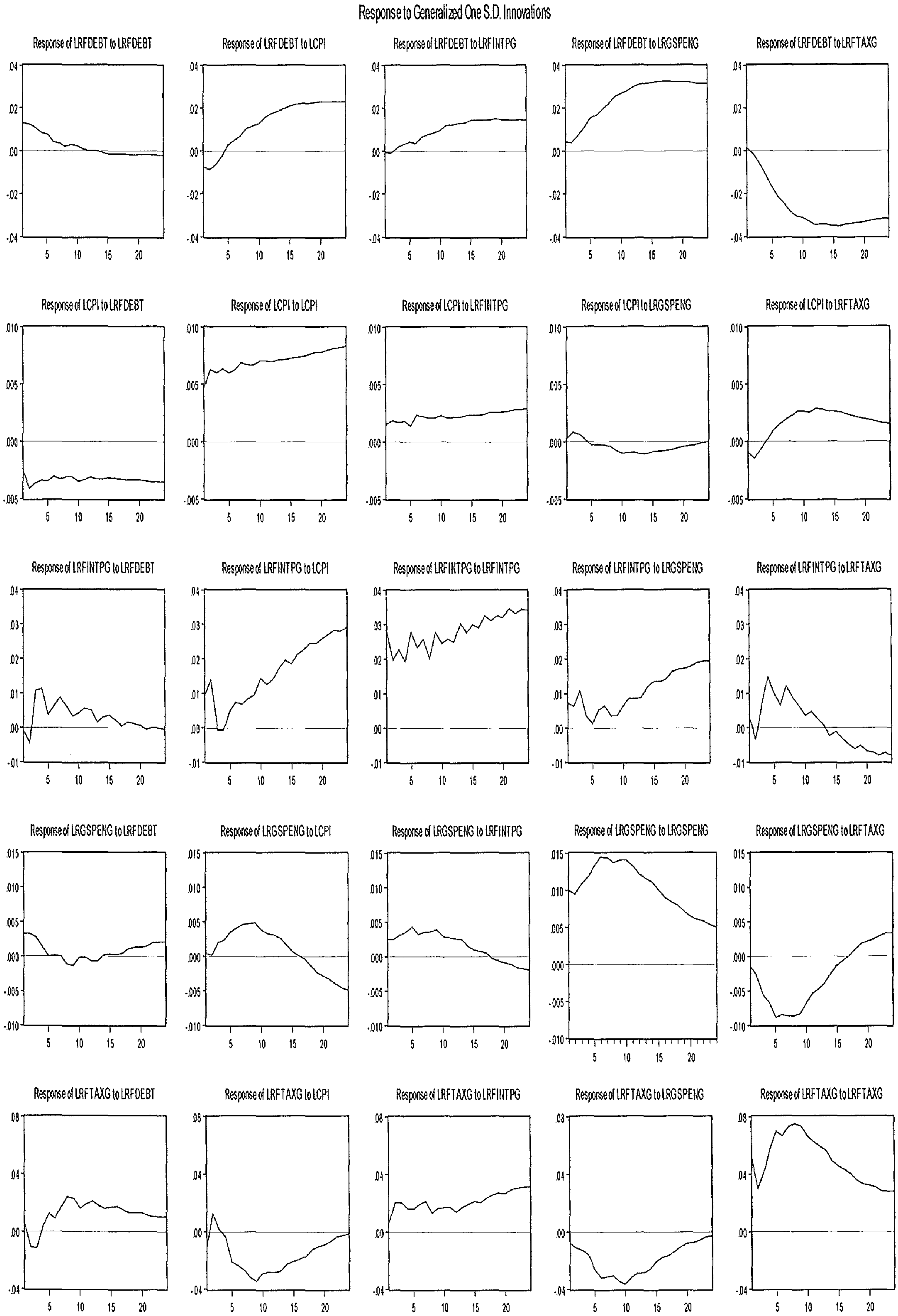
Excluded	Chi-sq	df	Prob.
D(LRFDEBT)	14.64360	5	0.0120
D(LCPI)	7.441919	5	0.1898
D(LRFINTPG)	6.056248	5	0.3008
D(LRFTAXG)	7.075061	5	0.2151
All	41.15464	20	0.0036

Dependent variable: D(LRFTAXG)

Excluded	Chi-sq	df	Prob.
D(LRFDEBT)	5.173803	5	0.3950

D(LCPI)	20.35811	5	0.0011
D(LRFINTPG)	12.33437	5	0.0305
D(LRGSPENG)	5.849256	5	0.3212
All	73.90407	20	0.0000

Appendix G: Results of Generalised Impulse Response for the USA



Appendix H: Results of Variance Decomposition for the USA

Variance Decomposition of LRFDEBT: Period	S.E.	LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG
1	0.013077	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.018383	96.48654	1.008994	0.002565	0.044845	2.457057
3	0.022926	85.16382	0.654881	0.783279	2.597750	10.80027
4	0.028100	65.98014	1.506759	1.358200	8.618021	22.53688
5	0.035772	45.27146	6.865235	0.991204	15.12012	31.75198
6	0.043974	30.89218	8.738358	0.662958	20.63987	39.06663
7	0.053001	21.71455	10.27039	0.716955	23.75444	43.54366
8	0.062995	15.49292	12.30240	0.678376	25.80143	45.72488
9	0.073276	11.60908	13.93878	0.637072	27.94998	45.86508
10	0.083046	9.129632	15.28695	0.667633	29.51405	45.40174
11	0.092890	7.308092	16.66337	0.808759	30.38620	44.83358
12	0.102820	5.964912	17.93417	0.855536	31.13910	44.10628
13	0.112224	5.008071	19.13596	0.896112	31.91505	43.04481
14	0.121095	4.302918	20.26246	0.908652	32.46789	42.05808
15	0.129695	3.762802	21.21725	0.959386	32.81008	41.25047
16	0.137943	3.338046	22.18100	0.977756	33.09973	40.40347
17	0.145656	3.001783	23.06348	0.988669	33.40070	39.54537
18	0.152888	2.734008	23.83409	0.995734	33.63552	38.80065
19	0.159771	2.518104	24.54226	1.021795	33.77901	38.13883
20	0.166347	2.335570	25.23472	1.026560	33.90344	37.49971
21	0.172522	2.180362	25.84380	1.032408	34.03974	36.90369
22	0.178357	2.049860	26.40250	1.036119	34.13676	36.37477
23	0.183939	1.938695	26.90756	1.045645	34.19900	35.90910
24	0.189294	1.838869	27.38372	1.046495	34.25680	35.47412

Variance Decomposition of LCPI: Period	S.E.	LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG
1	0.004633	32.16688	67.83312	0.000000	0.000000	0.000000
2	0.007898	37.99692	60.77666	0.028980	1.197054	0.000391
3	0.009983	37.34449	61.07531	0.092471	1.044532	0.443201
4	0.011941	34.18034	63.04089	0.169209	0.748024	1.861539
5	0.013595	32.85728	61.72863	0.362484	0.734447	4.317165
6	0.015260	30.09552	62.00948	0.296242	0.964265	6.634492
7	0.017118	27.62362	61.95342	0.248785	1.159510	9.014671
8	0.018803	25.65234	61.54430	0.238225	1.354685	11.21045
9	0.020423	24.06121	60.65173	0.218496	1.765577	13.30299
10	0.022074	23.06614	59.83508	0.195082	2.199394	14.70430
11	0.023612	22.15915	59.41390	0.209663	2.492414	15.72487
12	0.025085	21.18687	58.99738	0.205689	2.767492	16.84257
13	0.026527	20.44838	58.66393	0.212550	3.057985	17.61716
14	0.027861	19.93298	58.51025	0.202321	3.283554	18.07090
15	0.029173	19.37340	58.56815	0.199012	3.434367	18.42507
16	0.030442	18.90341	58.67675	0.196141	3.534740	18.68895
17	0.031655	18.54092	58.88003	0.192563	3.600806	18.78569
18	0.032848	18.26400	59.17415	0.182307	3.633474	18.74607
19	0.034022	17.99835	59.57718	0.178546	3.616587	18.62933
20	0.035152	17.76373	59.99542	0.171817	3.577023	18.49201
21	0.036272	17.57229	60.44555	0.164900	3.525301	18.29195
22	0.037377	17.42591	60.92386	0.156979	3.455972	18.03728
23	0.038466	17.26885	61.44048	0.150643	3.370685	17.76934

