AN ECONOMETRIC ANALYSIS OF THE EUROZONE SOVEREIGN DEBT CRISIS: THE CASE OF GREECE

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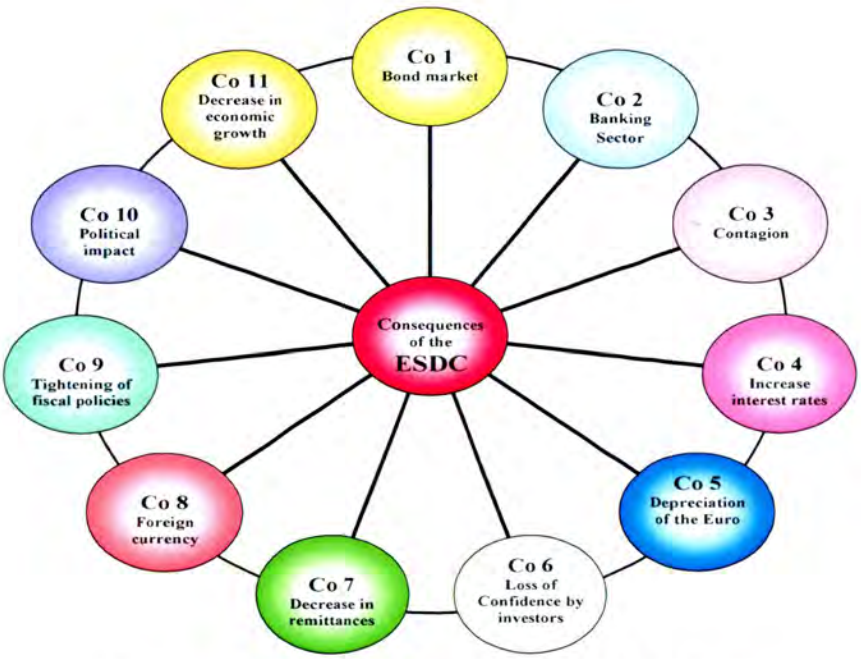
Dissertation submitted in partial fulfillment of the requirements for the degree Master of Commerce in Economics at the Mafikeng Campus of the North West University (NWU-MC)



Consequences of the Eurozone Sovereign Debt Crisis

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Mafikeng

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DEDICATION

I dedicate this dissertation to my husband Paul Saah and our daughter Jeolla Kefeyin Saah.

PREFACE

One of the contributions made by North-West University at Mafikeng (NWU-MC) to the activities of the financial economic community in South Africa has been the establishment of an active research group (EMERG) that has an interest in institutional finance, modeling and economic crises.

Under the guidance of my supervisor Prof. Janine Mukuddem-Petersen and my co-supervisor Prof. Mark A. Petersen this group has recently made valuable contributions to the existing knowledge about the modeling and optimization of financial institutions.

The work in this dissertation originated from our interest in the Eurozone sovereign debt crisis and econometric modeling. From the onset it became apparent that little work has been done on this topic although it has been identified as an area of potential growth.

A total of six research outcomes were collected in this project of which five are research articles submitted for possible publication and one is an accepted chapter in a book entitled the "Economics of Debt", published by NOVA in New York. An acceptance letter is attached after the list of appendix F.

DECLARATION

I, **GISELE MAH,** hereby declare that apart from the assistance acknowledged, the work contained in this dissertation for the degree of Master of Economics at the North West University (Mafikeng Campus) is my own. It has not been submitted before for any degree or its equivalence at this or any other university. I also declare that all secondary information used has been duly acknowledged in this dissertation.

Signature..... Date.....

GISELE MAH

The above declaration is confirmed by:

Signature..... Date.....

Supervisor

Signature..... Date.....

Co-supervisor

CERTIFICATE OF ACCEPTANCE FOR EXAMINATION

This dissertation entitled **"AN ECONOMETRIC ANALYSIS OF THE EUROZONE SOVEREIGN DEBT CRISIS: THE CASE OF GREECE"**, submitted by **GISELE MAH**, student number 23098880 of the Department of Economics in the Faculty of Commerce and Administration is hereby recommended for acceptance for examination.

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ABSTRACT

The European sovereign debt crisis started in 2008 with the collapse of Iceland's banking system. Subsequently, several European countries faced the implosion of financial institutions, high government debt and rapidly rising bond yield spreads in government securities. In this context, Greece is an example of a country whose government debt is a matter of grave concern since it has received the second bailout but still threatens to default. This is ironic since a developed economy like Greece is considered to aide developing economies. The main aim of this dissertation is to conduct an econometric analysis of the determinants of the Greek sovereign debt crisis while the secondary aim is an extensive literature review of the Eurozone sovereign debt crisis. Regarding the former aim, the variables selected include the government deficit, current account balance, inflation, gross savings and general government debt of Greece. This annual data (from 1976 to 2010) was collected from the World Development Indicators, European Commission data base and the International Monetary Fund. The Vector Error Correction Model framework was used to estimate our model. Also, the Granger causality analysis helped to identify the direction of causation. Furthermore, the Variance Decomposition and the Generalized Impulse Response Function were employed to analyze the shocks of all our variables on each other. Finally, for the latter aim, we critically review the evolution, causes, consequences and cures of the Eurozone sovereign debt crisis and then formulate some suggestions on how to mitigate the effects of this crisis.

The results of the econometric analysis show that there is a significant negative relationship between general government debt with government deficit and inflation. However, a significant positive relationship between general government debt and current account balance was found. There is an insignificant negative relationship between gross savings and general government debt. The past value of the general government debt and government deficit has the ability to determine the present value of inflation; and in turn, pass value of inflation, can predict the present value of current account balance and gross savings. Variation in most of our variables is highly explained by our variables itself, with the exception of current account balance where variation is explained mostly by general government debt. The response of general government debt to itself is positive. Gross government debt to government deficit and general government debt to current account balance is negative. General government debt to inflation is positive. A shock of gross government debt has an increasing negative effect on gross savings over the study period. Among the causes of the Eurozone sovereign debt crisis is the rapid growth of government debt levels, trade imbalances, monetary policy inflexibility, and loss of confidence. Consequences of this crisis involve disrupted bond markets and the banking sector, depreciation of the Euro, reduced economic growth, loss of confidence, reduced remittances and tight fiscal measures. Some measures were taken and many are proposed as a cure for this crisis. This dissertation recommends that policies aimed at decreasing the level of general government debt should increase expenditure hence deficit in an income generating investment, increase inflation while decreasing current account balance.

Key words: Sovereign Debt Crisis, General government debt, Greece, Cointegration, Vector Error Correction Model, Granger Causality, Variance Decomposition, Generalized Impulse Response Function.

JEL Classification H62, H63, H68.

TABLE OF CONTENTS

ACKNOWLEDGEMENTS i

DEDICATION ii

PREFACE iii

DECLARATION iv

CERTIFICATE OF ACCEPTANCE FOR EXAMINATION v

ABSTRACT vi

TABLE OF CONTENTS vii

LIST OF TABLES xi

LIST OF FIGURES xiii

GLOSSARY OF TERMS xiv

LIST OF ACRONYMS xvii

CHAPTER 1 1

INTRODUCTION TO THE STUDY 1

1.1 BACKGROUND 1

1.2 PROBLEM STATEMENT 6

1.3 AIMS AND OBJECTIVES OF STUDY 7

1.3.1 Aims 7

1.3.2 Objectives 8

1.4. RESEARCH QUESTIONS AND HYPOTHESIS 8

1.4.1 Research Questions 8

1.4.2 Research Hypotheses 9

1.5 SIGNIFICANCE OF THE STUDY 9

1.6 LIMITATIONS AND DELIMITATIONS OF THE STUDY 10

1.7 STRUCTURE OF THE DISSERTATION 10

CHAPTER 2 12

LITERATURE REVIEW 12

2.1. INTRODUCTION 12

2.2. THEORETICAL PERSPECTIVES 12

2.2.1. Keynesian View 12

2.2.2 Ricardian View 14

2.2.3 Neoclassical View 15

2.2.4 Debt Sustainability 16

2.2.4.1 Inter-temporal Budget Constraint 16

2.2.4.2 Model-based Sustainability 18

2.2.5 Cobb Douglas Production Function of Government Debt 18

2.3. EMPIRICAL LITERATURE 19

2.3.1 Studies on Sovereign Debt 19

2.3.2 Evolution, Causes, Consequences and Cures of the ESDC 22

2.3.2.1. The Evolution of the ESDC 22

2.3.2.2 The Causes of the ESDC 29

2.3.2.3. Consequences of the Eurozone Sovereign Debt Crisis 34

2.3.2.4 Cures for the Eurozone Sovereign Debt Crisis 42

CHAPTER 3 54

METHODOLOGY 54

3.1 INTRODUCTION 54

3.2 AREA OF STUDY 54

3.3 MODEL SPECIFICATION 55

3.4 DATA DESCRIPTION 56

3.5. ESTIMATING THE MODEL 58

3.5.1 Descriptive Statistics 61

3.5.2 Visual Inspection 61

3.5.3 Unit Root Test 61

3.5.3.1 Dickey-Fuller and Augmented Dickey-Fuller (DF and ADF) 62

3.5.3.2 Phillips Perron (PP)Tests 64

3.5.4 Lag Order Selection Criteria 65

3.5.5 Cointegration 66

3.5.5.1 The Johansen Cointegration Test 67

3.5.5.2 Testing for Weak Exogeneity 68

3.5.5.3 Testing for Linear Restrictions in the Cointegrating Vectors 69

3.5.6 Vector Error Correction Model (VECM) Estimates 70

3.5.7 Diagnostic Tests 71

3.5.7.1 Stability Test 72

3.5.7.2 Autocorrelation LM Test 72

3.5.7.3 Heteroskedasticity 73

3.5.7.4 Normality Tests 74

3.5.8 Causality Test 74

3.5.9 Variance Decomposition 76

3.5.10 Generalized Impulse Response Function 77

CHAPTER 4 79

EMPIRICAL ANALYSIS AND INTERPRETATION 79

4.1 INTRODUCTION 79

4.2 DESCRIPTIVE STATISTICS OF VARIABLES USED IN THIS STUDY 80

4.3 VISUAL INSPECTION RESULTS 81

4.4 UNIT ROOT TEST RESULTS 84

4.5 VAR LAG ORDER SELECTION CRITERIA 88

4.6. COINTEGRATION TEST RESULT 88

4.7 WEAK EXOGENEITY RESULTS ON BETA 91

4.8 LONG RUN RESTRICTION RESULTS 91

4.9 VECM ESTIMATES RESULTS 92

4.10 DIAGNOSTIC AND STABILITY TEST RESULTS 96

4.7.1 Stability Test Results 97

4.7.2 Autocorrelation LM Test Results 97

4.7.3 White Heteroskedasticity Test Results 98

4.7.4 Normality Tests Results 99

4.8 GRANGER CAUSALITY TEST RESULTS 100

4.9 RESULTS OF VARIANCE DECOMPOSITION 102

4.10 RESULTS OF GIRF 104

CHAPTER 5 107

CONCLUSIONS AND RECOMMENDATIONS 107

5.1 INTRODUCTION 107

5.2 SUMMARY AND CONCLUSIONS 107

5.3 POLICY RECOMMENDATIONS 111

5.4 FUTURE RESEARCH 112

BIBLIOGRAPHY 113

APPENDIX 122

APPENDIX A: Johansen Cointergration Results 122

APPENDIX B: Vector Error Correction Estimates Result 125

APPENDIX C: Autocorrelation LM Test 127

APPENDIX D: WHITE Heteroskedasticity Results 128

APPENDIX E: Normality Results 129

APPENDIX F: Variance Decomposition Results 130

LIST OF TABLES

Table 2.1 Starting Point of the ESDC in the PIIGS Countries 23

Table 3.1 Source of Our Variables 57

Table 4.1 Summary of the Descriptive Statistics of the Variables at Level Form 81

Table 4.2 ADF and PP Test at Level Form 85

Table 4.3 ADF and PP Test at First Difference 87

Table 4.4 Selection of the Lag Length 88

Table 4.5 Cointegration Results with Trace and Maximum Eigenvalues 87

Table 4.6 Results of the Weak Exogeneity Tests 91

Table 4.7 Results of Restrictions on Beta 92

Table 4.8 Long Run Coefficient and Level of Significance 92

Table 4.9 Error Correction Term Results 94

Table 4.10 Short Run Error Correction Results 95

Table 4.11 Summary of Diagnostics and Stability Test Results 96

Table 4.12 Serial Correlation LM TEST Results 98

Table 4.13 VEC Residual Heteroskedasticity Tests: No Cross Terms 99

Table 4.14 VEC Residual Normality Tests 99

Table 4.15 Pairwise Granger Causality Test with Lags: 2 101

Table 4.16 Variance Decomposition Results of LGDEBT on the Independent Variables 103

LIST OF FIGURES

Figure 1.1: Total Government Debt of the PIIGS Countries from 1990 to 2010 4

Figure 1.2: Annual Statistics of the Greek Government Debt from 1976 -2011 6

Figure 2.1 Causes of the Eurozone Sovereign Debt Crisis 30

Figure 2.2: Consequences of the Eurozone Sovereign Debt Crisis 35

Figure 2.3: GDP Growth Rates of the PIIGS Countries from 1990 to 2010 41

Figure 2.4. Proposed Cures of the Eurozone Sovereign Debt Crisis 43

Figure 3.1 A Stepwise Progression of the Econometric Analysis of the Data..... 60

Figure 4.1 Selected Variables at Level Form 82

Figure 4.2 Selected Variables at First Difference 83

Figure 4.3 Stability Test Results 97

Figure 4.4 Generalized Impulse Response Function Results.....
.....106

GLOSSARY OF TERMS

Austerity: is a policy of deficit cutting in the amount of benefits and public service provided. It is used by government to reduce deficit spending and increase taxes.

Bailout: is an act of giving financial assistance to an economy that is failing in an attempt to save it from collapsing.

Bond: is debt instruments issued by the government, banks, and companies to raise money from the public.

Budget deficit: is the amount by which a government spending exceeds its income over a particular period of time.

Government debt: is the debt owed by a central government.

Cointegration: is an econometric technique use for testing the relationship between non-stationary time series variables, two or more variables are said to be cointegrated when they move together at the same wavelength.

Cologne debt Initiative London Club: is a forum for debtor nations to initiate negotiations with private sector lenders to reschedule payments on commercial bank debt.

Contagion: is when significant economic changes in one country will spread to other countries, the spread of either economic booms or economic crises throughout a geographic region.