24	0.039540	17.13456	61.93520	0.143739	3.281359	17.50513

Variance Decomposition of LRFINTPG: Period	S.E.	LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG
1	0.028149	0.113433	14.27522	85.61135	0.000000	0.000000
2	0.035487	1.703282	24.52572	72.82605	0.128464	0.816481
3	0.043902	7.185500	18.40348	73.03883	0.242221	1.129969
4	0.050964	10.16462	15.47722	67.36151	1.663008	5.333648
5	0.059067	7.959152	13.59272	70.69830	3.060978	4.688851
6	0.064350	7.679972	15.76069	69.12752	3.087303	4.344512
7	0.070920	7.864176	17.14763	66.65454	3.043725	5.289927
8	0.075043	7.753530	19.12387	64.08986	3.432276	5.600463
9	0.080499	6.906369	19.53592	64.91386	3.642513	5.001340
10	0.085314	6.399971	23.12502	62.37843	3.533798	4.562780
11	0.090042	6.135538	25.33639	61.03244	3.249028	4.246605
12	0.094482	5.878900	27.80425	59.39065	3.027872	3.898332
13	0.099949	5.278604	29.74795	58.72425	2.763883	3.485310
14	0.105098	4.860078	32.96280	56.49744	2.500405	3.179270
15	0.110399	4.513959	35.06836	55.24811	2.282113	2.887456
16	0.115643	4.151976	37.60310	53.48906	2.095829	2.660030
17	0.121420	3.767837	39.42692	52.35163	1.936868	2.516747
18	0.127205	3.449918	41.83829	50.46165	1.855301	2.394835
19	0.132933	3.167317	43.61570	49.14770	1.809793	2.259490
20	0.138593	2.916668	45.44486	47.68155	1.779052	2.177867
21	0.144576	2.681167	46.85750	46.58171	1.756555	2.123068
22	0.150459	2.475665	48.55569	45.11895	1.781193	2.068498
23	0.156204	2.296933	49.80307	44.08116	1.815297	2.003544
24	0.161909	2.138797	51.09580	42.97021	1.839044	1.956148

Variance Decomposition of LRGSPENG: Period	S.E.	LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG
1	0.009996	10.57885	8.315184	2.910238	78.19573	0.000000
2	0.013880	11.03670	7.474000	3.198579	76.95147	1.339257
3	0.018048	8.839384	10.32584	2.759949	72.76973	5.305093
4	0.022180	6.172142	9.697886	2.956452	73.03839	8.135130
5	0.027041	4.152646	9.053384	3.113976	72.43151	11.24848
6	0.031555	3.052631	9.325842	2.483285	73.97384	11.16440
7	0.035510	2.410452	9.873885	2.140407	74.32016	11.25510
8	0.038952	2.089887	9.886464	1.999100	74.63392	11.39063
9	0.042211	1.878313	9.826141	1.965614	75.09057	11.23936
10	0.044955	1.658476	9.688984	1.810930	76.27213	10.56948
11	0.047186	1.506246	9.497228	1.723622	77.39812	9.874784
12	0.049024	1.416553	9.272134	1.686909	78.30112	9.323287
13	0.050641	1.344832	9.003581	1.671865	79.17101	8.808715
14	0.052023	1.275071	8.715051	1.605182	80.05755	8.347142
15	0.053150	1.225435	8.390086	1.555184	80.80443	8.024867
16	0.054077	1.186319	8.109706	1.520955	81.37182	7.811195
17	0.054908	1.157963	7.867507	1.490470	81.80138	7.682680
18	0.055698	1.165231	7.673317	1.449172	82.03455	7.677731
19	0.056428	1.191721	7.585805	1.412947	82.02875	7.780780
20	0.057093	1.219473	7.590331	1.380952	81.89062	7.918629
21	0.057746	1.263440	7.672515	1.350111	81.63175	8.082182
22	0.058422	1.347480	7.837890	1.320465	81.19334	8.300826
23	0.059100	1.439899	8.124486	1.291207	80.60549	8.538921
24	0.059759	1.531810	8.482799	1.263845	79.97327	8.748273

Variance Decomposition of LRFTAXG: Period	S.E.	LRFDEBT	LCPI	LRFINTPG	LRGSPENG	LRFTAXG
1	0.050847	1.004753	3.307292	3.356507	3.550231	88.78122
2	0.063949	3.500868	3.499674	10.47142	7.419104	75.10893
3	0.079606	4.283966	2.882888	16.12210	7.481260	69.22978
4	0.099680	2.840345	1.897978	13.78705	9.728784	71.74584
5	0.124222	2.785020	3.114966	12.73835	13.56146	67.80020
6	0.145109	2.425433	4.616554	13.66818	16.84469	62.44514
7	0.166438	2.901060	5.034980	14.04655	18.91281	59.10460
8	0.185992	4.010062	5.416761	12.92122	19.97805	57.67391
9	0.204289	4.560942	6.121140	12.73929	21.27332	55.30531
10	0.218749	4.511210	6.579894	12.84784	22.71246	53.34860
11	0.230855	4.737114	6.740752	12.97844	23.56405	51.97964
12	0.241162	5.103923	6.868572	12.88097	24.11815	51.02839
13	0.250519	5.246868	7.033919	13.15825	24.61015	49.95081
14	0.257920	5.320929	7.048190	13.61813	25.09421	48.91854
15	0.264244	5.482999	6.967181	14.18563	25.28981	48.07438
16	0.269668	5.676574	6.859930	14.63744	25.36304	47.46302
17	0.274732	5.771694	6.747393	15.34640	25.37449	46.76002
18	0.278949	5.817160	6.590278	16.11256	25.37241	46.10759
19	0.282743	5.874464	6.427919	16.89924	25.25783	45.54055
20	0.286226	5.946538	6.275589	17.60547	25.09987	45.07253
21	0.289681	5.958682	6.126880	18.45198	24.91601	44.54645
22	0.292815	5.950722	6.004436	19.26944	24.72623	44.04917
23	0.295904	5.950054	5.899443	20.07880	24.48574	43.58596
24	0.298903	5.949659	5.814193	20.81773	24.24086	43.17756

Cholesky Ordering: LRFDEBT LCPI LRFINTPG LRGSPENG LRFTAXG

Appendix I: Results of Comparative Johansen cointegration for the USA

Date: 03/31/15 Time: 10:13
Sample (adjusted): 1972 2012
Included observations: 41 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: LUDEBT LUINF LUGDPG LUPB LRUNTRA
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.600652	91.22621	88.80380	0.0330
At most 1	0.472343	53.59139	63.87610	0.2693
At most 2	0.287897	27.37973	42.91525	0.6589
At most 3	0.209412	13.45887	25.87211	0.7018
At most 4	0.089068	3.824748	12.51798	0.7673