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

Debt restructuring: is the process that allows a sovereign entity facing cash flow problems and financial distress to reduce and renegotiate its delinquent debts in order to improve or restore liquidity and rehabilitate so that it can continue its operation.

Debt service default: is when the borrower fails to make a payment of interest or principal within the specified grace period.

Debt sustainability: is when a country can service its debt without building up protracted arrears.

Error correction model: is a dynamic model in which the movement of the variables in any periods is related to that of the previous period's gap from long-run equilibrium.

European Financial Stability Facility: is a special purpose vehicle which helps preserve financial stability in Europe by providing financial assistance to Eurozone states in difficulty.

European Financial Stabilization Mechanism: is an emergency funding programme which relies on funds raised on the financial markets and guaranteed by the European commission using the budget of the European Union as collateral.

European Sovereign Debt Crisis: is a period of time in which several European countries faced the collapse of financial institutions, high government debt and rapidly rising bond yield spreads in government securities.

Eurozone: is an economic and monetary union (EMU) member states of the EU that have adopted the euro as their common currency tender which is freely convertible at market exchange rates.

Generalized Impulse Response Function: is an analysis used to construct the time path of the dependent variables in the vector autoregressive model to shocks from all the independent variables.

Global Financial Crisis: refers to an economic scenario where the economies of countries all over the world are facing a liquidity crunch and taking steps forward to combat this issue.

Government bills: are bonds with maturity of less than one year.

Government bonds: is a bond issued by a national government generally promising to pay a certain amount (the face value) on a certain date, as well as periodic interest payments. They are usually in the country's currency. These bonds have maturity period of more than ten years.

Government notes: are bonds with maturity period of one year to ten years.

Haircut: is a common expression for the reduction of creditors' claim either through a reduction of the normal value or of softening of interest and repayment terms.

HIPC Initiative: is a program of debt relief for the heavily indebted poor countries developed by the leader of the seven major industrialized nations. The initiative establishes a set of conditions and time table required for debt relief.

Monetary policy: is the process by which the monetary authority of a country controls the supply of money, often targeting a rate of interest for the purpose of promoting economic growth and stability.

Sovereign bonds: are bonds issued in the international currency and it can be sold to the other countries and foreign investors.

Sovereign credit default swap (CDS): is an over-the-counter (OTC) credit protection contract in which a protection seller pays compensation to a protection buyer to make a contingent payment in the case of a pre-defined credit event.

Sovereign debt crisis: is when national government cannot pay the debt it owes and therefore seeks some form of assistance.

Sovereign debt: is debt owed directly by a country's national government or owed indirectly by virtue of that government's guarantee.

Sovereign default: is the failure or refusal of the government of a sovereign state to pay back its debt in full. It may be accompanied by a formal declaration of a government not to pay or only partially pay its debts, or the de facto cassation of due payments.

Trade imbalance: is when there is either a trade surplus or trade deficit. Trade imbalance is the difference between the monetary value of exports and imports of output in an economy over a certain period. A positive balance is when the amount of exports is greater than the amount of imports, and this is known as a trade surplus. Whereas a negative balance is when there are greater imports than exports, also known as a trade deficit or trade gap.

Vector Error Correction Model: is an econometric technique used in the estimation of the long-run and short-run equilibrium parameters in a relationship with non-stationary variables.

LIST OF ACRONYMS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag
CDS	Credit Default Swaps
CPI	Consumer Price Index
CAB	Current Account Balance
ECM	Error Correction Model
EMU	European Monetary Union
GDP	Gross Domestic Product
GDEBT	General Government Debt
GDEF	Gross National Deficit
GFC	Global Financial Crisis
GIRF	Generalized Impulse Response Function
GSAV	Gross Savings
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
PP	Phillips-Perron
P-value	Probability Value
SC	Schwarz Information Criterion
T –value	Test Statistics Value
VAR	Vector Autoregressive Regression
VECM	Vector Error Correction Model

CHAPTER 1

INTRODUCTION TO THE STUDY

1.1 BACKGROUND
1.2 PROBLEM STATEMENT
1.3 AIMS AND OBJECTIVES OF THE STUDY
1.4 RESEARCH QUESTIONS AND HYPOTHESIS
1.5 SIGNIFICANCE OF THE STUDY
1.6 LIMITATIONS AND DELIMITATIONS OF THE STUDY
1.7 STRUCTURE OF THE DISSERTATION

1.1 BACKGROUND

African countries experienced the Sovereign debt crisis in the 1960s and 1970s when they accepted loans for political and economic stability from international lenders after their independence. The developed economies helped these countries to come out of debt through aids and development assistance. Europe was responsible for half of the aide given to developing countries. Later on, many of these governments were unable to honour their debts, leading to the formation of the Paris and London Clubs in the 1970s. In 1996, the leaders of the leading seven industrial nations agreed upon the Highly Indebted Poor Country (HIPC) initiative which was subsequently endorsed by the International Monetary Fund (IMF) and the World Bank. The HIPC Initiative was intended to establish a set of conditions required for debt relief and a means to deliver multilateral, relief but it failed to live up to the expectations of both creditor and debtor nations (Callaghy, 2002). By 1999, intensive public pressure led to the Cologne Debt Initiative (CDI) which was intended to provide faster, broader and deeper relief. The CDI expanded the list of HIPC nations from twenty six to thirty three and promised to relieve 70% of the approximately £130 billion of these nations debts by the early 2000s. Within three years, the list of nations considered for debt relief under these initiatives expanded to thirty eight. Six of these nations completed all the necessary conditions and received relief under one or both of the

initiatives, twenty nations reached a phase in the set of conditions that allowed for some limited debt relief and twelve were still being considered (Kaiser, 2010).

The Eurozone sovereign debt crisis (ESDC) started in 2008 with the collapse of Iceland's banking system and it spread primarily to Greece and Ireland in 2009 and to Portugal in 2011 (Sandoval *et al.* 2011). During this period, several European countries faced the collapse of financial institutions, high government debt and rapidly, rising bond yield spreads in government securities. The most affected countries are Portugal, Ireland, Italy, Greece and Spain collectively called PIIGS. This crisis is of concern because statistics from AMECO (European Commission data base) shows that the sovereign debt rate -- the total government debt to gross domestic product (GDP) ratio -- of most European countries has been constantly increasing up to values of more than 100 % and they are not able to meet up with their financial commitments.

In particular, Greece had a sovereign debt rate of 144.967 % in 2010 and 165.336 % in 2011 according to AMECO; this value is measured by the ratio of total government debt to GDP. Ironically, Greece cannot sustain its debt while a country like Japan had a government debt rate of 220.282 % in 2010 yet it is not experiencing the sovereign debt crisis. This is because the government bonds of Greece and other PIIGS countries have high yield demands and their banking and financial sectors are fragile.

This arising government debt in Greece started building up from 1970 with the first and second oil shock which affected the country. Later in 1981, it joined the European Economic Community and elections took place in this same year which resulted in accumulated public debt. According to Alogoskoufis (2012), Greece initiated a fiscal consolidation and structural reforms program in 1990 in preparation to join the European currency whereby it signed the Maastricht treaty in 1991. By 1997, a growth and stability pact was adopted by 27 member states of the European Union which was aimed to maintain fiscal discipline. This pact sought to ensure that member states would maintain budget discipline in order to diminish systemic risk. In addition, this pact was implemented to encourage monetary stability, coordination of monetary and economic policies from members of the monetary union thus lowering the degree of national sovereignty and clout for certain member states. This was later reformed in 2005 but the criterion

of 3% of GDP annual budget deficit and a 60% of GDP national debt levels were maintained. During the 1990s, Greece experienced an increase in economic growth, stable inflation rate and sustainable debt to GDP rate.

In late 2000, the Greek economy was affected by the slowdown of the world economy which had an effect on its shipping and tourism industry, hence accumulating its national debts. By 2002, when it adopted the euro as a currency, it had access to get loans at low interest rate and also low bond rates of the Eurobond market. This resulted in them increasing their consumption spending, resulting in difficulties to refinance their debts from 1990 to 2008. During 2001 to 2008, the growth rates increased, unemployment decreased, public debt to GDP ratio was stable at 100%.

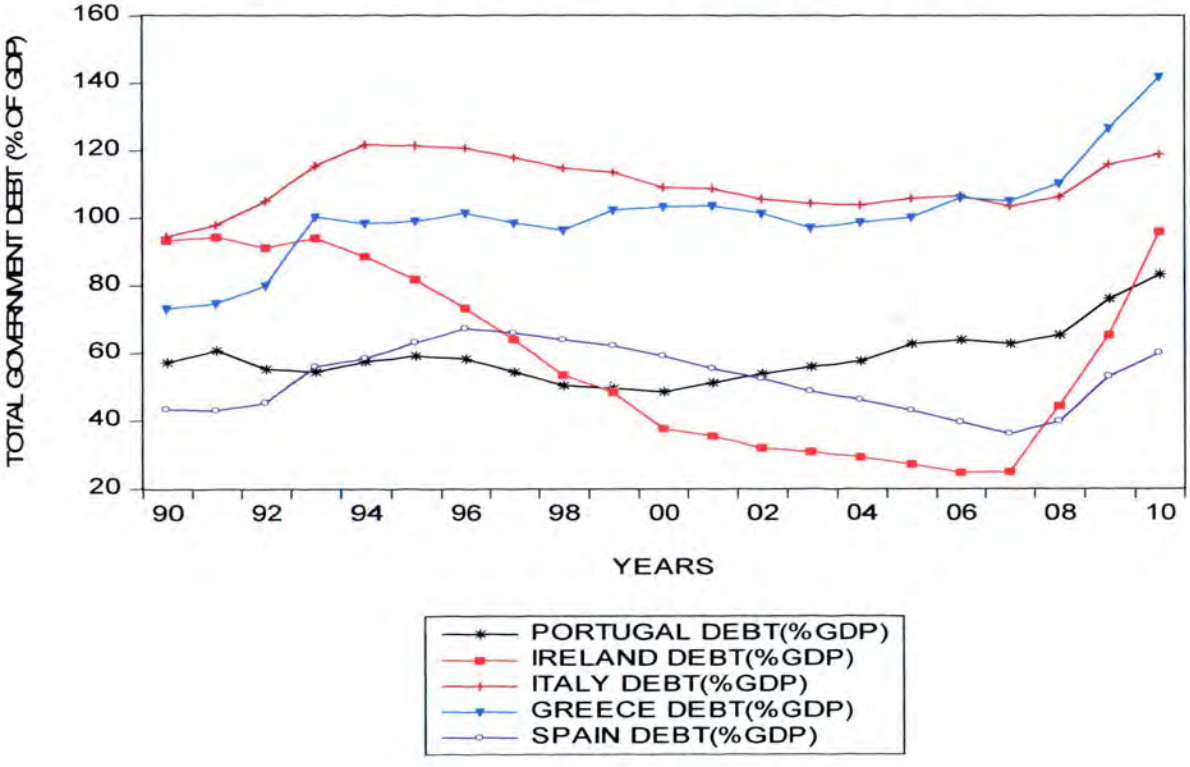
As Arghyrou and Tsoukalas (2010) mentioned, the USA subprime mortgage crisis and the 2007-2008 financial crisis slowed down the growth rate in Greece to 2%, while the economic recession in 2009 affected access to credit, world trade and domestic consumption. All these crises caused an increase in fiscal deficit, increase in cost of borrowing, decrease in competiveness due to high inflation in the Eurozone, rigid labour and product market, as well as increased doubts in the reimbursement of Greek debt in the market.

Elections took place in Greece in 2010, this resulted in its fiscal deficit to worsen and the economy entered into prolonged recession, leading to speculation of Greek bonds. In April 2010, Greece was excluded from the international financial markets. In 2009, the spread of bonds started to rise from 235 basis points in December 2009 to 477 basis points in April 2010 thus causing continually downgrading of its bonds by rating agencies. Anand et *al.* (2012) and Calice *et al.* (2011) confirmed that on 2 May 2010, the European Union (EU) and the International Monetary Fund (IMF) gave a bailout package of €110 billion to Greece which was to be followed by implementation of austerity measures. After the first bailout, the European Financial Stability Facility (EFSF) was created to issue bonds or other debt instruments in the markets. In October 2011, private investors agreed to take a 50% cut on the face value of bonds and not the 21% that was agreed upon in July 2011 (Armingeon & Baccaro, 2011). According Castel (2012), Greece was granted a second rescue package of €130 billion in 2012. The package was authorized to be released in installments with the first being €39.4 billion in loans. This amount will be disbursed from the Eurozone's temporary bailout fund known as the EFSF. According to

Nellas and Becatoros (2012), Greece voted to stay in the Eurozone in June 2012 after the New Democracy Party won the elections.

So far in June 2012, Greece has undergone five series of austerity measures in order to reduce deficit spending and increase taxes. The Figure1.1 below shows how the Greek government debt has been increasing over the years up to the point where it became unsustainable as compared to that of other countries in the Eurozone who are also experiencing this debt crisis. There was a sharp increase in government debt from 2008 until 2011 where Greece topped the chart compared to other Eurozone countries.

Figure 1.1: Total Government Debt of the PIIGS Countries from 1990 to 2010



SOURCE: *Adapted from IMF*

Greece is facing the debt crisis on two fronts, a long run build up of public sector debt due to persistent high budget deficit and a rapid buildup of excessive external debt due to several years of massive current account deficits. As Greece has been living beyond its means, it must immediately cut spending and imports to check its unsustainable deficits. This government has a budget deficit and public sector debt above 100 % of GDP, much of which is held by EU banks,

(Rossi & Aguilera, 2010). The recent wide spread of unsustainable debt in developed economies culminated in the Eurozone sovereign debt crisis, and this phenomena with special reference to the Greek case is the main motivation for this study.