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.600652	37.63482	38.33101	0.0599
At most 1	0.472343	26.21166	32.11832	0.2215
At most 2	0.287897	13.92087	25.82321	0.7292
At most 3	0.209412	9.634119	19.38704	0.6579
At most 4	0.089068	3.824748	12.51798	0.7673

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA	@TREND(71)
-9.353043	-2.914292	0.738233	-23.34044	-0.003081	0.822711
-4.631891	-2.248097	-2.888150	4.441736	-0.041299	-0.093177
-6.083096	1.950970	0.648456	-10.78268	-0.025211	0.534505
3.822930	-1.245515	-0.580027	11.80915	-0.072598	-0.424544
6.414794	1.797930	-0.370041	-5.585953	0.025001	0.067535

Unrestricted Adjustment Coefficients (alpha):

D(LUDEBT)	0.002219	0.005767	0.017120	-0.009496	-0.006086
D(LUINF)	0.189461	0.014819	-0.153480	-0.034992	-0.032664
D(LUGDPG)	0.087307	0.241633	-0.183047	0.037926	0.175189
D(LUPB)	0.029800	0.000841	-0.009143	0.014552	0.010815
D(LRUNTRA)	-0.540551	3.324696	2.013308	5.648832	-1.661357

1 Cointegrating Equation(s): Log likelihood -60.25746

Normalized cointegrating coefficients (standard error in parentheses)

LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA	@TREND(71)
1.000000	0.311588	-0.078930	2.495492	0.000329	-0.087962
	(0.06149)	(0.04672)	(0.34952)	(0.00134)	(0.01148)

Adjustment coefficients (standard error in parentheses)

D(LUDEBT)	-0.020754
	(0.07062)
D(LUINF)	-1.772034
	(0.56479)
D(LUGDPG)	-0.816588
	(1.23886)
D(LUPB)	-0.278720
	(0.09083)
D(LRUNTRA)	5.055796
	(23.8478)

2 Cointegrating Equation(s): Log likelihood -47.15163

Normalized cointegrating coefficients (standard error in parentheses)

LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA	@TREND(71)
1.000000	0.000000	-1.338564	8.689858	-0.015068	-0.281764
		(0.22554)	(1.79030)	(0.00672)	(0.05555)
0.000000	1.000000	4.042634	-19.88002	0.049416	0.621982
		(0.66587)	(5.28564)	(0.01983)	(0.16402)

Adjustment coefficients (standard error in parentheses)

D(LUDEBT)	-0.047465	-0.019431
	(0.07812)	(0.02755)
D(LUINF)	-1.840672	-0.585457
	(0.62969)	(0.22206)
D(LUGDPG)	-1.935806	-0.797653
	(1.31306)	(0.46305)
D(LUPB)	-0.282614	-0.088736
	(0.10135)	(0.03574)
D(LRUNTRA)	-10.34383	-5.898917
	(25.9380)	(9.14699)

3 Cointegrating Equation(s): Log likelihood -40.19120

Normalized cointegrating coefficients (standard error in parentheses)

LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA	@TREND(71)
1.000000	0.000000	0.000000	1.652606	0.003493	-0.073514
			(0.47849)	(0.00188)	(0.01499)
0.000000	1.000000	0.000000	1.373377	-0.006640	-0.006958
			(1.46379)	(0.00574)	(0.04586)
0.000000	0.000000	1.000000	-5.257314	0.013866	0.155577
			(1.26694)	(0.00497)	(0.03969)

Adjustment coefficients (standard error in parentheses)

D(LUDEBT)	-0.151604	0.013969	-0.003916
	(0.08318)	(0.02868)	(0.02101)
D(LUINF)	-0.907040	-0.884892	-0.002457
	(0.65581)	(0.22615)	(0.16561)
D(LUGDPG)	-0.822315	-1.154772	-0.752117
	(1.47173)	(0.50750)	(0.37166)
D(LUPB)	-0.226997	-0.106573	0.013642
	(0.11577)	(0.03992)	(0.02923)
D(LRUNTRA)	-22.59098	-1.971012	-8.695733
	(29.7308)	(10.2521)	(7.50802)

4 Cointegrating Equation(s): Log likelihood -35.37414

Normalized cointegrating coefficients (standard error in parentheses)

LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA	@TREND(71)
1.000000	0.000000	0.000000	0.000000	0.037790	-0.048867
				(0.01090)	(0.01672)
0.000000	1.000000	0.000000	0.000000	0.021862	0.013525
				(0.00777)	(0.01192)
0.000000	0.000000	1.000000	0.000000	-0.095241	0.077169
				(0.03197)	(0.04903)
0.000000	0.000000	0.000000	1.000000	-0.020753	-0.014914
				(0.00610)	(0.00936)

Adjustment coefficients (standard error in parentheses)

D(LUDEBT)	-0.187907	0.025796	0.001592	-0.322912
	(0.08477)	(0.02909)	(0.02077)	(0.19160)
D(LUINF)	-1.040811	-0.841309	0.017839	-3.114574
	(0.68365)	(0.23459)	(0.16755)	(1.54523)
D(LUGDPG)	-0.677327	-1.202009	-0.774115	1.457089
	(1.54146)	(0.52894)	(0.37778)	(3.48409)
D(LUPB)	-0.171365	-0.124698	0.005202	-0.421376
	(0.11723)	(0.04023)	(0.02873)	(0.26498)
D(LRUNTRA)	-0.995894	-9.006719	-11.97221	72.38317
	(28.6664)	(9.83668)	(7.02551)	(64.7935)

Appendix J: Results of Comparative Johansen cointegration for GREECE

Date: 03/31/15 Time: 10:13
Sample (adjusted): 1972 2012
Included observations: 41 after adjustments
Trend assumption: Linear deterministic trend (restricted)
Series: LGDEBT LGINF LGGDPG LGPB LRGNTRA
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.598407	98.98966	88.80380	0.0076
At most 1	0.433109	61.58473	63.87610	0.0768
At most 2	0.346531	38.31363	42.91525	0.1339
At most 3	0.309473	20.86976	25.87211	0.1850
At most 4	0.129527	5.687453	12.51798	0.5010

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.598407	37.40493	38.33101	0.0636
At most 1	0.433109	23.27110	32.11832	0.3987
At most 2	0.346531	17.44387	25.82321	0.4211
At most 3	0.309473	15.18231	19.38704	0.1839
At most 4	0.129527	5.687453	12.51798	0.5010

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA	@TREND(71)
-13.01985	-0.236471	0.037061	-7.765780	-0.086569	-0.364225
-0.971250	-1.715697	-0.545303	-2.039476	-0.064341	-0.413618
3.489948	0.606694	-1.092711	1.638326	-0.010699	0.026937
-2.779739	-2.088328	-0.427021	-1.958943	0.078599	-0.078820
1.189505	0.569072	-0.274933	1.083029	0.093057	0.125678

Unrestricted Adjustment Coefficients (alpha):

D(LGDEBT)	0.069915	0.005139	0.003048	-0.002372	-0.005403
D(LGINF)	0.019054	0.189647	-0.167142	-0.014704	-0.043931
D(LGGDPG)	-0.258298	0.155272	0.171341	0.181339	0.303740
D(LGPB)	-0.059041	0.025298	0.033491	0.069273	-0.012267
D(LRGNTRA)	-0.842319	0.905631	3.100980	-1.621901	-1.157834

1 Cointegrating Equation(s): Log likelihood -131.2536

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA	@TREND(71)
1.000000	0.018162	-0.002846	0.596457	0.006649	0.027975
	(0.03008)	(0.01486)	(0.04958)	(0.00209)	(0.00875)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	-0.910286
	(0.13419)
D(LGINF)	-0.248081
	(0.94602)
D(LGGDPG)	3.362998
	(2.23700)
D(LGPB)	0.768702
	(0.34391)
D(LRGNTRA)	10.96686
	(15.6253)

2 Cointegrating Equation(s): Log likelihood -119.6180

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA	@TREND(71)
1.000000	0.000000	-0.008709	0.580839	0.006030	0.023841
		(0.01491)	(0.04404)	(0.00214)	(0.00757)
0.000000	1.000000	0.322762	0.859905	0.034088	0.227582
		(0.15541)	(0.45899)	(0.02229)	(0.07892)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	-0.915277	-0.025350
	(0.13407)	(0.01778)
D(LGINF)	-0.432276	-0.329883
	(0.84830)	(0.11253)
D(LGGDPG)	3.212190	-0.205320
	(2.21611)	(0.29397)
D(LGPB)	0.744131	-0.029443
	(0.34018)	(0.04513)
D(LRGNTRA)	10.08727	-1.354604
	(15.5370)	(2.06102)

3 Cointegrating Equation(s): Log likelihood -110.8961

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA	@TREND(71)
1.000000	0.000000	0.000000	0.587141	0.006393	0.025186
			(0.04386)	(0.00213)	(0.00762)
0.000000	1.000000	0.000000	0.626333	0.020639	0.177726
			(0.45210)	(0.02197)	(0.07855)
0.000000	0.000000	1.000000	0.723667	0.041668	0.154467
			(0.75390)	(0.03663)	(0.13099)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	-0.904640	-0.023501	-0.003542
	(0.13860)	(0.01882)	(0.01253)
D(LGINF)	-1.015592	-0.431287	0.079928
	(0.78801)	(0.10700)	(0.07124)
D(LGGDPG)	3.810162	-0.101369	-0.281470
	(2.25928)	(0.30678)	(0.20425)
D(LGPB)	0.861012	-0.009124	-0.052579
	(0.34346)	(0.04664)	(0.03105)
D(LRGNTRA)	20.90953	0.526741	-3.913536
	(14.3872)	(1.95361)	(1.30068)

4 Cointegrating Equation(s): Log likelihood -103.3049

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA	@TREND(71)
1.000000	0.000000	0.000000	0.000000	-0.065177	-0.169730
				(0.01770)	(0.02246)
0.000000	1.000000	0.000000	0.000000	-0.055707	-0.030201
				(0.01490)	(0.01891)
0.000000	0.000000	1.000000	0.000000	-0.046543	-0.085773
				(0.02999)	(0.03805)
0.000000	0.000000	0.000000	1.000000	0.121895	0.331976
				(0.02990)	(0.03794)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	-0.898047	-0.018548	-0.002529	-0.543787
	(0.14139)	(0.02849)	(0.01326)	(0.08634)
D(LGINF)	-0.974719	-0.400580	0.086207	-0.779779
	(0.80376)	(0.16195)	(0.07540)	(0.49082)
D(LGGDPG)	3.306088	-0.480063	-0.358905	1.614690
	(2.26631)	(0.45665)	(0.21259)	(1.38394)
D(LGPB)	0.668451	-0.153790	-0.082160	0.326069
	(0.30998)	(0.06246)	(0.02908)	(0.18929)
D(LRGNTRA)	25.41799	3.913801	-3.220952	12.95187
	(14.1781)	(2.85678)	(1.32997)	(8.65798)

Appendix K: Results of Comparative VECM for the USA

Vector Error Correction Estimates
Date: 03/31/15 Time: 10:29
Sample (adjusted): 1972 2012
Included observations: 41 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LUDEBT(-1)	1.000000
LUINF(-1)	0.311588 (0.06149) [5.06704]
LUGDPG(-1)	-0.078930 (0.04672) [-1.68938]
LUPB(-1)	2.495492 (0.34952) [7.13973]
LRUNTRA(-1)	0.000329 (0.00134) [0.24519]
@TREND(70)	-0.087962 (0.01148) [-7.66469]
C	-72.46786

Error Correction:	D(LUDEBT)	D(LUINF)	D(LUGDPG)	D(LUPB)	D(LRUNTRA)
CointEq1	-0.020754 (0.07062) [-0.29389]	-1.772034 (0.56479) [-3.13753]	-0.816588 (1.23886) [-0.65914]	-0.278720 (0.09083) [-3.06855]	5.055796 (23.8478) [0.21200]
D(LUDEBT(-1))	0.473435 (0.21141) [2.23945]	-4.900059 (1.69079) [-2.89809]	5.019302 (3.70876) [1.35337]	-0.490524 (0.27192) [-1.80393]	-7.627298 (71.3927) [-0.10684]
D(LUINF(-1))	0.022175 (0.02222) [0.99797]	-0.076512 (0.17771) [-0.43055]	-0.547205 (0.38981) [-1.40379]	0.015397 (0.02858) [0.53875]	-9.284830 (7.50368) [-1.23737]
D(LUGDPG(-1))	-0.004764 (0.01182) [-0.40321]	-0.072396 (0.09450) [-0.76614]	-0.322645 (0.20728) [-1.55659]	0.003779 (0.01520) [0.24864]	4.611633 (3.99003) [1.15579]
D(LUPB(-1))	-0.142571 (0.15618) [-0.91286]	1.527210 (1.24910) [1.22265]	-0.805736 (2.73990) [-0.29407]	0.125892 (0.20089) [0.62668]	63.39726 (52.7425) [1.20201]
D(LRUNTRA(-1))	3.26E-05 (0.00045) [0.07266]	-0.000318 (0.00359) [-0.08870]	0.002608 (0.00787) [0.33135]	2.69E-05 (0.00058) [0.04663]	-0.399015 (0.15150) [-2.63381]
C	0.015164	0.038295	-0.089073	0.034875	-0.704108

	(0.01002)	(0.08013)	(0.17578)	(0.01289)	(3.38363)
	[1.51342]	[0.47789]	[-0.50674]	[2.70608]	[-0.20809]
R-squared	0.365406	0.383463	0.443607	0.404032	0.341451
Adj. R-squared	0.253419	0.274662	0.345420	0.298862	0.225237
Sum sq. resids	0.079466	5.083049	24.45701	0.131470	9062.630
S.E. equation	0.048345	0.386654	0.848130	0.062183	16.32630
F-statistic	3.262928	3.524449	4.517976	3.841679	2.938116
Log likelihood	69.86639	-15.37943	-47.58505	59.54571	-168.8425
Akaike AIC	-3.066653	1.091680	2.662685	-2.563205	8.577683
Schwarz SC	-2.774092	1.384241	2.955246	-2.270644	8.870244
Mean dependent	0.020203	-0.013119	-0.003104	0.028571	1.002432
S.D. dependent	0.055952	0.453996	1.048288	0.074263	18.54826

Determinant resid covariance (dof adj.)	3.32E-05
Determinant resid covariance	1.30E-05
Log likelihood	-60.25746
Akaike information criterion	4.939388
Schwarz criterion	6.652960

Appendix L: Results of Comparative VECM for Greece

Vector Error Correction Estimates
Date: 03/31/15 Time: 10:30
Sample (adjusted): 1972 2012
Included observations: 41 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LGDEBT(-1)	1.000000
LGINF(-1)	0.018162 (0.03008) [0.60377]
LGGDPG(-1)	-0.002846 (0.01486) [-0.19153]
LGPB(-1)	0.596457 (0.04958) [12.0304]
LRGNTRA(-1)	0.006649 (0.00209) [3.18884]
@TREND(70)	0.027975 (0.00875) [3.19561]
C	-16.96953