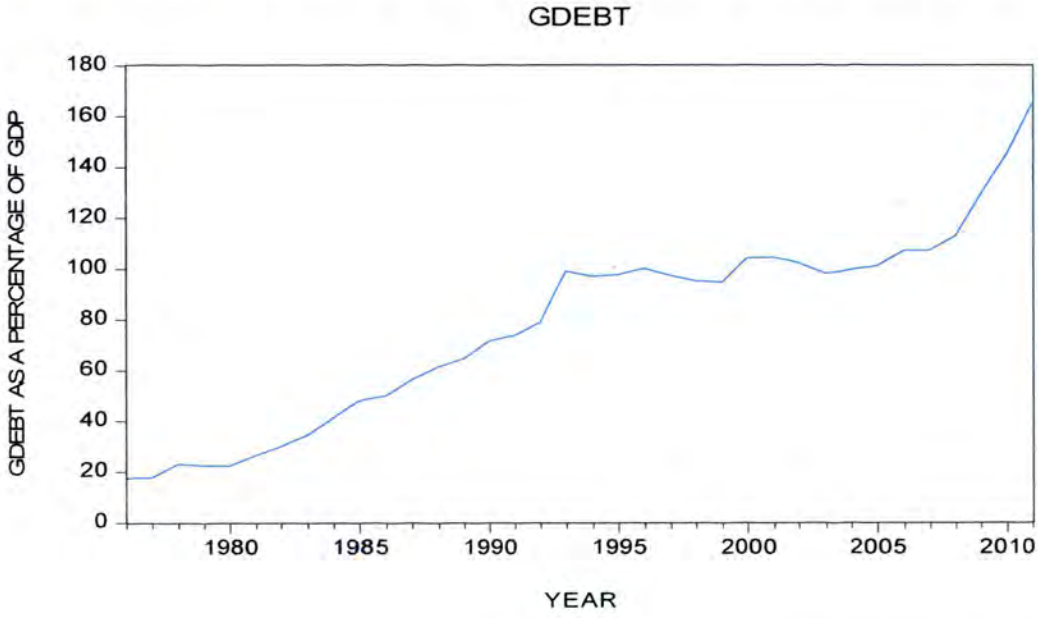
Theoretically, we adopted the Inter-temporal budget constraint (IBC) which requires that the total government spending must be within the funds available for it over some long period. The public sector income statement of one period budget constraint will explain the evolution of the net debt as the difference between revenue and expenditure excluding interest expenditure as $B_{t+1} = (1+r)B_t - PB_{t+1}$. The IBC shows the government debt should be backed by the expected future cash flow.

Evidently, various approaches have been used by other researchers to study sovereign debt. Some of these include the loanable funds model for Greece by Hsing (2010), the public debt decomposition for 15 market access countries by Budin *et al.* (2005), and the panel data regression for middle income countries by Sinha *et al.* (2011). Contrary to these studies we investigated the Greek sovereign debt crisis using the VECM, Granger causality, Variance Decomposition and GIRFs. To the best of our knowledge, there is no study that has focused on analyzing the determinants of the Greek sovereign debt crisis, using the VECM to ultimately estimate the relationship between government debts and its causes. In addition, employing the Granger causality approach to determine the direction of causation, utilizing the Variance Decomposition to measure the contributions of each type of shock to the forecast error variance, and finally measuring the effects of shocks among our variables via GIRFs are novel in this context. Furthermore, our literature review presents an up-to-date, comprehensive and unique overview of the evolution, causes, consequences and cures of the Eurozone debt crisis. Ultimately this dissertation provides significant information to financial role-players, economists and policy makers, on how to mitigate the effects of the Eurozone sovereign debt crisis, with special emphases on the Greek case and to anticipate the impact of shocks and future crises.

1.2 PROBLEM STATEMENT

The Greek government debt has been increasing from 2001 to 2008 as shown in Figure 1.2 below. This increase exceeds the percentage stated in the growth and stability path. From 2010 to 2012, the Greek national debt has increase sharply and has become unsustainable. In particular, they have been unable to run their economy without bailouts. So far, they have had two bailouts, the first one was €110 billion in 2010 and the second was €130 billion in 2012. If they default, it will lead to the downgrading of the credit rating of the PIIGS countries and loss of confidence by investors. Moreover, if Greece defaults its debt, the banks of countries that provided the debt will face a tremendous liquidity problem which will lead to low production, less development, reduced trade and a situation leading to global economic depression.

Figure 1.2: Annual statistics of the Greek government debt from 1976 -2011



SOURCE: *Adapted from AMECO*

The Greek sovereign debt crisis makes their funding difficult and costly to have. Also it will cause interest to increase since investors will be nervous about the repayment of their debt. In addition, the increase in unsustainable national debt will cause increase in export prices, depreciation of the Euro, increase in unemployment, reduction in remittances sent to developing countries and tightening of fiscal policy.

Despite the first and second bailout of Greece, it is still experiencing rising debt and debt crisis. It has also undergoing series of austerity measures which are implemented as a result of this crisis. So far in June 2012, they have undergone five austerity measures which are aimed to reduce deficit spending and increase taxes. This has affected its citizens so much, by lowering their standard of living due to increase in taxes, decrease in salaries and bonuses, increase in unemployment and privatization.

Furthermore, much money is spent on external debt services; this reduces savings and foreign exchange earnings that could have been used to invest in the economy. Also, the fact that Greece is in debt discourages inflows of foreign direct investment since investors are afraid of high taxes and macroeconomic policy distortion. Since the Greek government can no longer generate enough revenue to service its foreign debt as required, this has led its economy into a high fiscal deficit and high rate of inflation.

The debt crisis in Greece is making investors scared to investment in Greece. This affects foreign investment in the country as well as growth because earnings from foreign investment and the capital investment will be lost.

Finally, Greece and other European countries experiencing this sovereign debt crisis gave aids and development assistance to developing countries in the past years. For them now, not being able to pay their debts will make that they will not be able to help the developing countries as they did at first. This will greatly affect the developing countries negatively in terms of the aids they receive from the European countries, development assistance, investment in the developing economy just to mention a few. Hence the ESDC has a negative effect on Europe, Africa and the world at large.

1.3 AIMS AND OBJECTIVES OF STUDY

1.3.1 Aims

The major aims of this research are:

Research Aims 1.3.1.1 *To investigate the main determinants of the high level of sovereign debt in Greece*

Research Aims 1.3.1.2 *To estimate a debt model for Greece from the period 1976 to 2010, and to ultimately analyse the relationship between the independent and dependent variables.*

Research Aims 1.3.1.3 *To determine the direction of causation of our variables.*

Research Aims 1.3.1.4 *To analyse the impact of the various shocks on the level of sovereign debt in Greece.*

Research Aims 1.3.1.5 *To review the evolution, causes, consequences and cures of the Eurozone sovereign debt crisis.*

1.3.2 Objectives

The specific objectives are aligned with aforementioned aims.

Research Objectives 1.3.2.1 *To systematically review related studies and economic theory to help identify the determinants of the sovereign debt in Greece.*

Research Objectives 1.3.2.2 *To estimate a VECM using time series data (from 1976 to 2010) in order to analyse the short and long run relationship between Greek sovereign debt and its determinants.*

Research Objectives 1.3.2.3 *To use the granger causality test to analyse the direction of causation among our variables.*

Research Objectives 1.3.2.4 *To employ the variance decomposition and the GIRF in order to evaluate the impact of the sovereign debt crisis shocks on the Greek sovereign debt level.*

Research Objectives 1.3.2.5 *To review studies that investigate the evolution, causes, consequences and cures of the Eurozone debt crisis.*

1.4. RESEARCH QUESTIONS AND HYPOTHESIS

In this section, specific research questions and a hypothesis is provided.

1.4.1 Research Questions

Specific research questions are listed below.

Research Questions 1.4.1.1 *What are the main determinants of the high level of sovereign debt in Greece?*

Research Questions 1.4.1.2 *How are these determinant factors related to government debt in Greece?*

Research Questions 1.4.1.3 *What is the direction of causation among our variables?*

Research Questions 1.4.1.4 *What is the response of government debt level in Greece due to the sovereign debt crisis shock?*

Research Questions 1.4.1.5 *How did the Eurozone sovereign debt crisis evolve and what are the causes, consequences and cures? Then, to categorize the pertinent findings by using a matrix analysis.*

1.4.2 Research Hypotheses

The main hypothesis of this dissertation is given below:

In this study, we hypothesize that the independent variables considered are positively related to the high level of general government debt in Greece. We therefore present our hypothesis as follows:

Null Hypothesis: Government deficit, current account balance, inflation and gross savings will positively affect the level of general government debt in Greece.

Alternative Hypothesis: Government deficit, current account balance, inflation and gross savings will negatively affect the level of general government debt in Greece.

1.5 SIGNIFICANCE OF THE STUDY

This study is significant because:

1.5.1 To the best of our knowledge, this study is the first of its kind to conduct a detailed econometric analysis to investigate the determinants of the sovereign debt crisis in Greece. This will help policy makers to formulate appropriate policies to reduce the rising government debt.

1.5.2 Our contribution to the available literature of assessing the impact of the sovereign debt crisis on the Greek debt level via GIRF analysis will be novel.

1.5.3 For the first time, the main variables that contribute to the high levels of debt in Greece will be identified by utilizing the variance decomposition econometric test.

1.5.4 The Granger causality results will indicate which variables will have a knock-on effect and policy makers will then be able to target these variables first.

1.5.5 The extensive review of literature on the evolution, causes, consequences and cures of the Eurozone sovereign debt crisis will enhance the existing body of knowledge.

1.6 LIMITATIONS AND DELIMITATIONS OF THE STUDY

There are limitations experienced in relation to acquiring quarterly data. However, we studied the selected period (1976-2010) using annual data that is available and this is a delimitation.

1.7 STRUCTURE OF THE DISSERTATION

This study will consist of five chapters organized in the following manner:

CHAPTER 1 Introduction to the Study
CHAPTER 2 Literature Review
CHAPTER 3 Methodology
CHAPTER 4 Empirical Analysis and Interpretation
CHAPTER 5 Conclusions and Recommendations
Bibliography
Appendix

Chapter 1 is the introductory chapter. It provides a general introduction/background of the study, problem statement, purpose, aim and objectives, research questions and hypothesis, significance of study, delimitations and limitations of the study and finally the structure of the dissertation.

Chapter 2 reviews the relevant theoretical and extensive empirical literature regarding the Eurozone sovereign debt crisis with special emphasis on the Greek debt crisis.

Chapter 3 includes the research methodology, where we provide a detailed explanation of the evaluation techniques implemented in this study. In this chapter, we will also specify our model

aligned with the theoretical framework and some relevant empirical studies. Moreover, the source and definition of the variables used will be explained in detail.

Chapter 4 provides the estimation and interpretation of the results of the different tests conducted in the previous chapter.

Chapter 5 includes the summary, conclusion and recommendations.

The bibliography contains all the articles, books and other sources used throughout the dissertation

The appendix list, this includes some of our results that could not be added in our chapters.

CHAPTER 2

LITERATURE REVIEW

2.1. INTRODUCTION
2.2. THEORETICAL PERSPECTIVES
2.3. EMPIRICAL LITERATURE

2.1. INTRODUCTION

This chapter examines existing debt theories and an extensive literature review of the Eurozone sovereign debt crisis (ESDC). The reason for this literature review is to guide us in choosing appropriate variables to be used in our study. Under the theoretical literature; we explored theories relating to government debt with budget deficit, and debt sustainability. The empirical literature provides a summary of existing studies on the subject, the methods that was implored by other researchers and their results. It is followed by an overview of literature on the evolution, causes, consequences and cures of the ESDC.

2.2. THEORETICAL PERSPECTIVES

We discussed the point of view of the Keynesian, Ricardian and Neoclassical Economist on theories that relates to government debt and budget deficit and the effect of government debt on the economy. It is followed by debt sustainability theories which include the intertemporal budget constraint and model based sustainability. Finally, we consider the Cobb Douglas function which relates government debt as deficit.

Government debt is defined by Black *et al.* (2012) as the sum of all outstanding financial liabilities of the government whereby they have the responsibility to repay the principle debt and the debt servicing. The government borrows using treasure bill, bonds or bank loans. This debt

can be an internal (when government borrows from domestic residents or institution) and/or external debt (when government borrows from other governments, residents or institutions).

Government deficit is the amount by which the government's expenditures exceed its receipts during a specific period of time. This deficit can be cyclical or structural. The former deficit occurs when the economy is at a low level of economic activity, while the latter deficit is incurred when the economy is operating at its potential output. In the sequel, we will investigate the different theories or points of views on budget deficit and government debt.

2.2.1. Keynesian View

Keynesian economists are of the point of view that deficit spending could be as a result of increase in government expenditure or decrease in taxes and the performance of the economy. To them, during a recession in an economy, fiscal policy which either involves a reduction in taxes or increases in government expenditure are appropriate to bring the economy out of recession This automatically stabilizes the economy when the economy is in a recession. Furthermore, debt finance fiscal expansion increases aggregate demand to equate supply at full employment and price stability. The government is able to change national income by changing aggregate demand. They are criticized in that, it is easy to increase budget deficit and public debts in periods of economic recession, but it is difficult to reverse the trend during a recovery. Furthermore, economic problem of most countries are structural rather than cyclical in nature, so debt financing has less ability to stabilize the economy from the macroeconomic point of view (Black *et al.*, 2012).

The effects of government debt according to Keynesian is that, many consumers are myopic and do not have enough liquidity, hence making current consumption sensitive to increase in disposable income. Economic resources are considered to be underemployed at the moment of deficit financing. A deficit financed tax cut will increase consumption and national income. Hence the economy moves to a higher growth path, and investment is stimulated. A properly timed budget deficit is thus seen to increase both current and future wellbeing. Extra taxes in the future, if there are to be any, may then readily be paid out of higher incomes. The government uses the aggregate demand to change total production and income in the economy.

According to Keynes in the General theory of employment, public debt is good when an economy is in a recession whereby there is a decrease in investment, employment, output growth rate. In such situations, Keynes encourages public borrowing which is a short term fiscal policy measure that will stimulate the economy hence bringing the economy out of recession.

2.2.2 Ricardian View

They were of the point of view that it is irrelevant for the government to use taxes or debt finance to meet up with its public expenditure because the behaviour of individuals is the same in both cases. Their view is based on the assumption that: individual must live infinitely, there is a competitive capital markets, there is no uncertain environment, individual act rationally and all taxes are non-distortionary. In this regard, deficit is considered as a symptom rather than a problem. In addition, the government can finance any given level of expenditure by imposing taxes, borrowing from the public or abroad or print money.

Furthermore, when government borrows instead of levying taxes to finance the public expenditure, the present generation will be under taxed and as the loan will be paid from tax income in the future. Debt finance is the postponement of the tax burden that will fall on the next generation, since the present generation will not want the future to be in a worse position. The present generation will have to reduce their private spending, encourage taxes to be paid by the present generation and neutralized debt finance by terms of its effect on aggregate demand.