Error Correction:	D(LGDEBT)	D(LGINF)	D(LGGDPG)	D(LGPB)
CointEq1	-0.910286 (0.13419) [-6.78347]	-0.248081 (0.94602) [-0.26224]	3.362998 (2.23700) [1.50335]	0.768702 (0.34391) [2.23521]
D(LGDEBT(-1))	-0.124969 (0.12533) [-0.99711]	-0.064660 (0.88355) [-0.07318]	5.831948 (2.08929) [2.79135]	0.199833 (0.32120) [0.62215]
D(LGINF(-1))	0.078346 (0.02795) [2.80281]	-0.236976 (0.19706) [-1.20256]	-0.891453 (0.46598) [-1.91309]	-0.270556 (0.07164) [-3.77675]
D(LGGDPG(-1))	-0.013758 (0.01052) [-1.30743]	-0.007674 (0.07418) [-0.10345]	-0.112704 (0.17541) [-0.64251]	-0.011847 (0.02697) [-0.43932]
D(LGPB(-1))	0.223004 (0.10827) [2.05977]	0.931683 (0.76325) [1.22068]	-1.852639 (1.80482) [-1.02650]	0.051695 (0.27747) [0.18631]
D(LRGNTRA(-1))	0.004147 (0.00238) [1.74234]	0.017701 (0.01678) [1.05497]	-0.033804 (0.03968) [-0.85202]	-0.005299 (0.00610) [-0.86882]
C	0.089354	0.117462	-0.694508	-0.123351

	(0.01701)	(0.11992)	(0.28357)	(0.04359)
	[5.25294]	[0.97952]	[-2.44920]	[-2.82954]
R-squared	0.629816	0.110674	0.414642	0.363699
Adj. R-squared	0.564490	-0.046266	0.311343	0.251410
Sum sq. resids	0.148082	7.359532	41.15119	0.972594
S.E. equation	0.065995	0.465249	1.100150	0.169132
F-statistic	9.641039	0.705199	4.014014	3.238968
Log likelihood	57.10653	-22.96618	-58.25194	18.52141
Akaike AIC	-2.444221	1.461765	3.183021	-0.562020
Schwarz SC	-2.151660	1.754326	3.475582	-0.269459
Mean dependent	0.052502	-0.017485	-0.101885	-0.112921
S.D. dependent	0.100003	0.454846	1.325716	0.195481

Determinant resid covariance (dof adj.)	0.001059
Determinant resid covariance	0.000415
Log likelihood	-131.2536
Akaike information criterion	8.402614
Schwarz criterion	10.11619

Appendix M: Results of Comparative Serial correlation for the USA

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 03/31/15 Time: 10:33
Sample: 1970 2012
Included observations: 41

Lags	LM-Stat	Prob
1	14.24902	0.9572
2	18.20285	0.8337
3	18.52578	0.8193
4	33.55503	0.1178
5	36.69432	0.0617
6	34.84958	0.0910
7	16.06069	0.9130
8	28.91538	0.2675
9	15.43782	0.9305
10	27.50431	0.3312
11	27.06412	0.3527
12	21.48939	0.6650

Probs from chi-square with 25 df.

Appendix N: Results of Comparative Serial correlation for Greece

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 03/31/15 Time: 10:33
Sample: 1970 2012
Included observations: 41

Lags	LM-Stat	Prob
1	25.26023	0.4479
2	18.33569	0.8278
3	17.13472	0.8768
4	30.11292	0.2201
5	19.07074	0.7937
6	28.49854	0.2854
7	33.26207	0.1246
8	10.62679	0.9946
9	51.79051	0.0013
10	24.51687	0.4897
11	16.76115	0.8903
12	10.87834	0.9935

Probs from chi-square with 25 df.

Appendix O: Results of Comparative heteroskedasticity for the USA

VEC Residual Heteroskedasticity Tests: Includes Cross Terms
Date: 03/31/15 Time: 10:38
Sample: 1970 2012
Included observations: 41

Joint test:

Chi-sq	df	Prob.
456.9926	405	0.0378

Individual components:

Dependent	R-squared	F(27,13)	Prob.	Chi-sq(27)	Prob.
res1*res1	0.765144	1.568632	0.1983	31.37090	0.2562
res2*res2	0.898911	4.281447	0.0042	36.85534	0.0978
res3*res3	0.870938	3.249147	0.0146	35.70847	0.1218
res4*res4	0.682127	1.033215	0.4955	27.96720	0.4127
res5*res5	0.588179	0.687670	0.8010	24.11533	0.6239
res2*res1	0.875433	3.383761	0.0123	35.89275	0.1177
res3*res1	0.775475	1.662965	0.1683	31.79448	0.2398
res3*res2	0.907609	4.729865	0.0026	37.21197	0.0912
res4*res1	0.710598	1.182228	0.3873	29.13450	0.3544
res4*res2	0.901174	4.390534	0.0037	36.94814	0.0960
res4*res3	0.802723	1.959159	0.1016	32.91166	0.2000
res5*res1	0.723532	1.260062	0.3391	29.66480	0.3294
res5*res2	0.908000	4.752025	0.0025	37.22801	0.0909
res5*res3	0.725873	1.274933	0.3305	29.76077	0.3250
res5*res4	0.524190	0.530438	0.9201	21.49178	0.7627

Appendix P: Results of comparative heteroskedasticity for Greece

VEC Residual Heteroskedasticity Tests: Includes Cross Terms
Date: 03/31/15 Time: 10:37
Sample: 1970 2012
Included observations: 41

Joint test:

Chi-sq	df	Prob.
432.5165	405	0.1663

Individual components:

Dependent	R-squared	F(27,13)	Prob.	Chi-sq(27)	Prob.
res1*res1	0.712578	1.193690	0.3798	29.21569	0.3505
res2*res2	0.826313	2.290637	0.0592	33.87882	0.1696
res3*res3	0.732987	1.321729	0.3048	30.05245	0.3118
res4*res4	0.863218	3.038595	0.0195	35.39196	0.1292
res5*res5	0.889836	3.889108	0.0065	36.48328	0.1051
res2*res1	0.846399	2.653138	0.0339	34.70235	0.1466
res3*res1	0.641578	0.861855	0.6428	26.30470	0.5017
res3*res2	0.913829	5.106033	0.0017	37.46699	0.0867
res4*res1	0.596918	0.713018	0.7787	24.47363	0.6039
res4*res2	0.875144	3.374817	0.0124	35.88091	0.1179
res4*res3	0.795856	1.877062	0.1167	32.63012	0.2096
res5*res1	0.888209	3.825502	0.0071	36.41657	0.1065
res5*res2	0.932669	6.669500	0.0004	38.23944	0.0742
res5*res3	0.920567	5.579987	0.0011	37.74324	0.0820
res5*res4	0.846690	2.659090	0.0336	34.71428	0.1463

Appendix Q: Results of comparative normality for the USA

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 03/31/15 Time: 10:35
Sample: 1970 2012
Included observations: 41

Component	Skewness	Chi-sq	df	Prob.
1	0.784468	4.205168	1	0.0403
2	-0.436918	1.304463	1	0.2534
3	-0.544141	2.023276	1	0.1549
4	0.174872	0.208965	1	0.6476
5	-0.062280	0.026505	1	0.8707
Joint		7.768378	5	0.1695

Component	Kurtosis	Chi-sq	df	Prob.
1	3.997853	1.701006	1	0.1922
2	4.232511	2.595102	1	0.1072
3	2.695561	0.158334	1	0.6907
4	2.412292	0.590059	1	0.4424
5	4.120967	2.146634	1	0.1429
Joint		7.191136	5	0.2068

Component	Jarque-Bera	df	Prob.
1	5.906175	2	0.0522
2	3.899565	2	0.1423
3	2.181610	2	0.3359
4	0.799025	2	0.6706
5	2.173139	2	0.3374
Joint	14.95951	10	0.1335

Appendix R: Results of comparative normality for Greece

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 03/31/15 Time: 10:36
Sample: 1970 2012
Included observations: 41

Component	Skewness	Chi-sq	df	Prob.
1	0.524076	1.876815	1	0.1707
2	1.007875	6.941385	1	0.0084
3	0.242878	0.403098	1	0.5255
4	1.085212	8.047518	1	0.0046
5	-2.742439	51.39332	1	0.0000
Joint		68.66214	5	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	4.648428	4.642079	1	0.0312
2	5.400480	9.843937	1	0.0017
3	2.718311	0.135554	1	0.7127
4	5.909342	14.45980	1	0.0001
5	18.49800	410.3211	1	0.0000
Joint		439.4025	5	0.0000

Component	Jarque-Bera	df	Prob.
1	6.518895	2	0.0384
2	16.78532	2	0.0002
3	0.538652	2	0.7639
4	22.50731	2	0.0000
5	461.7144	2	0.0000
Joint	508.0646	10	0.0000

Appendix S: Results of comparative VEC Granger Causality for the USA

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 03/31/15 Time: 10:38
Sample: 1970 2012
Included observations: 41

Dependent variable: D(LUDEBT)

Excluded	Chi-sq	df	Prob.
D(LUINF)	0.995940	1	0.3183
D(LUGDPG)	0.162578	1	0.6868
D(LUPB)	0.833314	1	0.3613
D(LRUNTRA)	0.005279	1	0.9421
All	2.284247	4	0.6836

Dependent variable: D(LUINF)

Excluded	Chi-sq	df	Prob.
D(LUDEBT)	8.398955	1	0.0038
D(LUGDPG)	0.586964	1	0.4436
D(LUPB)	1.494877	1	0.2215
D(LRUNTRA)	0.007867	1	0.9293
All	13.92524	4	0.0075

Dependent variable: D(LUGDPG)

Excluded	Chi-sq	df	Prob.
D(LUDEBT)	1.831598	1	0.1759
D(LUINF)	1.970615	1	0.1604
D(LUPB)	0.086480	1	0.7687
D(LRUNTRA)	0.109793	1	0.7404
All	3.439296	4	0.4872

Dependent variable: D(LUPB)

Excluded	Chi-sq	df	Prob.
D(LUDEBT)	3.254167	1	0.0712
D(LUINF)	0.290251	1	0.5901
D(LUGDPG)	0.061821	1	0.8036
D(LRUNTRA)	0.002174	1	0.9628
All	4.296154	4	0.3674

Dependent variable: D(LRUNTRA)

Excluded	Chi-sq	df	Prob.
D(LUDEBT)	0.011414	1	0.9149

D(LUINF)	1.531084	1	0.2159
D(LUGDPG)	1.335846	1	0.2478
D(LUPB)	1.444838	1	0.2294
All	8.815952	4	0.0659

Appendix T: Results of comparative VEC Granger Causality for Greece

VEC Granger Causality/Block Exogeneity Wald Tests
Date: 03/31/15 Time: 10:38
Sample: 1970 2012
Included observations: 41

Dependent variable: D(LGDEBT)

Excluded	Chi-sq	df	Prob.
D(LGINF)	7.855733	1	0.0051
D(LGGDPG)	1.709376	1	0.1911
D(LGPB)	4.242645	1	0.0394
D(LRGNTRA)	3.035737	1	0.0814
All	18.28754	4	0.0011

Dependent variable: D(LGINF)

Excluded	Chi-sq	df	Prob.
D(LGDEBT)	0.005356	1	0.9417
D(LGGDPG)	0.010701	1	0.9176
D(LGPB)	1.490051	1	0.2222
D(LRGNTRA)	1.112954	1	0.2914
All	2.651484	4	0.6177

Dependent variable: D(LGGDPG)

Excluded	Chi-sq	df	Prob.
D(LGDEBT)	7.791658	1	0.0052
D(LGINF)	3.659908	1	0.0557
D(LGPB)	1.053694	1	0.3047
D(LRGNTRA)	0.725943	1	0.3942
All	18.78377	4	0.0009

Dependent variable: D(LGPB)

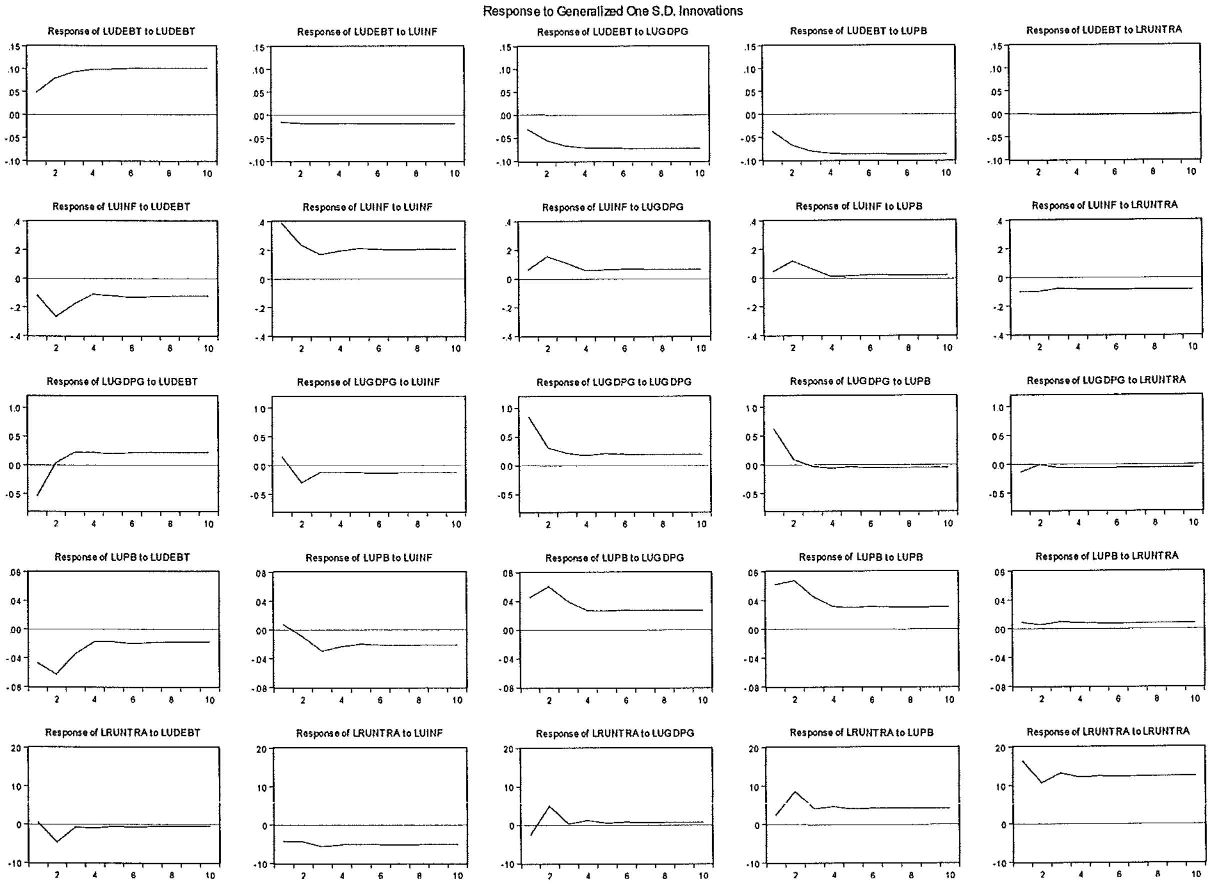
Excluded	Chi-sq	df	Prob.
D(LGDEBT)	0.387069	1	0.5338
D(LGINF)	14.26386	1	0.0002
D(LGGDPG)	0.193004	1	0.6604
D(LRGNTRA)	0.754844	1	0.3849
All	17.02091	4	0.0019