Also, when debt issuing is substituted for taxation, it does not make a difference for the real state and development of the economy. When debt that is financed by public expenditure, it does not affect the economy since future taxes are embodied in current public debt. On the other hand, the present value of the expected share of current and future taxes of house hold consumption is subtracted from the expected present value of their current and future income in order to determine their net wealth position. The substitution of a budget deficit for taxation does not alter the present value of current and future taxes, as long as the present value of government expenditure remains unchanged. Furthermore, it does not affect the lifetime budget constraint of consumption households and thus has no impact on their consumption path. Increase in current disposable income as a result of tax cut leads to an equal increase in private savings. This increase in private savings exactly offsets the decrease in government savings due to the same

tax cut hence national savings is unaffected. If national savings does not change, real interest rate and investment will not change as such there is no need to borrow abroad. When public debt is sold to foreigners, surplus savings will go abroad to buy foreign securities, net capital inflow is zero hence no effect on exchange rate and current account balance. Ultimately, the Ricardian economist postulates that the government should borrow from the public and abroad to finance any given level of expenditure because deficit is just a symptom.

They are criticized on the point that there is a need that the public expenditure should benefits the future generation. The present generation should pay the taxes while the debt finance will spread the burden over present and future as long as the maturity is long, hence avoiding excess burden on the present generation. Moreover, a generation cannot be separated from another clearly since they overlaps. Additionally, debt future generation implications are not easy to determine and finally, a test needs to be conducted since one can expect present generation savings to increase government debt.

2.2.3 Neoclassical View

The Neoclassical economists saw government deficit as structural deficit and mentioned that it affects interest rates on private investment. To them, deficit occurs when government borrows from the public or foreign sources to finance its expenditures. When government competes with other borrowers to borrow funds, this causes an upward pressure on interest rate which crowd out private investors who are competing for the same funds. In the long run, deficit reduces the stock of private investment, hence economic growth. But if the government invests the borrowed funds, it produces capital, and then the burden of debt on future generation is reduced.

When funds to finance the deficit are obtained from abroad, it becomes an additional debt serving problem since debt interest has to be paid alongside the principal amount. This constitutes a transfer from domestic country to individuals living abroad thus affecting the domestic citizens. Deficits put pressures on the government; this pressure may make the monetary authority to monetize the debt. Monetization will cause money supply to increase hence causing inflation in the economy. Also, large deficit may cause government to default.

Given the time path of government expenditure, households will experience a positive net wealth effect that stimulates consumption and private savings, hence a decline in national savings. In a closed economy, real interest rate will go up and investment will reduce while in an open economy, capital inflow will be induced through an appreciation of the exchange rate and deterioration of the current account. In this case, the future standard of living will be affected negatively through retardation of domestic capital accumulation or through growing foreign indebtedness. Government debt represents an alternative which can be used to satisfy the assets producing income for the economy. Therefore, public debt crowds out private assets lowering the economy's capital stock. The Neoclassical economist believes that when the government borrows from the country or abroad, it affects the economy of the country.

2.2.4 Debt Sustainability

Debt sustainability is when a country can service its debt without building up protracted arrears. It can be seen as a short, medium and long term concept. Government debt sustainability is when the government is able to service its accumulated debt at any point in time, as such; it has to be solvent and liquid. In this regard, solvency is when the net present value of government's future primary balance is as high as the net present value of the outstanding government debt in the medium to long term. Furthermore, liquidity is when the government has the ability to maintained access to financial markets hence ensuring its ability to service all upcoming obligations in the short term. The different theories on sustainability of debt are discussed below.

2.2.4.1 Inter-temporal Budget Constraint

Inter-temporal budget constraint (IBC) requires that the total government spending must be within the funds available for it over some long period. According to Salvi (2011), the IBC starts with a public sector income statement with one period budget constraint which explains the evolution of the net debt as

$$B_{t+1} = (1+r)B_t - PB_{t+1} \tag{2.1}$$

where B_t is the stock of public net debt, r is the interest rates, PB_t is the difference between revenue and expenditure excluding interest expenditure. The IBC becomes

$$B_t = \sum_{i=1}^{\infty} (1+r)^{-i} PB_{t+1} \quad . \tag{2.2}$$

When IBC is analyzed in the context of per GDP measures, the equation becomes

$$B_t = \sum_{i=1}^{\infty} (1+g/1+r)^{i} PB_{t+1} \quad . \tag{2.3}$$

where g is the GDP growth rate. The IBC shows that the present value of the flow of primary balances must be equal to the present stock of net debt. The government debt should be backed by the expected future cash flow.

Burnside (2004) added the IBC fiscal sustainability analysis is based on government budget constraint with the following identity:

Net issuance of debt = interest payment – primary balance – seigniorage **(2.4)**

where by net issuance of debt is gotten by subtracting any amortization payments made in the period from the gross receipts from issuing new. The identity can be express mathematically as

$$B_t - B_{t-1} = I_t - X_t - (M_t - M_{t-1}) \tag{2.5}$$

where B_t is the stock of public debt at the end of the primary balance (revenue – noninterest expenditures) and M_t is the monetary base at the end of the period t.

A life time budget constraint is derived with the assumptions that time is discrete, debt is real, debt issued at $t-1$ pays a real interest r_{t-1} and debt has a maturity period. With these assumptions, the lifetime budget constraint is gotten as

$$b_{t-1} = \sum_{i=0}^{\infty} (X_{T+1} + \delta_{t+1}) / R_{t-1}^{\;t+i-1} \tag{2.6}$$

where by b_t is the end of period t stock of real debt, X_t is the real primary surplus, δ_t is the real value of seigniorage revenue and $R_{t-1}^{\;t+i-1}$ is the summation of $(1+r_t)(1+r_{t+1})...(1+r_{t+i})$ with an impose condition.

Bagni (2004) disagrees with the IBC and says that it is just an imposed constraint by the creditors to the debtors.

2.2.4.2 Model-Based Sustainability

Bohn (2005) disagrees with the IBC in sustainability analyses and introduces the Model-Based sustainability (MBS) where it generalizes the IBC to a world of uncertainty. It is assumed that the creditors are optimizing agent so that the government does not have a negative debt in the long-run and that financial markets are complete. The model based sustainability criterion is as

$$B_t = \sum_{n=0}^{\infty} E_t(U_{t,n} PB_{t+n}) \tag{2.7}$$

where $U_{t,n}$ the economy is the pricing kernel for contingent claims and PB_{t+n} is the difference between revenue and expenditure excluding interest expenditure. The MBS criterion differs from the IBC in its future surpluses which depends on the distribution of primary surpluses across the states nature.

2.2.5 Cobb Douglas production function of government debt

According to Engen and Glenn (2004), the Cobb Douglas production function is used to explain the effect of changes in government debt on interest rates where interest rate is determined by the Marginal Productivity of Capital (MPK) which could increase if capital decrease or crowded out by government debt. The function

$$Y = AK^{\alpha} L^{(1-\alpha)} \tag{2.8}$$

where by interest rates is determine by

$$r = MPK = \alpha * (Y / K) = \alpha * A * (L / K)^{1-\alpha} . \tag{2.9}$$

If government debt completely crowds out capital, so that $\partial K / \partial D = -1$, then exogenous increase in government debt causes the interest rate to increase. This theoretical framework shows that change in interest rate is affected by the government budget deficit which is equal to change in government debt. Secondly, interest rates in credit markets are influenced by factors other than government debt. Also, interest rates are affected by labour and influence output.

Engen and Glenn (2004) view government debt as government budget deficit which can be used interchangeably.

2.3. EMPIRICAL LITERATURE

This section provides an extensive literature review on sovereign debt. In particular, two main subsections are considered. Firstly, we review studies related to our main aim of estimating a debt model for Greece from the period 1976 to 2010. In this regard we concentrate on studies related to sovereign debt and those that contribute to the body of literature with respect to selecting appropriate variables, understanding the relationships between the variables, identifying various methods and their advantages and disadvantages. Secondly, we extensively review the literature in terms of the evolution, causes, consequences and cures of the Eurozone sovereign debt crisis.

2.3.1 Studies on Sovereign Debt

Budina *et al.* (2005) studied the determinants of public debt in 15 market access countries. The determinants of public debts to GDP ratios were primary deficit as a share of GDP, real GDP growth, real interest rates, real exchange rates and inflation. The method used was the public debt decomposition, the framework analyses the public debt trend between 1990 and 2002 by decomposing past changes in public debt-to-GDP ratios into a number of explanatory factors. Result show that public sector debt decreases due to increase in real GDP growth, real exchange rate appreciation, fiscal surplus, reduction in real interest rate. Similarly to the study of Budina *et al.*, our study used the independent variable inflation. However, unlike the aforementioned study, Greece is experiencing a deficit but not a surplus. Furthermore, our methodology and timeframe differs from the public debt decomposition framework.

Sinha *et al.* (2011) conducted a study of the determinant of public debt for middle and high income group countries using panel data regression. The data was from 1993 to 2008 for high income group countries and 1980 to 2008 for middle income group countries. They estimated a model using the Indian market, where their dependent variable was public debt to GDP of the country and their independent variables were: current account balance, central government

expenditure, long term interest rate, and real GDP growth rate, Inflation at consumer price, Foreign Direct Investment (FDI) and population density. The result shows that all variables except current account balance and population density was significant, the adjusted R square was less. They added auto regressive terms of the variables, the results shows that inflation, interest rate, population density, FDI and expenditure are insignificant while current account and GDP growth are the only two variables that significantly affect total debt of the middle income group countries when using the auto regressive model. Their total debt is negatively related to GDP growth while current account is positively related to total public debt. For the high income group countries, the auto regressive model shows that the total debt depends on the GDP growth rate while other variables are insignificant. Our work added government deficit, savings and drop population density, FDI, central government expenditure and interest rates as independent variables, our method will be VECM and not panel data. Interestingly, this study by Sinha *et al.* had a positive significant relationship between public debt and current account for low income countries when they used an auto regressive model.

Hsing (2010) examined the long term interest rate in Poland with sample of 2001Q1 to 2009 Q1 using loanable fund model of an open economy. The result shows that government debts as a percentage of GDP leads to higher long term interest rates in Poland, while in the case of Greece Hsing (2010), studied the government debt and long term interest rate in Greece. He used the extended open-economy loanable funds model to examine whether the Greek long-term interest rate would be affected by government debt and other related macroeconomic variables. The dependent variable is government bond yield while the independent variables are: real short term interest rates, real GDP, government debt to GDP ratio, expected inflation, nominal effective exchange rate. His sample size was 2000Q2 to 2009 Q2. Results show that, increase in government debt to GDP ratio will increase government bond yield while increase short term interest rates, increase percentage change in real GDP, increase expected inflation rate, increase EU government bond yield and increase effective nominal exchange rate would increase the government bond yield. This result was similar to that of a close economy loanable funds model but the explanatory power was lower. In contrast to the study by Hsing (2010), we used the VECM, variance decomposition and the GIRF to investigate the determinants of the Greek debt crisis. In addition, our data will be annual and not quarter.

Pattillo *et al.* (2002) used a multi regression analysis to test whether debt and per capital growth are related. They used a three years average panel data for 93 developing countries for the period 1969 to 1998. The result shows that reasonable levels of external debt that help finance production investment may be expected to enhance growth but beyond certain levels, while additional indebtedness may reduce growth. Debt has a nonlinear effect on growth; the average impact of debt on per capital growth is negative for debt level of 35-40 % GDP. Similarly, and as alluded earlier, we used the same annual data but our method will be the VECM to analyze the relationship between general government debt and its determinants. GIRF will be employed to focus on the impact of our independent variables on general government debt.

Checherita and Rother (2010) postulated that high long term interest rates resulting from more debt financed government budget deficit can crowd out private investment, thus reducing output growth. They investigated the relationship between government debt to GDP ratio and per capital GDP growth rate in a sample of 12 euro area countries using a linear regression. They got data from European commission AMECO database covering the period 1970 to 2011. Their variables were: growth rate of GDP per capital, the GDP per capital, gross government debt as a share of GDP, savings as a share of GDP. Their result shows a highly significant nonlinear relationship between the government debt ratio and the per capital GDP growth rate for the 12 euro area countries. They also investigated the impact of the government debt to GDP ratio on potential GDP growth; they found the same concave relationship with the variables debt and debt squared highly statistically significant across all models and with debt turning point in broadly similar range. They concluded that there is evidence of a nonlinear impact of debt on per capital GDP growth rate across twelve euro area countries over a long period of time starting from 1970. It reveals a concave relationship between the public debt and the economic growth rate with the debt turning point at 90 to 100 % of GDP. The government budget deficits are found to be linearly and negatively associated with the growth rate of both real and potential output. The fact that the change in the debt ratio and the budget deficits are linearly and negatively associated with growth may point to a more detrimental impact of the public debt stock even below threshold, hence targeting a higher stock even below threshold hence targeting a higher debt level to support growth is not a policy option.

Yue (2010) says sovereign debt borrowing is associated with recurrent debt crisis. Since there is no international bankruptcy law that exists, a defaulting country and its lenders usually renegotiate over the reduction of the defaulted debt to resolve a debt crises. He said that because sovereign debt crisis have a great impact on borrowing countries and on international capital markets, it is important to understand sovereign default risk and the role of debt crisis resolution in sovereign debt markets. He investigated the interaction between default and debt renegotiation with a dynamic borrowing frame work, they found that debt recovery rates decreases with indebtedness and in turn affect the countries ex ante incentive to default.

Scheclrek (2004) explored the relationship between debt and growth for a number of developing and industrial economies. The result shows that total external debt levels are lower when growth rates are high where by this negative relationship is driven by the incidence of public external debt. They used the system GMM dynamic panel econometric techniques with panel data for the period 1970 and 2002 with an average of 5 years. There is a significant negative relationship between total external debt and economic growth for the developing countries. The result of the industrial countries shows that they were no robust linear and nonlinear relationship between gross government debt and economic growth. This is contrast to that of the developing countries.

2.3.2 Evolution, Causes, Consequences and Cures of the ESDC

The ESDC is unique due to the diversity of countries, policies, cultures and financial systems involved. We will discuss how this crisis evolved in different countries in the Eurozone, their causes from the point of view of different authors, the consequences of this crisis and finally the cures which were implemented at the beginning of the crisis and some of the proposed cures.

2.3.2.1. The Evolution of the ESDC

The evolution of the ESDC varies for different countries. In this section, we consider how this crisis evolved in Portugal, Ireland, Italy, Greece and Spain (PIIGS). Table 2.1 below highlights the starting point of the ESDC in the PIIGS countries.

Table 2.1 Starting Point of the ESDC in the PIIGS Countries

	PORTUGAL	IRELAND	ITALY	GREECE	SPAIN
Starting point	The GFC and the deterioration in trade balance	Huge real estate bubble at the origin of the crisis.	Slow GDP growth of 1 % per annum from 2000 to 2007, as compared to the Eurozone countries	From the US subprime crisis in 2007 with a 25 basis point	Fall in housing prices from 2007 after the GFC
Literature	Armingeon & Baccaro (2011)	Armingeon & Baccaro (2011)	Anand *et al.* (2012)	Arghyrou & Tsoukalas (2010)	Anand *et al.* (2012)

In the sequel, details of the evolution of the crisis in each country are discussed.

2.3.2.1.1 Portugal

Armingeon and Baccaro (2011) argued that Portugal shares similarities with Greece in regard to the economic crisis and its repercussions for its fiscal position. The debt and public deficit of Portugal increased due to the Global Financial Crisis (GFC) and the deterioration in trade balance.

Anand *et al.* (2012) provides statistics about the Portuguese fiscal deficit from -3.1 % in 2007 to -10 % in 2009 and the public debt of 68 % of GDP in 2007 to 83 % in 2009. The downturn in GDP growth for Portugal was one of the mildest compared to the rest of the Eurozone. Portugal, however, has a large external current account deficit and external debt because of large private sector borrowing.

According to Armingoen and Baccaro (2011), the Portugal socialist government failed to secure a majority in support of the austerity measures suggested in March 2011. This caused them to step down with an early election taking place on the 5th of June 2011 where the majority conservative party and another conservative party obtained the majority of parliamentary seats.

According to Calice *et al.* (2011), the bailout package for Portugal in May 2011 was valued at €78 billion. Armingeon and Baccaro (2011) mentioned that this bailout had extensive conditions which were to freeze the public wages and pensions until 2013, levy pension, increase taxes, reduce the number of civil servants in government, regional and at local levels as well as to reduce spending on defense, state owned enterprises, regional and local government.

2.3.2.1.2 Ireland

Anand *et al.* (2012) reiterates that from 2002 to 2007, Ireland had low interest rates leading to a rapid expansion of credit and property valuations. This was as a result of a rise in mortgage origination that was accompanied by banks relying heavily on wholesale external borrowing. The Irish banks came under duress in 2007 when property prices decreased.

According to Whelan (2011), after 2003, the Irish banks increased their property lending at rapid rates and financed much of this expansion with bonds issued to international investors. International bond borrowing of the six main Irish banks rose to almost €100 billion by 2007. The Irish banks also built up huge exposures to property developers, many of whom had made fortunes during the boom and doubled down on property with even more extravagant investments.

Armingeon and Baccaro (2011) added that Ireland had a huge real estate bubble at the beginning of the SDC which was caused by the rapid expansion of bank balance sheets when the real estate boom was being financed. Ireland's debt crisis can also be ascribed to excessive buildup of bank lending which turned into a fiscal problem and not public debt as in the case of Greece.

In 2008, Irish construction investment collapsed and international investors became concerned about the exposure to property investment loans by Irish banks. By late 2008, when the world economy entered a severe recession, the Irish government implemented a sequence of contracting budget where total tax was to increase and spending was to decrease by €20.8 billion. This adjustment was the equivalent to 13% of the 2010 GDP level and was the largest budgetary adjustment made so far in any advanced economy. Despite this change, the Irish economy could not be stabilized because their banks had financed much of the housing activity in 2002. These banks turned to government for help by 2009, with the losses of the Irish banks being large -- especially at the Anglo Irish Bank. The government began using state funds to recapitalise the

guaranteed banks. The decline in bank equity resulted in most national banks experiencing liquidity problems, tax revenue losses and an increase in social welfare payment as a result of the collapse in construction activity and an unemployment rate increase. In 2010, there was not only a budget deficit but Ireland was facing a large bill in relation to fixing its banking sector (Whelan, 2011).

A National Asset Management Agency (NAMA) was set up to issue Irish government bonds to the banks so that distressed property assets could be purchased at a discount. In September 2010, the government estimated that the Anglo Irish Bank cost the state about €30 billion. These costs were being converted through a promise note, but were later counted against Ireland's general government deficit in 2010. When the aforementioned bank could not find funding for the maturing bonds or replace the corporate deposits that began to leave the system, they turned to European Central Bank (ECB) for emergency funding. The amount borrowed from the ECB by the guaranteed banks increased from €36 billion in April 2010 to €50 billion in August 2010 and by September 2010 it was €74 billion. Because the bank ran out of eligible collateral used in obtaining loans from ECB, it allowed the Central Bank of Ireland to make emergency liquidity assistance loans (Whelan, 2011).

According to Armingeon and Baccaro (2011), Calice *et al.* (2011) and Anand *et al.* (2012), the Eurozone countries and IMF agreed on an €85 billion rescue package for Ireland in November 2010. It included measures to recapitalize and reduce the size of the financial sector. After the negotiations of the bailout package, the Irish government resigned in 2011 and the new government made timid attempts to put the issue of loan renegotiation on the European agenda.

According to Forelle and Stubbington (2012), due to the agreement by the European leader on the 29th of June 2012, Ireland may return to the international markets since their troubled banks may directly access the region's rescue funds. Ireland banks can be recapitalized directly on the Eurozone's fund without it being added to their government debt. This will help Ireland who was spending more than €60 billion which crippled its public finances funds to resolve its banking sector.

2.3.2.1.3 Italy

Anand *et al.* (2012) mentioned that the Italian economy had a slow GDP growth of 1 % per annum from 2000 to 2007, as compared to about 2 % for the Eurozone countries. It had a lower fiscal deficit of -4.6 % of GDP as compared to - 6 % for the Eurozone. In 2011, Italy's public debt was 119 % and external debt ratios 108 % with large private tradable debt which made rescue packages difficult to implement (see Anand *et al.* (2012).

According to Jones (2012), by September 2011, the credit agencies downgraded Italy's rating because of the high cost of borrowing and the indecisiveness of political leaders. The political fight in Italy made matters worse with the government undecided on when to refinance its obligations in the markets. The Italian government found out that it was borrowing at unsustainable high interest rates, which made the repayment of Italian public debt difficult.

Jones (2012) added that, Italy has been highly indebted in 2011; its debts have been to the public sector. Also, Italian 10-year bonds reached an unsustainable level in August 2011 where by Jean-Claude Trichet (ECB president) and Mario Draghi (Italian Bank governor) called for immediate measures to promote growth.

Erlanger and Geitner (2012) mentioned that Italy wanted to block €130 billion until pressure is removed on the other economies, as a result of this, on the 29 June 2012, the leader of the European countries agreed that the continent's bailout funds be used to recapitalize struggling banks. This will help in stimulating the financial markets but Germany may suffer since its tax payers will be at risk. Italy will receive the bailout funds but it will not be added directly to their sovereign debt.

2.3.2.1.4 Greece

According to Alogoskoufis (2012), Greece initiated a fiscal consolidation and structural reforms program in 1990. In 2000, it became a member of the Eurozone. Greece did not have any difficulties in refinancing its debts from 1990 to 2008 thus stabilizing them. From 2001 to 2008, its growth rates increased, unemployment decreased, public debt to GDP ratio was stable at 100%. Greece began to face difficulties in debt refinancing when its government bond spreads over comparable German government bonds from about 30 basis points in 2007 to 285 basis

points in March 2009. Arghyrou and Tsoukalas (2010) agreed with Alogoskoufis (2010) and added that the starting point of the Greek crisis is from the US subprime mortgage crisis.

Alogoskoufis (2012) added that the main reasons for the crisis in Greece was high public debt levels, large government deficits and the adoption of fiscal problems by the new 2009 government. Movrogordatos and Marantzidis (2010) added that when a new government took over, they accused their predecessor of concealing a deficit of 13 % and rising debt. Armingeon and Baccaro (2011) mentioned that Greece started to have problems when they became a Eurozone member on the basis of fake public finance statistics.

After the 2009 elections, the Greek fiscal deficit worsened and the economy entered into prolonged recession. This caused speculation with Greek bonds and by April 2010, Greece was excluded from international financial markets. Specifically, when the budget failed to convince the markets in 2009, the bond spreads started to rise from 235 basis points in December 2009 to 477 basis points in April 2010. Also, bonds were continually downgraded by rating agencies. By the end of March 2010, the Greek government could no longer refinance its maturing debts or raise new capital. In 2010, the Greek economy threatened to destabilize the Eurozone and slow down the recovery of the European economy from the recession of 2009. Alogoskoufis (2012) mentioned that in November 2011, the Greek prime minister resigned and an interim coalition government was formed.

Armingeon and Baccaro (2011) said that Greece is facing both economic and political challenges and that Greece had to default if the European Union (EU) and IMF did not pour huge amounts of money into the country. Also, Armingeon and Baccaro (2011) explained that in May 2010, Greece requested a 3 years agreement from the IMF, ECB and European Commission. The IMF contributed €30 billion while other Eurzone partners added 80 billion Euros. Anand *et al.* (2012) and Calice *et al.* (2011) confirmed that on 2 May 2010, the EU and IMF gave a bailout package of €110 billion to Greece which will be followed by implementation of the austerity measures.

According to Armingeon and Baccaro (2011), on the 9 May 2010, the following measures were implemented in Greece. They included wage decreases in the public sector, freezing pensions until 2013, reforming the pension scheme, increasing indirect taxes, stopping minimum wages and facilitating collective dismissal. These austerity measures were observed but still Greece

could not improve its public finance. Alogoskoufis (2012) concurs and added that alongside the first bailout package, the European Financial Stability Facility (EFSF) was created to issue bonds or other debts instruments in the markets. In October 2011, private investors agreed to take a 50% cut on the face value of bonds and not the 21% that was agreed upon in July 2011.

According Castel (2012), Greece was granted a second rescue package of 130 billion Euros in 2012. The package was authorized to be released in installments with the first being €39.4 billion in loans. This amount will be disbursed from the Eurozone's temporary bailout fund known as the EFSF.

According the Nellas and Becatoros (2012), Greece voted to stay in the Eurozone in June 2012 after the New Democracy Party won the elections and the pro-bailout parties won enough seats to form a joint government. The new leader Antonis Samaras mentioned that the Greek people voted for Greece to remain in the European path and in the Eurozone.

2.3.2.1.5 Spain

Anand *et al.* (2012) reiterates that the Spanish economy witnessed a real estate boom with construction representing about 16 % of GDP. After the GFC, housing prices fell significantly from 2007, there was a rise in the levels of personal debt as the real estate boom collapsed, tax revenues decline and deficits soared. Also, the budget position moved to a deficit of over 11 % in 2009 and interest rates on lending to companies and other categories increased. The Spanish banks relied heavily on wholesale finance from abroad.

According to Sandoval *et al.* (2011), the GFC caused Spain's investment, export and private consumption to decrease. The aforementioned contribution mentioned that Spain's unemployment rate increased to about 20 % alongside its government deficit from 2 % of GDP in 2007 to 11.0 % in 2009.

According to Carballo-Cruz (2011), the Spanish economy experienced a recession in the last quarter of 2009 where GDP fell to about 6.3%, unemployment increased from 8.3 % in late 2007 to 20.1 % in late 2010, housing investment decreased by about 41%. Carballo-Cruz (2011) reiterated that a fiscal consolidation process was initiated in Spain which reduced their public expenditure on GDP ratio by eight tenths. By April 2011, the government submitted a new

stability programme where it has to reduce public deficit by 3 % of GDP by 2013, public debt to 70 % of GDP by 2012-2013, spending by 65% and consumption by 35%.

Erlanger and Geitner (2012) mentioned that on the 29 June 2012, the leader of the European countries agreed that the continent's bailout funds be used to recapitalize struggling banks of Spain. Spain was to receive the bailout funds but this was not be added directly to their sovereign debt. Clenning (2012) added that the bailout of Spain can be about €100 billion which will be put directly in the banks and not through government hence the government will not be at risk to pay loans not paid by their banks. Also, the funds would be able to buy government bonds hence reducing high interest rates demanded by investors.

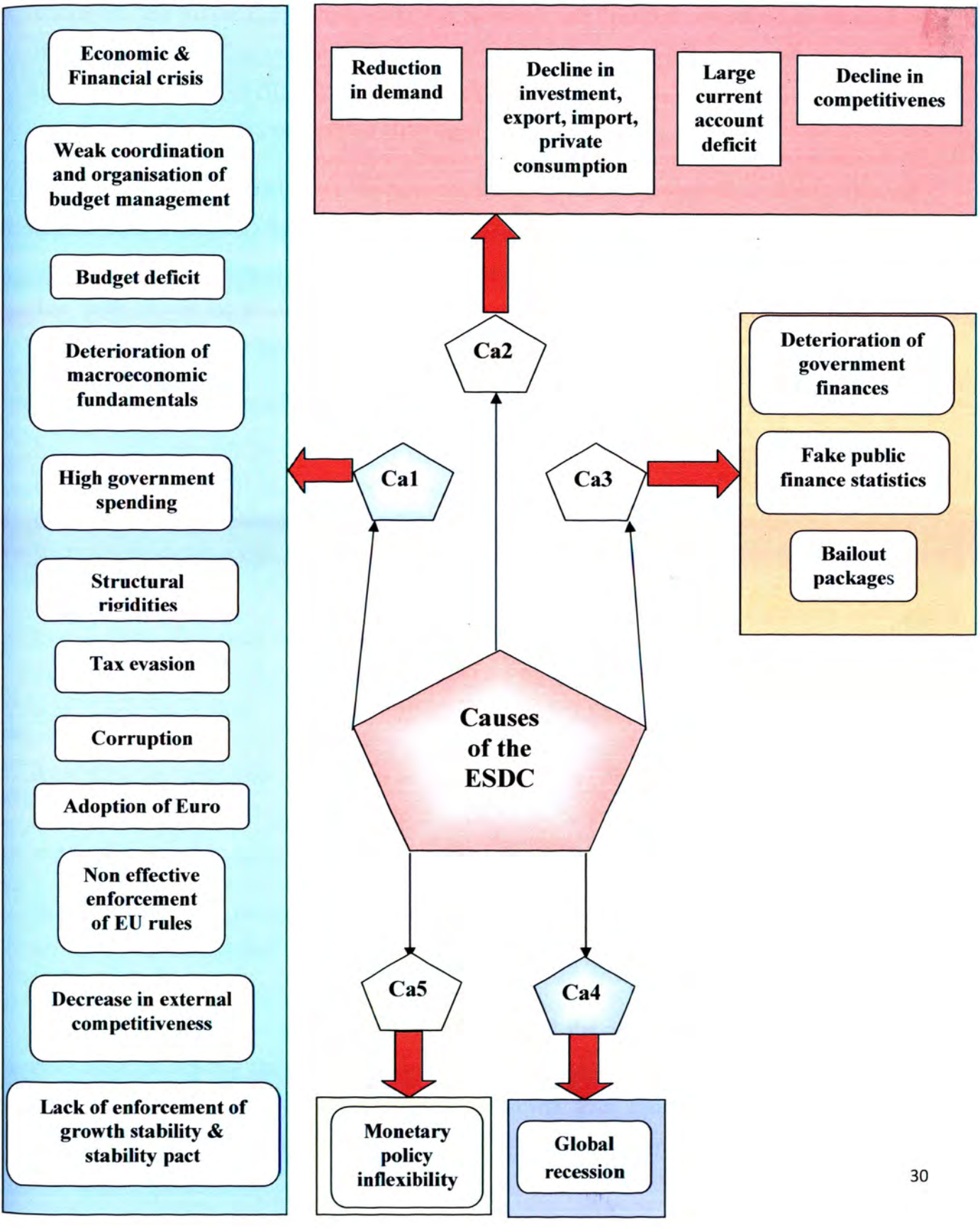
2.3.2.1.6 Summary of PIIGS Countries Government Debt

In Figure 1.1 above, data from the IMF was analyzed using a statistical software package called EViews 7. This figure demonstrates how the government debts have changed over the years. In particular, the graphical analysis demonstrates that from 1990, Greece, Ireland and Italy have been in debt where their debt to GDP ratio was more than postulated in projected stability and growth paths. By 1994, the debts of Ireland started to decrease significantly until 2007 when it started to increase again. As for Greece and Ireland, they exhibited a slight fluctuation from 1994 to 2006. In 2007, the total debt to GDP ratio of all PIIGS countries increased with Greece being worst with a debt to GDP ratio of 142.02 % in 2010 followed by Italy with 119.01 %. Spain and Portugal have complied with the stability and growth pact of 60 % debt to GDP ratio from 1990 to 2004. In 2005, Portugal had a debt to GDP ratio of 62.75% which is above the pact. On the other hand, Spain was still within the pact until 2010 with debt to GDP ratio of 60.11%. We conclude that in 2007, all the PIIGS countries experienced a rapid increase in their total government debt due to the GFC followed by the debt crisis.