Dependent variable: D(LRGNTRA)

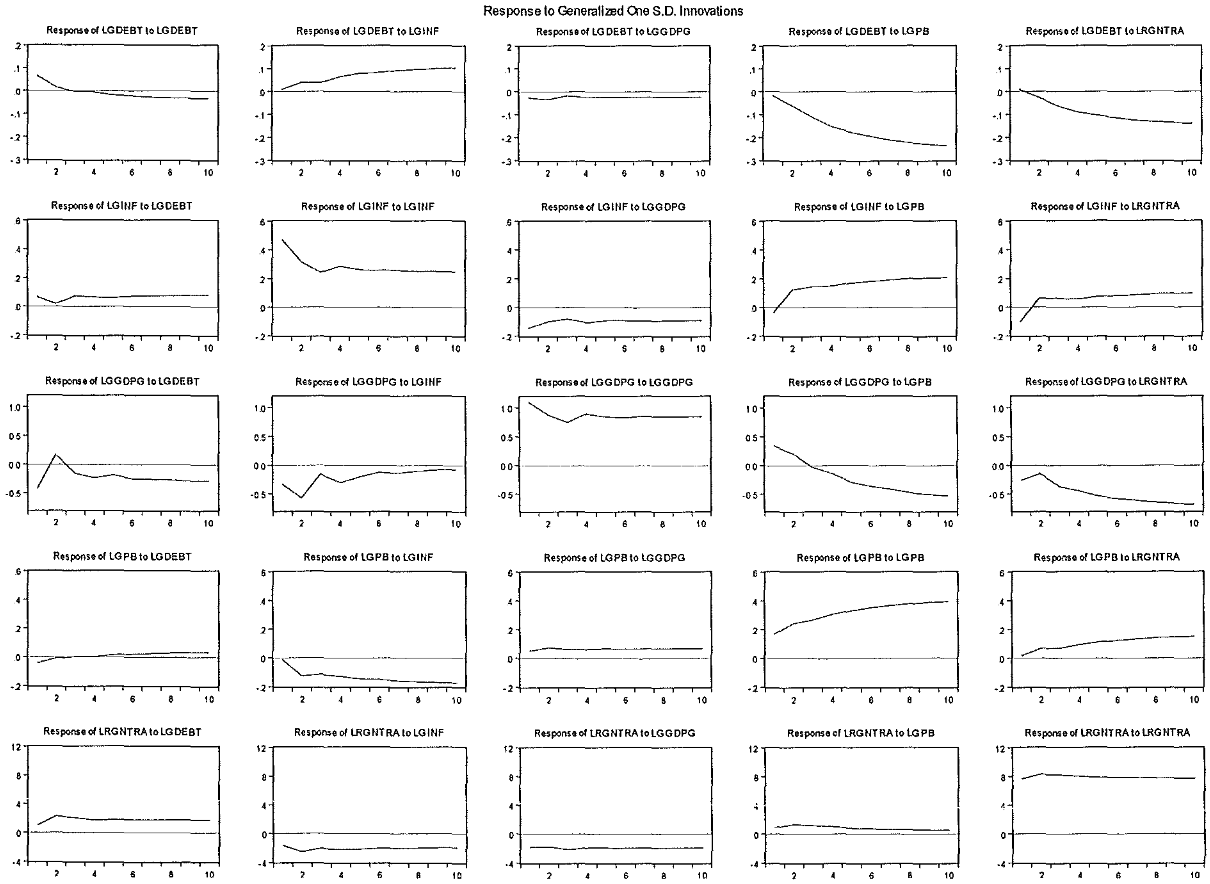
Excluded	Chi-sq	df	Prob.
D(LGDEBT)	0.843362	1	0.3584

D(LGINF)	0.434181	1	0.5099
D(LGGDPG)	0.057563	1	0.8104
D(LGPB)	0.046635	1	0.8290
All	1.880270	4	0.7578

Appendix U: Results of comparative GIRF for the USA



Appendix V: Results of comparative GIRF for Greece



Appendix W: Results of comparative variance decomposition for the USA

Variance Decomposition of LUDEBT: Period	S.E.	LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA
1	0.048345	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.093477	98.48425	0.612252	0.408598	0.493350	0.001554
3	0.133063	97.72337	0.927816	0.662488	0.685405	0.000919
4	0.166580	97.25499	1.179452	0.796542	0.768290	0.000723
5	0.195214	96.98120	1.318013	0.876552	0.823661	0.000575
6	0.220432	96.81775	1.396398	0.925198	0.860165	0.000492
7	0.243190	96.70985	1.448419	0.957556	0.883737	0.000438
8	0.264041	96.63212	1.486747	0.980613	0.900122	0.000400
9	0.283369	96.57423	1.515159	0.997781	0.912454	0.000372
10	0.301463	96.52991	1.536782	1.010965	0.921996	0.000350

Variance Decomposition of LUINF: Period	S.E.	LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA
1	0.386654	9.778031	90.22197	0.000000	0.000000	0.000000
2	0.508606	33.34737	62.28131	0.038356	4.268593	0.064378
3	0.561321	37.49089	55.77491	0.038683	6.632957	0.062556
4	0.602393	35.90278	56.25814	0.052890	7.725814	0.060379
5	0.647621	34.57597	56.78326	0.076596	8.503219	0.060955
6	0.689483	34.16216	56.39770	0.090713	9.287191	0.062241
7	0.727503	33.75954	56.15337	0.099457	9.924845	0.062784
8	0.763630	33.29733	56.11471	0.108470	10.41641	0.063080
9	0.798425	32.92222	56.07626	0.116344	10.82174	0.063440
10	0.831746	32.62922	56.01420	0.122742	11.17008	0.063762

Variance Decomposition of LUGDPG: Period	S.E.	LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA
1	0.848130	39.97080	0.100415	59.92879	0.000000	0.000000
2	0.999574	28.91537	9.172521	61.07806	0.722008	0.112039
3	1.126361	26.62562	7.457021	65.18881	0.601426	0.127119
4	1.223209	25.92922	6.440421	66.80338	0.675032	0.151939
5	1.314812	24.62934	5.808040	68.61926	0.786882	0.156484
6	1.402487	24.02446	5.366605	69.57145	0.870999	0.166491
7	1.485696	23.67572	4.954806	70.27746	0.919791	0.172219
8	1.563825	23.38310	4.622960	70.85152	0.964995	0.177422
9	1.638254	23.11318	4.357701	71.34341	1.004435	0.181276
10	1.709555	22.89959	4.136450	71.74231	1.036931	0.184721

Variance Decomposition of LUPB: Period	S.E.	LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA
1	0.062183	57.37432	1.695418	10.09113	30.83913	0.000000
2	0.097829	64.21895	10.17320	10.94425	14.65459	0.009014
3	0.114520	55.65653	20.84436	11.75183	11.74051	0.006765
4	0.122151	50.86018	24.19120	13.15421	11.78774	0.006666
5	0.128308	47.92610	26.14316	14.08761	11.83703	0.006103
6	0.134780	45.47926	28.08918	14.79909	11.62694	0.005532