2.3.2.2 The Causes of the ESDC

This section encapsulates the most prominent causes of the ESDC. Specifically, these include: rising government debt (Ca1), trade imbalances (Ca2), monetary policy inflexibility (Ca3), loss of confidence (Ca4) and global recession (Ca5) as shown in Figure 2.2 which is explained in detail below.

Figure 2.1 Causes of the Eurozone Sovereign Debt Crisis



2.3.2.2.1 Rising government debt

Checherita and Rother (2010) mentioned that economic and financial crises have contributed to the accumulation of government debt. As a result, the Eurozone government deficit ratio increased from 0.6% of GDP in 2007 to 6.6% of GDP in 2011, while the gross government debt ratio increased from 66% to 88.5% of GDP during the same period.

According to Akram et *al.* (2011), the major causes of the ESDC were the weak coordination and organization which were evident in the budget management process. This system did not allow the tracking of spending effectiveness due to overabundance and ambiguity in the budget lines. The cause behind the deficit was the amplified consumer demand resulting in high volume of manufacturing imports (see, for instance, Rossi & Aguilera (2010)).

Estenssoro (2010) mentioned that government budget deficit in the Eurozone moved from 2% of GDP in 2008 to 6.3% in 2009. This contributed to an increase in the gross debt-to-GDP ratio from 69.4% in 2008 to an estimated 84.7% in 2010 hence violating the Eurozone's deficit-to-GDP requirement. Portugal, Ireland, Greece and Spain lacked credibility with the financial markets and were unable to correct the problem on their own. In response, yields on the debt issued by the Portugal, Ireland, Italy, Greece and Spain (PIIGS) rose sharply against yields on German debt. This made the PIIGS' existing budget deficits more expensive and limited their ability to issue new debt hence forcing Greece to ask for emergency financial assistance from the IMF on 23rd April 2010.

According to Arghyrou and Tsoukalas (2010), steady deterioration of macroeconomic fundamentals from 2001 to 2009 led to the ESDC. Also, there was a double shift in market expectations, from a regime of credible commitment to future EMU participation.

Nelson *et al.* (2011) mentioned that the causes of Greek sovereign debt crisis involved both domestic and international factors. Domestic factors that contributed to Greece's accumulated debt are high government spending, structural rigidities, tax evasion and corruption while international factors were the adoption of the Euro and the non-effective enforcement of EU rules aimed at limiting the accumulation of debt. Furthermore, Nelson *et al.* (2010) added that the lack of enforcement of the Stability and Growth Pact contributed to an increase in government debt levels. The adoption of the Euro as its national currency in 2001 by Greece has

contributed to a buildup in debt since they could enjoy the benefit of borrowing at favourable interest rates; this encouraged them to borrow more.

According to the Bank of Thailand inflation report (2011), Greek SDC was caused by: the lack of fiscal discipline due to populist welfare policies, mismatched government revenues and expenditures, a decline in Greece competiveness relative to other countries in the Eurozone of more than 25 % from 2000 and the expenses incurred by the Greek government to stimulate the economy. After the GFC in 2008, this contributed to a large fiscal burden and loss of confidence by investors in the repayment of the government ability.

According to Kouretas and Vlamis (2010), the endogenous factors causing the SDC in Greece was as a result of high public deficit and a decrease in external competitiveness which affected its fiscal policy. Also, it was caused by the increase in expenditure which caused high levels of accumulated public debts. Exogenous factors include the failure of the Eurozone government to support Greece, the lack of solidarity funds at the European Union level and the global crisis of 2007 which affected Greece and its major trading partners in the Balkan Peninsula.

According to Whelan (2011), the primary causes of the Irish SDC is the fall in construction activity and the rise in unemployment which led to a huge deficit whereby income tax revenues were lost and a rise in social welfare payment, the real GDP of Ireland decrease by 3.5 % in 2008 and by 7.6 % in 2009. Sandoval *et al.* (2011) adds that this unemployment rates increased from 4.5 % in 2007 to 13 % in March 2009.

2.3.2.2.2 Trade Imbalances

According to Artus *et al.* (2010), the presence of trading supremacy by countries like Germany in the EMU that enjoy both skill and technological competitiveness will make it hard for other EMU economies to manage excessive external account imbalances without undergoing deep slumps in the short run. The GFC resulted in a global reduction in demand, it reduced Italy's export, private consumption and output with the country's unemployment rate continuing to be the lowest amongst Europe's debt ridden nations. Spain experienced sharp declines in investment, export, import, private consumption, while weaker import and rising government demand provided some offset. Spain had a large current account deficit; bond yields are narrowing and are continuing to fall as of 6th April 2011 (Sandoval *et al.*, 2011). The bank of

Thailand's inflation report (2011) revealed that there was the decline in Greece competitiveness relative to other countries in the Eurozone.

Nelson *et al.* (2011) mentioned that declines in Greece's international competitiveness resulted in relatively high wages and low productivity. Greek exports to its major trading partners grew at 3.8% per year which was relatively lower compared to the rate of other countries' exports to the same Greek trading partners. Furthermore, Greece's crisis has brought to light imbalances within the Eurozone, whereby countries like Germany, have relied on exports for economic growth and pursued policies that aim to promote such export-led growth, such as wage moderation to keep the costs of production low and make exports competitive. By contrast, countries like Greece have had higher levels of wage growth and more expansionary fiscal policies, leading to less competitive exports and lower levels of savings.

2.3.2.2.3 Monetary Policy Inflexibility

Liu (2011) mentioned that the ESDC was rooted in the dysfunction of the monetary union without a political union. The ECB had no formal representation of all members of the Eurozone, governance and fiscal policy union. This caused the Eurozone member countries to lack authority over their common currency. Thus they were unable to use monetary measures such as devaluation of their common currency or lowering of interest rates to solve their debt problems.

2.3.2.2.4 Loss of Confidence

According to Calice *et al.* (2011), there was loss of confidence in 2008 because of the deterioration of Eurozone government finances. This loss of confidence resulted in the spread of credit between the Eurozone and Germany widening.

According to the Bank of Thailand inflation report (2011), during the GFC in 2008, Greece spent too much to stimulate the economy, this contributed to a large fiscal burden and loss of investor confidence in the government debt repayment abilities.

Armingeon and Baccaro (2011) said that Greece started to have problems when they became a Eurozone member on the basis of fake public finance statistics. The fake statistics contributed to decrease the confidence of investors hence leading to SDC.

According to Sandoval *et al.* (2011), speculation arose after Ireland's bailout that Portugal would also require a bailout, this caused investors to lose confidence and markets slashed Portugal's credit rating to near-junk status on 29 March 2011 while 10-year bond yields rose above 8 %.

2.3.2.2.5 Global Recession

Whelan (2011) mentions that in 2008 the global economy went into a recession, this caused the GDP of Ireland to decrease hence increasing its fiscal deficit.

According to Armanious (2011), the GFC affected the Greek financial markets by putting strain on many government budgets. In Greece, the GFC caused tourism and shipping revenues to decline rapidly. The Bank of Thailand inflation report said that the government of Greece spent too much to stimulate the economy during the 2008 GFC. This increased the fiscal burden and resulted in investors losing confidence in the ability of the Greek government to pay their debt. The global recession also wreaked havoc in other Eurozone countries.

2.3.2.3. Consequences of the Eurozone Sovereign Debt Crisis

The ensuing section identifies many consequences of the ESDC. Some effects are immediate while others will be felt later both in Europe and in the world at large. The Figure 2.3 below illustrates the primary consequences of the ESDC.

Figure 2.2: Consequences of the Eurozone Sovereign Debt Crisis

2.3.2.3.1 Bond Market

According to Ayadi (2011), the ESDC will affect the bond market by not allowing the weak peripheral EU countries to face redemptions on investors' claims leading to defaults with contagion effects. This crisis could destabilise the bond and credit derivative swap (CDS) markets, weaken the European banking system and consequently spread the distress to other European countries. Armanious (2011) added that Greek bonds were downgraded in November

2009 while the Greek and German 10-year bond spread reached 650 basis points because of this crisis.

2.3.2.3.2 Banking Sector

Liu (2011) said that the immediate effect of the ESDC is on the banking sector. The banks' funding conditions are affected by the low quality of government debt which weakened bank balance sheets, increased their riskiness, making funding more costly and difficult to obtain. Also, sovereign debt risk reduces the value of collateral that banks can use to increase wholesale funding.

According to Arteta and Hale (2008), the ESDC exacerbates negotiations on sovereign debt which causes credit to become expensive for domestic firms hence decreasing their borrowing. Also, the ESDC causes aggregate demand to decrease due to the tightening of monetary and fiscal policy. When the aggregate demand decreases, profit also reduces which may result in borrowing becoming more difficult. Firms may demand less credit since they accumulated inventory and produce less in the previous years. Moreover, when government postpones their discussion on debt restructuring, it strains the banking system hence putting strain on domestic liquidity and increasing the demand for foreign credit. The ESDC can cause reduction in foreign credit to private sectors by reduction in supply and demand for credit.

According to the Statistical Economic and Social Research and Training Centre for Islamic Countries (SESRIC) report on the GFC (2011), it was concluded that the ESDC caused a fall in market capitalization because foreign investors withdrew much of their investments from the countries where they invested in and also in developing countries. This caused the collapse of the financial system which affected the markets for capitalization.

Furthermore, Nelson *et al.* (2010) added that the EU and US have the strongest and largest economic relationship in the world. If any of the European countries default on their debts, the US banks lose out.

According to the Bank of Thailand inflation report (2011), Greek defaults cause capital losses to commercial banks in France and Germany of about 1.8% and 1.2 %, respectively, of total foreign

claims. Also, the spread of defaults may lead to credit crunches and make claims by foreign investors difficult since most of the Greek bonds are issued under their law.

According to Wright (2011), the primary benefit from default is the defaulting country can keep the resources that it would have paid its creditors while the direct cost of default on the economy of the defaulting country are: it may damage the domestic financial system by inducing a domestic banking crisis, hence domestic output will fall. The mechanism through which the domestic economy may be affected by a default is through international trade where the countries in default experience a significant decline in foreign trade which may indicate the imposition of trade sanction (Rose 2005).

2.3.2.3.3 Contagion

Nelson *et al.* (2011) mentioned that the Greek sovereign debt crisis will lead to contagion. According to Massa et al. (2011), this SDC will affect developing countries through financial contagion. Financial contagion in developing countries will be through intermediaries, stock markets and shifts in investor's sentiments and changes in their perception.

According to Liu (2011), if Greece defaults, the real danger lies in the possibility that it could set off a chain reaction. Greece's default would lead to a downgrading of the credit rating of the other PIIGS countries which will make it difficult for these economies to refinance their debt and could be expected to default in turn.

According to Levy and Panizza (2006), Strurzenegger and Zettelmeyer's (2007), empirical evidence shows that the direct costs of default are small and the length of time that countries in default are excluded from capital markets is short.

2.3.2.3.4 Interest Rates

Nelson *et al.* (2011) argue that the ESDC is associated with higher interest rates because investors will become increasingly nervous about the sustainability of some countries' debt. These cause interest rates for new bonds to increase, hence making it more difficult for those countries in debt to borrow and service their existing debt. Furthermore, Greek default could affect the U.S. commercial interests since Greece's debt held by US creditors is about $16.6

billion. Kelch *et al.* (2011) adds that, the ESDC problem would reduce the US long-term interest rates over a projected period.

Armanious (2011) reports that the Greek financial crisis in 2009 has caused interest rates to increase making the 10-year government bond yield to rise to about 12 % at the end of 2010. The spread of the 10-year bond widen from about 130 in 2009 to about 900 in 2010.

2.3.2.3.5 Export, Import and Depreciation of Euro

According to Massa *et al.* (2011), the ESDC might cause the Euro to depreciate against the US Dollar thus affecting the flow in developing countries. Currency pegged to the Euro may benefit from a weaker Euro that makes its exports more competitive in world markets while countries with Dollar-based exports will suffer from depreciation of the Euro against the Dollar. Also, a weaker Euro will cause people travelling from developing to developed countries to have lower purchasing power. Also, in the long run, decreasing exports and foreign investment in developing countries will affect the transfer of technology and knowledge in the long run. Kelch *et al.* (2011) concurred that the ESDC will cause the Euro to depreciate relative to the U.S. Dollar making the Eurozone exports cheaper in global markets hence increasing competitive pressure on U.S. exports.

According to Nelson *et al.* (2010), this crisis will cause the Euro to weaken. When the Euro is weaker, it will lower U.S. exports to the Eurozone and increase U.S. imports from the Eurozone, widening the U.S. trade deficit. Furthermore, it will make purchases and U.S. investments in Eurozone countries cheaper in Dollar terms, impacting trade and growth in the region. The EU is the US's biggest trading partner and hundreds of billions of Dollars flow between the EU and the US each year. This crisis could cause financial instability in the EU; and this instability may make the US more attractive to investors and encourage capital flows to the US.

According to the SESRIC report on the GFC (2011), the SDC will cause developed countries to reduce their imports of commodities and minerals exports hence reducing their GDP.

Arteta and Hale (2008) concluded that the ESDC can cause the Euro to collapse. This happens when the cost of production consists of more domestic currency, therefore less borrowing in foreign currency will occur. Since lending is then in foreign currency, this will reduce the

demand for foreign credit. Also, if a domestic market sells liabilities dominated by foreign currency, their net worth reduces and their borrowing constraints are tightened.

According to the Bank of Thailand inflation report (2011), the ESDC can have a dramatic impact on global currencies since the European market accounts for about one-third of the world's exports. Although Thai exports to the PIIGS countries, volatility in foreign exchange and stock markets worldwide will affect Thai's economy.

2.3.2.3.6 Investor Loss of Confidence

According to Nelson *et al.* (2011), the ESDC will cause the Euro to weaken; the weakening of the Euro will result in loss of confidence by investors.

According to Massa *et al.* (2011), the ESDC reduces investors' appetite for risk; this may delay or cancel investments and thereby reduces the portfolio flows to developing countries.

Liu (2011) suggested that if any of the Eurozone countries defaults, it will cause doubt in the Euro as a common currency and as a prime reserve currency for international trade.

The Bank of Thailand inflation report (2011) concluded that, the CDS of the PIIGS countries have been increasing thereby causing the financing cost of the nearby countries to increase. This rising financing cost will affect the ability of the government to repay their loans leading to default and hence loss of confidence.

2.3.2.3.7 Decreases in Remittances

According to Massa *et al.* (2011), this crisis will cause unemployment to increase hence leading to a decrease in remittances sent to developing countries. In the long run, the ESDC will cause a decrease in the import of manufacturing goods from developing countries. This will affect the manufacturing sector of the developed countries causing unemployment and poverty rates to increase.

According to the SESRIC report on the GFC (2011), this crisis will causes remittances to reduce because unemployment in develop countries will rise. Also, the political altitude of the government towards new immigration will be tightened hence reducing the remittances sent home.

2.3.2.3.8 Foreign Currency

According to Shiraj and Isam (2011), borrowing from the domestic source will cause resources to be transfered within the economy which may crowd out funds for the private sector while external debt brings new resources into the economy. If debt is dominated in a foreign currency in a case of emergency, it will be difficult for the government to monetize the debt.

2.3.2.3.9 Tightening of Fiscal Policies

According to the Bank of Thailand inflation report (2011), the Greek SDC will affect its citizens when its fiscal measures are tightened and in turn it could also affect global financial markets.

2.3.2.3.10 Political Impact

The ESDC has led to a premature end to a number of European national governments and affected the election outcome as follows.

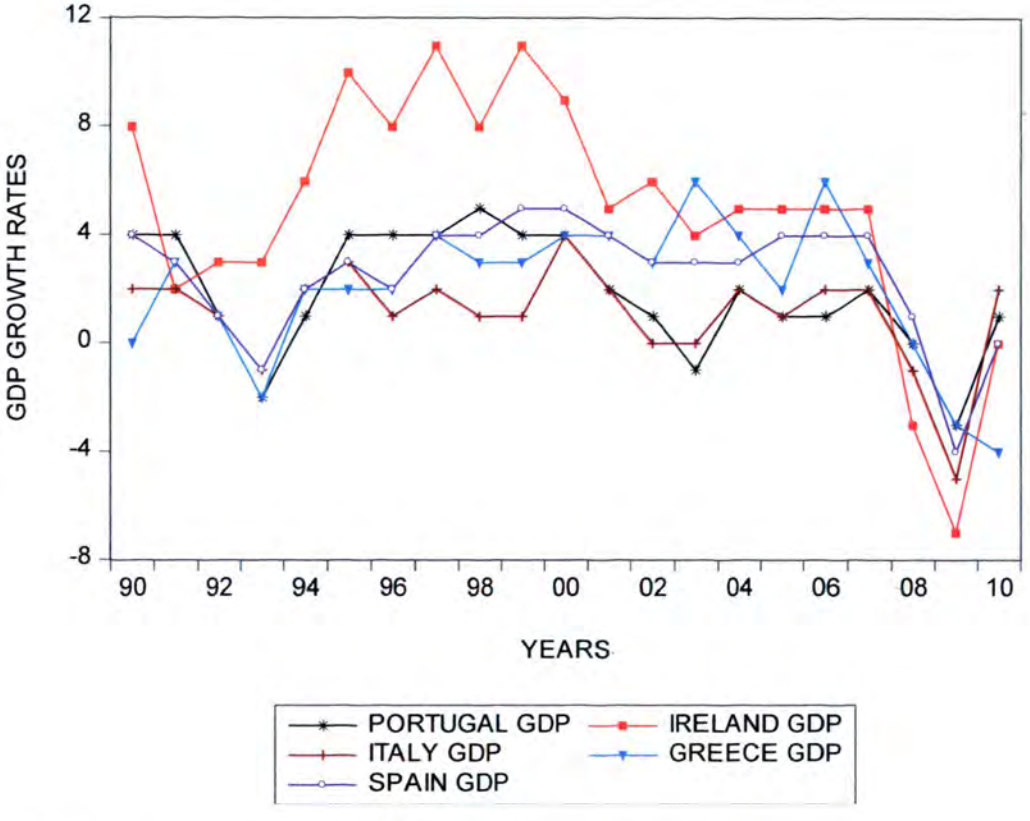
According to Armingoen and Baccaro (2011), the crisis caused the Portuguese Prime Minister, Jose Scretes, to resign after his government's austerity measures were rejected. These measures were intended to avoid a bailout package in March 2011 and an early election took place on the 5 June 2011 where by the major conservative party and another conservative party obtained the majority of parliamentary seats.

The Irish government resigned after negotiating the bailout package, and new elections were held in February 2011.

2.3.2.3.11 Decreases in Economic Growth

According to Kelch *et al.* (2011), the SDC causes investment to decrease, leading to a decrease in economic growth. Massa *et al.* (2011) adds that a decrease in growth may lead to a decrease in demand from commodities by the EU and an increase in unemployment. The figure 2.4 below represents GDP growth rates of the PIIGS countries from 1990 to 2010.

Figure 2.3: GDP Growth Rates of the PIIGS Countries from 1990 to 2010



SOURCE: *World Data Bank (World Development Indicator)*

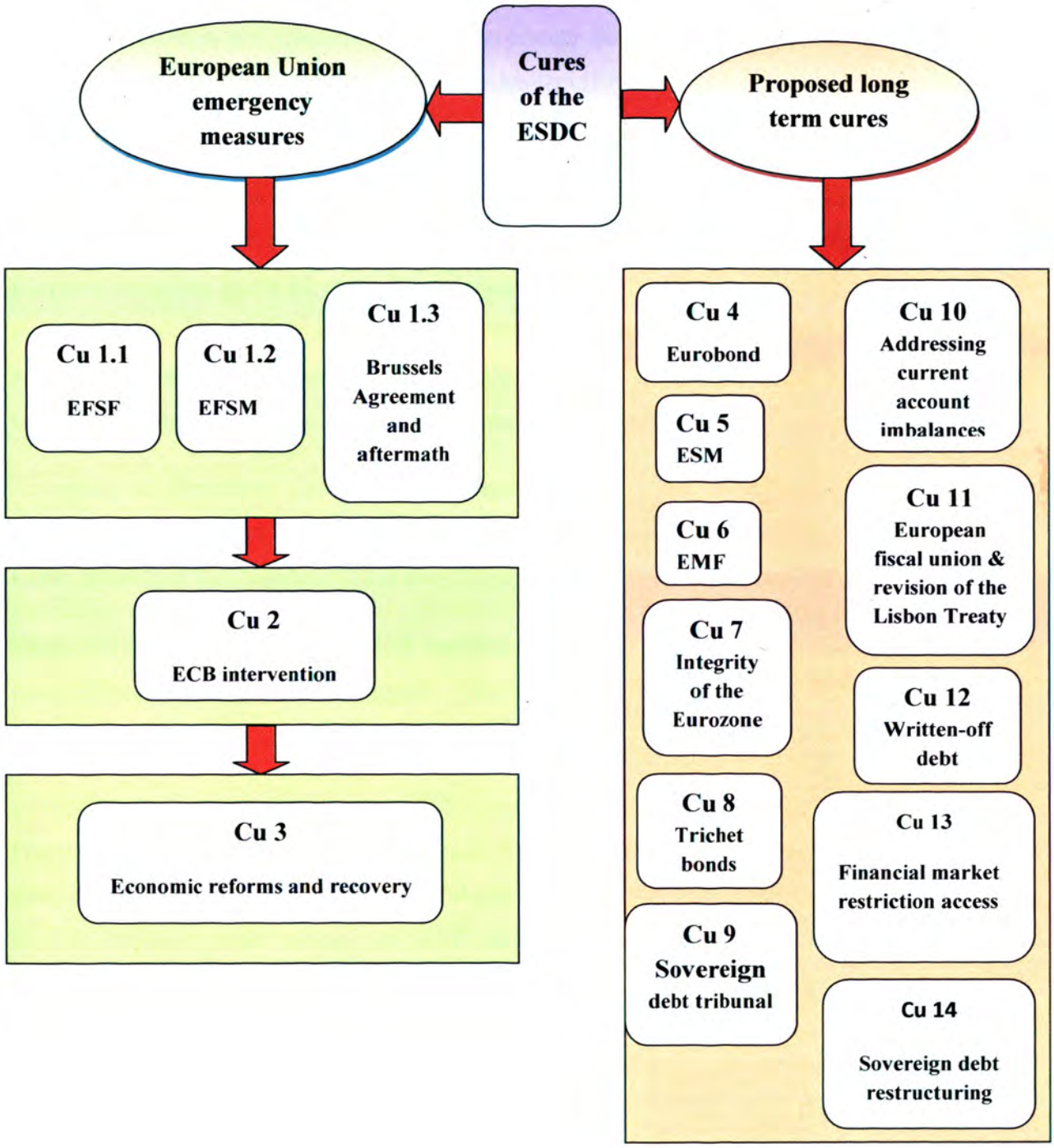
In Figure 2.4 above, data retrieved from the World data bank show that from 1994 onwards the GDP growth of the PIIGS countries have been fluctuating at a constant rate between 0 - 4 % with that of Ireland being between 8-11 %. In 2001, Ireland's GDP dropped and all the PIIGS countries fluctuated in the range 0 – 5 % until 2006. As from 2007 it started to decrease sharply with Ireland's GDP being the lowest at -7%. As from 2009, the GDP growth rate started to increase gradually as shown. The statistical package EViews 7 was used to display the aforementioned analysis. Before the Eurozone debt crisis began in 2008, the GDP of most PIIGS countries started to decrease in 2007 implying that the Eurozone debt crisis did affect GDP. We

conclude that the GFC in 2007 resulted in the decrease of GDP growth and this decrease was exacerbated by the SDC which started in 2008.

2.3.2.4 Cures for the Eurozone Sovereign Debt Crisis

Many cures have been suggested for the ESDC. During the crisis some solutions were implemented and many others were proposed to resolve the ESDC in the long term. According to Bedford *et al.* (2005), in 2002 the IMF proposed the creation of a Sovereign Debt Restructuring Mechanism (SDRM) to act as a formal resolution framework. It failed to attract sufficient support in 2003 and, instead, attention turned towards a market-based approach. In 2002, the IMF introduced the Exceptional Access Framework (EAF) to specify the conditions under which the fund will lend in excess of standard access limits. They mentioned two areas in which the clarity of IMF policies could be improved. These are the strengthening of techniques for assessing debt sustainability and the review of the LIA policy. These measures were preventative, but when the ESDC started, some suggested other measures had to put in place. Ultimately, some of the cures were implemented while others are still under consideration. Some of these cures are mentioned in Figure 2.5 below.

Figure 2.4 Proposed Cures of the Eurozone Sovereign Debt Crisis



2.3.2.4.1 European Union Emergency Measures

There are many emergency measures that have been put in place by the EU in order to fight the SDC. For instance, the measures put in place were the European Financial Stability Facility (EFSF), European Financial Stabilisation Mechanism (EFSM) and the Brussels agreement.

2.3.2.4.1.1 European Financial Stability Facility (EFSF)

Anand *et al.* (2012) and Calice *et al.* (2011) mentioned that the EFSF is a special purpose vehicle which was created on the 9th May 2010. Its objective was to preserve financial stability of Europe's monetary union by providing temporary financial assistance to the Eurozone countries that are in need. On 24 June 2010, government heads agreed to increase EFSF's scope of activity and its guarantee commitments from €440 billion to €780 billion. The bonds are to be guaranteed by the European commission, the Eurozone countries and the IMF.

According to Steinbock (2012), before December 2011, the EFSF had €440 billion at its disposal. Yet this was not enough to assist Italy or Spain. The EFSF resources were the first step to the creation of the Eurobonds that could fortify the Eurozone markets in the long run.

Begg (2012) points out that the EFSF consists of three EU levels of supervisory authorities and their respective national counterparts. The focus of the EFSF was on micro-prudential supervision of individual financial entities.

According to Kapoor (2011), the EFSF is backed by guarantees from member states in proportion to their ECB capital subscription. Each member state is responsible for 120 % of its share of EFSF commitments with the total size of the guarantee being €440 billion. In its effort to seek an AAA credit rating, the EFSF employs three tools which are the guarantee from Eurozone states, a cash reserve set aside from borrowers plus a service fee and a loan-specific cash buffer. The AAA rating comes from all borrowing being backed by either a guarantee from a AAA rated country or by AAA assets held by the EFSF. Kapoor (2011) finally recommended that the EFSF should shift to guarantee 40% of losses on new bond issues by troubled member states and target a lower AA rating. Also, the EFSF should seek a preferred creditor status. Finally, Kapoor (2011) suggests that the EFSF should lower the cost of support provision to a purely cost recovery basis.