7	0.140937	43.25921	29.88267	15.39388	11.45915	0.005086
8	0.146641	41.38305	31.31835	15.92292	11.37096	0.004723
9	0.152109	39.80414	32.52493	16.37264	11.29389	0.004407
10	0.157421	38.43435	33.58557	16.75902	11.21694	0.004128

Variance Decomposition of LRUNTRA: Period	S.E.	LUDEBT	LUINF	LUGDPG	LUPB	LRUNTRA
1	16.32630	0.066557	7.148894	3.944132	12.05750	76.78292
2	21.06848	5.182084	12.92723	3.574087	15.46316	62.85345
3	25.18373	3.716252	15.21389	2.521400	15.22571	63.32275
4	28.30882	3.054517	16.17486	2.045017	16.01214	62.71346
5	31.18787	2.536591	16.56087	1.685228	16.25550	62.96180
6	33.78043	2.204481	16.93548	1.443587	16.47699	62.93946
7	36.20937	1.941900	17.21612	1.259036	16.60055	62.98239
8	38.47441	1.741180	17.42020	1.118561	16.71850	63.00156
9	40.61531	1.580589	17.57784	1.006243	16.80597	63.02936
10	42.64794	1.450686	17.70933	0.915085	16.87799	63.04691

Cholesky Ordering: LUDEBT LUINF LUGDPG LUPB LRUNTRA

Appendix X: Results of comparative variance decomposition for Greece

Variance Decomposition of LGDEBT: Period	S.E.	LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA
1	0.065995	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.097701	48.72256	14.64725	4.016452	30.82048	1.793259
3	0.158176	18.59683	11.89767	1.785264	62.58088	5.139355
4	0.235731	8.404267	13.27899	0.941025	71.56264	5.813079
5	0.313728	5.002076	14.48183	0.632872	74.37312	5.510099
6	0.388694	3.541766	14.57721	0.458617	76.07192	5.350485
7	0.462024	2.785512	14.75788	0.360270	76.86290	5.233447
8	0.532384	2.386890	14.89040	0.297935	77.30108	5.123697
9	0.599419	2.149053	14.94757	0.254448	77.60527	5.043665
10	0.663384	1.999748	15.00239	0.223750	77.79465	4.979464

Variance Decomposition of LGINF: Period	S.E.	LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA
1	0.465249	2.020506	97.97949	0.000000	0.000000	0.000000
2	0.593495	1.337451	88.59445	0.026356	6.594267	3.447478
3	0.671867	2.241342	81.30328	0.037140	12.33710	4.081139
4	0.759663	2.549802	77.24956	0.039996	15.87221	4.288431
5	0.836655	2.644677	73.20032	0.033687	19.44079	4.680523
6	0.908239	2.932949	69.50548	0.028642	22.60017	4.932766
7	0.978014	3.122247	66.46703	0.026094	25.24222	5.142409
8	1.043650	3.276518	63.76928	0.023475	27.59816	5.332573
9	1.106373	3.431015	61.44274	0.021399	29.62426	5.480586
10	1.166666	3.555798	59.44644	0.019878	31.37047	5.607411

Variance Decomposition of LGGDPG: Period	S.E.	LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA
1	1.100150	14.37625	6.451076	79.17267	0.000000	0.000000
2	1.550797	8.398134	18.60805	72.73623	0.000944	0.256643
3	1.757516	7.257250	15.07496	74.76112	2.161090	0.745586
4	2.030479	6.715746	13.08065	73.09703	5.881848	1.224725
5	2.289383	5.891833	10.89171	70.72340	10.60837	1.884696
6	2.537292	5.724271	8.990189	67.88143	15.13270	2.271408
7	2.786439	5.608370	7.583612	65.14621	19.07751	2.584295
8	3.029068	5.499869	6.461604	62.56702	22.60593	2.865579
9	3.264715	5.478842	5.577764	60.24390	25.62417	3.075326
10	3.493371	5.464155	4.880344	58.22629	28.18193	3.247285

Variance Decomposition of LGPB: Period	S.E.	LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA
1	0.169132	5.622135	0.182934	5.480175	88.71476	0.000000
2	0.322696	1.605319	15.01341	3.577529	79.80214	0.001604
3	0.438360	0.881388	14.71064	2.766530	81.61688	0.024555
4	0.553333	0.560662	14.50367	2.266741	82.63888	0.030056
5	0.668331	0.457512	14.84910	1.957522	82.68221	0.053664
6	0.777607	0.433797	14.87074	1.716039	82.89410	0.085318
7	0.882482	0.430780	14.93005	1.543612	82.97450	0.121059
8	0.982616	0.449583	15.00006	1.416939	82.98126	0.152159
9	1.077828	0.472479	15.03286	1.317775	82.99641	0.180475
10	1.168641	0.495345	15.06528	1.240209	82.99344	0.205724

Variance Decomposition of LRGNTRA: Period	S.E.	LGDEBT	LGINF	LGGDPG	LGPB	LRGNTRA
1	7.684481	1.983055	5.681318	7.528741	4.991470	79.81542
2	11.47247	5.021130	8.869986	5.742740	6.533873	73.83227
3	14.16112	5.528789	8.552496	6.041757	6.828325	73.04863
4	16.31714	5.406051	8.734104	6.098009	6.650986	73.11085
5	18.16051	5.484353	8.837026	6.125285	6.346509	73.20683
6	19.80197	5.489323	8.726888	6.206582	6.056710	73.52050
7	21.30654	5.468088	8.678187	6.254728	5.798742	73.80025
8	22.69604	5.462678	8.625432	6.299353	5.565483	74.04705
9	23.99478	5.447868	8.560092	6.343733	5.358557	74.28975
10	25.22075	5.432438	8.506367	6.380018	5.175868	74.50531

Cholesky Ordering: LGDEBT LGINF LGGDPG LGPB LRGNTRA

RESEARCH OUTPUT

ARTICLES:

Ogutu Miruka, Gisele Mah & Mamello A. Nchake. 2015. Financial Guarantees and Public Debt in South Africa. Pula: *Bowtwana journal of Africa studies.* Vol. 28.

Gisele Mah, Itumeleng Mongale, Janine Mukuddem-Petersen and Mark Petersen. 2014. Government Debt in Greece: An Empirical Analysis of the Determinants. *Journal of Governance and Regulation,* 3(2):7-17.

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Christelle Meniago, Janine Mukuddem-Petersen, Mark. A Petersen & Gisele Mah. 2013. Shocks and Household Debt in South Africa: A Variance Decomposition and a GIRF analysis. September, 2013. *Mediterranean Journal of Social Sciences*, 4(3)379-388. September 2013. ISSN 2039-2117.

BOOK CHAPTER:

Gisele Mah, Mark A, Petersen, Janine Mukuddem-Petersen & Lungile NP. Hlatshwayo. 2013. The causes, consequences and cures of the Eurozone Sovereign Debt Crisis. (Petersen, M., Economics of Debt). New York: Nova Science Publishers, ISBN: 978-1-62618-792-4, 2013, 123-170.

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Gisele Mah, Janine Mukuddem-Petersen & Mark A, Petersen. 2014. Determinants of Government Debt in Greece: An Empirical Analysis. (In International Work Conference on Time Series, organised by the faculty of Science, University of Granada: 27-29 June 2014, Spain).

Gisele Mah, Janine Mukuddem-Petersen, Itumeleng Mongale Pleasure & Mark Petersen. 2014. The policy of austerity measure: An assessment of its implications in Greece (2014 Global Development Finance Conference: 2-3 September, Dubai).