2.3.2.4.1.2 European Financial Stabilisation Mechanism (EFSM)

According to the European Commission of Economic and Financial Affairs (2012), the European Financial Stabilization Mechanism (EFSM) provides financial assistance to EU member states in financial difficulties. Under EFSM, the Commission is allowed to borrow up to a total of €60 billion in financial markets on behalf of the Union under an implicit EU budget guarantee. Zandstra (2011) added that the EFSM was to defend the spreading of the ESDC. Also, the European Commission pointed out that the EU should bear no debt servicing costs on the lending arrangement. All interest and loan principal is repaid by the beneficiary member state through the Commission.

According to Zandstra (2011), EU borrowing under the EFSM will enjoy AAA/Aaa credit ratings. This is reflected by: borrowings which are direct, unconditional obligations and are guaranteed by the 27 member countries. In cases of default, the debt service will be drawn from the EU budget. There should be sufficient funds to meet the EU's obligations and investors are only exposed to EU credit risk, not to the loan beneficiary funded by the EFSM. The EFSM has currently been activated for Ireland and Portugal to the amount of €48.5 billion. Of this, Ireland can lend up to €22.5 billion and Portugal up to €26 billion with its inaugural bond issue on 5 January 2011 disbursed over 3 years.

Ayadi (2011) mentioned the boost in CDS supply in the market while exercising a downward pressure on the spreads through a CDS transformer. This process could benefit from an EFSF guarantee for a fee.

The EFSM and EFSF can only be activated after a request for financial assistance has been made by the member state and a macroeconomic adjustment programme, incorporating strict conditionality, has been agreed with the Commission, in liaison with the ECB.

2.3.2.4.1.3 Brussels Agreement and Aftermath

According to the Europe Summit statement (2011), leaders of 17 European countries met in Brussels and agreed that Greek debt should be written off by 50 %, the regulatory capital ratio should increase to 9 % in order to avoid banking and financial crises. Also, they agreed to increase the fund held by the EFSF to about €1 trillion.

According to Anand *et al.* (2012), on the 2 May 2010, the EU and IMF gave a bailout package to Greece of €110 billion on implementation of the austerity measures that came into effect on the 9 May 2010. This prevented Greece from defaulting and slowed down the spread of the crisis to other peripheral countries. Loans of about €110 billion were extended by the Eurozone and IMF. The former gave about 80 billion Euros while the IMF gave 30 billion Euros. When Portugal admitted that it could not deal with its finances in April 2011, the European Finance Ministers in May 2010 approved a €78 billion rescue loan. Moody's lowered Greece's credit rating to junk status in June 2011 from B1 to CAA1.

According to Castel (2012), a second rescue package of €130 billion was approved for Greece. It was authorized to be released in installments with the first being worth €39.4 billion. This amount will be disbursed from the Eurozone's temporary bailout fund called the EFSF.

According to Artus *et al.* (2010), Greece is facing a liquidity crisis while Spain and Portugal are facing solvency crises. The credit lines granted by other Eurozone countries or IMF will be helpful to Greece since it is having a liquidity crisis. However, lending to a country dealing with a solvency crisis does not solve anything.

2.3.2.4.2 ECB Intervention

According to the ECB Monthly Bulletin (2011), the ECB responded to the ESDC by lowering interest rates and introducing a number of non-standard monetary policy measures. These measures were put in place to maintain the transmission mechanism of monetary policy by support funding conditions for banks that will enhance the provision of credit to the private sector and keep contagion in financial markets under control. All non-standard measures taken by the ECB were designed to be temporary in nature and complemented via standard interest rate decisions. Because of the flexibility of the ECB's operational framework, decisions on non-standard measures were taken separately from those that raised the ECB's key interest rates from their low levels.

According to Gerlach (2010), the ECB has repeatedly adjusted its collateral requirements to ensure that Greece's public debt remained eligible. On 3 May 2010, the ECB announced its decision to suspend the application of the minimum credit rating threshold in the collateral eligibility requirements in the case of marketable debt instruments issued or guaranteed by the

Greek government. The ECB policy has decided to accept Greek public debt as collateral irrespectively of its credit rating in order to prevent the financial tensions in Greece from becoming a crisis. Also, it has purchased public debt in order to facilitate the functioning of those financial markets that play a crucial role in the funding of the Greek and a few other governments.

2.3.2.4.3 Economic Reforms and Recovery

According to the European Council (2011), EU members adopted a new reform aiming to straighten rules in the Eurozone. The European Council adopted measures to preserve financial stability, sustainability and social inclusion as well as job creation so as to strengthen economic governance and competitiveness in the Eurozone.

According to the Europe Submit statement in 2011, measures taken by Italy to increase their competitiveness are that they will: cut down red tapes, abolish minimum tariffs in professional services and liberalise more the local public services and utilities.

Nechio (2011) mentioned that there are discrepancies in balance-of-payments accounts, such as current account and trade balances in the Eurozone. Most countries on the periphery of the Eurozone have large current account deficits and trade balance, making them dependent on external investment capital. Labour markets are also an important source of disparity across the region, labour costs and productivity across countries varies, these divergences reflect differences in legislation, wage-setting mechanisms, and severance costs among member countries, this caused a gap in trade competitiveness between Germany and the Eurozone.

2.3.2.4.4 Eurobonds

According to Jones (2010), the issuance of a common sovereign bond will provide liquidity and avoid speculation in the market. Bonds coming from a central issuing authority would be the same and can be interchanged no matter the country issuing it. They would have to be limited by 60 % of GDP or a net increase of 3 % of GDP on an annual basis.

Zandstra (2010) mentioned that a common Eurobond will stabilize the market for government bonds which will create a market in size and liquidity comparable to the US Treasury Bill

market. It will also put an end to speculative attacks on the Eurozone thereby signaling that the EU stands behind its Euro projects.

According to Steinbock (2012), Brussels is now agreeing on the Eurobonds as stability bonds. They want to transfer a share of national debt issuance of between 40 to 60 % of GDP to the Eurozone while allowing the remainder at national level.

Ayadi (2011) proposed a three pillar rescue mechanism to solve the ESDC which is by stabilising the bond market and the CDS market as well as to recapitalise ailing banks. To stabilise the bond markets, a mechanism will be created that will combine cash and synthetic instruments. In the bond markets, distressed sovereign bonds will be purchase at haircut where by the mechanism will rely on a credit enhancement instruments to reissue new risk notes with a guarantee from the EFSF, EU member states and highly rated insurance companies. The EFSF can also buy high-quality bonds not necessarily from the EU to diversify its portfolio and lower the correlation. To stabilise the CDS market, the enhanced mechanism would either provide guarantees to a specialised arm that writes protection on ailing countries and distressed banks or would issue these CDS while building the necessary reserves over time. To recapitalise ailing banks, safer issuances can be used as collateral to obtain funding from the central banks. If it is necessary to recapitalise distressed banks, the mechanism could guarantee subordinated debt instruments of banks that can be eligible as capital.

2.3.2.4.5 Euro Stability Mechanism (ESM)

The European Stability Mechanism (ESM) is a permanent rescue funding programme to succeed the temporary European Financial Stability and European Financial Stabilization Mechanism in the 17-member Eurozone.

According to the ECB Monthly Bulletin (2011), the ESM is an intergovernmental organisation with a capital structure of €80 billion paid in capital of €620 billion. Its instruments are loans and bonds purchased on the primary market with a permanent mechanism from July 2013 onwards. The ECB will be involved in conducting debt sustainability analysis, programme design and monitoring as well as the paying agent. A meeting was held on the 28-29 October 2010 where the European Council agreed to establish a permanent crisis management mechanism to safeguard financial stability in the Eurozone as a whole. This would replace temporary solutions

such as the Greek loan facility, EFSM and EFSF from 1 July 2013 with any outstanding claims after July 2013 to be paid under the new facility. The ESM can only be activated if it can safeguard the stability of the Eurozone as a whole. The strict conditionality attached to assistance are necessary to limit the moral hazard implicit in a crisis management mechanism and to ensure that the existence of the ESM does not weaken incentives for sound fiscal and macroeconomic policies in Eurozone countries.

2.3.2.4.6 Euro Monetary Fund (EMF)

Schulmeister (2011) mentioned that the European Monetary Fund manages and coordinates the public finances of the Eurozone countries in order to overcome in a sustainable way the crisis in Europe. The EMF has the following functions: it provides financial means to Eurozone governments by the selling guaranteed Eurobonds in the capital market. Also, it stabilizes the interest rates of the Eurobond at a lower level. These bonds are held by EMF investors and are non-tradable but can be liquidated at any time. Furthermore, it restores in a systemic way the public finances of the Eurozone countries under certain criteria. Finally, overcoming the widening interest rates differentials will assist in solving the ESDC.

2.3.2.4.7 Integrity of the Eurozone

Artus *et al.* (2010) is of the view that leaving the Eurozone would worsen the crisis situation because borrowing in their local currency will entail paying very high interest rates as before they joined the Eurozone. This could lead to a default on public and private debts. In the case of a solvency crisis -- as in Spain -- growth will slow due to the collapse in construction activity and job losses. This makes it impossible to reduce fiscal deficits and to limit the increase in public debt size.

2.3.2.4.8 Trichet Bonds

According to Economides and Smith (2011), the European authorities' solution relating to the ECB's purchase of outstanding sovereign debt in the market (as of January 2011) had only succeeded in buying a small amount of the distressed debt whilst pushing bond prices upwards as a result of such intervention. Economides and Smith (2011) propose the creation of Trichet bonds as a comprehensive solution to the current ESDC. These bonds will be of long duration (30 years) and be issued by countries in the EU and will be held as collateral for the new

sovereign bonds to insure at least full payment at maturity. These bonds are to be issued at market interest rates but will be offered for old debt at market value. Countries issuing the Trichet bonds will purchase the zero coupon collateral bonds directly from the ECB.

Some advantages of "Trichet Bonds" are listed below. Trichet Bonds eliminate uncertainties with respect to refinancing distressed countries' maturing debt. Trichet Bonds will be of much higher quality than present sovereign debt of distressed countries and will be liquid. Trichet bonds will require no bailouts and imply no moral hazard while they will provide debt relief for distressed economies. The exchange is voluntary and beneficial to both countries and debt holders. Such Trichet bonds, indeed, would have provided a better alternative to the remedies announced by EU officials on 12 March 2011. Had Trichet bonds been considered as an initial resort, and given the existence of appropriate and adequate incentives for countries issuing such bonds, as well as debt holders to participate in the exchange process, they could have served as better initial options than the subsequent European bailouts.

The likelihood of issuing Trichet bonds at present appear to be doubtful since no incentives would appear to exist – with respect to distressed EU countries such as Portugal, Ireland, Italy, Greece and Spain to issue such bonds. This can be attributed to the fact that such countries having had a "better offer" in agreeing to the 12 March 2011 remedies, are likely to be more reluctant to purchase "zero coupon collateral bonds" directly from the ECB. Apart from addressing whether such countries are able to "apply some of (or any of) their reserves held by the ECB for this purpose, or otherwise enter into an appropriate financing package with the ECB," there would appear to be less incentives for such countries to issue these Trichet bonds since they have relatively long term obligations (10-year bonds) at present. For these reasons, such possibilities of having provided collateral with exchanged sovereign bonds (via the issue of Trichet bonds by distressed European countries), have been significantly reduced. There is now an increased likelihood (with increased national deficits of certain distressed countries) that defaults will occur.

2.3.2.4.9 The Sovereign Debt Tribunal

According to Paulus (2010), sovereign debt tribunals could provide the legal structures that are indispensable to establishing smooth procedures for sovereign debt restructuring. A tribunal could be created based only on consensus among relevant stakeholders where the problem of sovereign default is better resolved. He suggested that the tribunal should be established under the control of a highly reputable institution which does not lend to sovereigns.

2.3.2.4.10 Addressing the Current Account Imbalances

According to Campa and Gavillian (2011), the current accounts of Greece, Portugal and Spain have been deteriorating continually since the end of the 1990s while that of Germany have consistently increased during the same period. A country with a large current account of trade deficit will either decrease their savings reserves or borrow to pay for their imports while countries with surplus in trade will increase their savings reserves or be net export of capital.

2.3.2.4.11 European Fiscal Union and Revision of the Lisbon Treaty

In October 2009, the Papandreou government consolidated a three-year fiscal consolidation plan which centered on deep cuts to public spending and enhanced revenue growth through tax increases and a crack-down on tax and social security contribution evasion through its wide range of reform proposals.

According to the European Council (2011), the stability and growth pact was reinforced to enhance fiscal policies. The leaders of each country agreed on the Euro plus pact whose aim was to improve competitiveness, strengthen the economic pillar of the monetary union and to achieve new economic policy coordination. The goals of this pact are to increase competitiveness, increase employment and contribute to the sustainability of public finances and to reinforce financial stability.

2.3.2.4.12 Written-Off Debt or Third Party Rescue Package

Lindert and Morton (1989) suggest handling the debt crisis by either write-downs of part of the debt (either unilaterally or bilaterally) or by third party rescue packages. These avoid destructive penalties by the creditors in the unilateral case. In this case, the debtor will calculate the share of

write-downs that would push marginal benefits down to the marginal cost. Creditors then decide whether to accept the imposed settlement or to hold out indefinitely. In the bilateral case, creditors and debtors work out a compromise from the start. The mechanisms of direct bargaining and write-downs are traditional and simple. In the case of three party approaches, a third party such as the IMF or World Bank should intervene. In practice, the third party intervention has brought delays and temporary rollovers. The third party would give new concessionary loans, bailing out the original creditors and granting a capital gain (a partial default) to the debtors at the expense of distance taxpayers.

2.3.2.4.13 Financial Market Access Restrictions

According to Wright (2011) a sovereign should be restricted from the financial markets after default as a form of legal sanctions by blocking access to credit markets. In such cases, when the fund servicing new loans are seized, creditors will be deterred from making new loans hence the country will be effectively cut off from credit markets. Secondly, the creditors' country should threaten not to give new credit to the country in default hence making creditors to gain by lending to or taking deposits from a country in default. Since the default reveals something about the country's credit worthiness, creditors should reduce lending to the default country.

Sovereign default is the failure or refusal of the government of a sovereign state to pay back its debt in full. It may be accompanied by a formal declaration of a government not to pay or only partially pay its debts, or the de facto cassation of due payments.

Default on debt contract occurs when a debtor has not met it legal obligations according to the debt contract. The precise terms under which a default occurs are defined in a debt contract and typically divided into two types. The first type of default is often referred to as a debt service default and occurs when the borrower fails to make a payment of interest or principal within the specified grace period. The second types of default referred to as a technical default occurs when the sovereign violates a covenant or condition of the contract.

2.3.2.4.14 Sovereign debt crisis and restructuring

Debt restructuring is the process that allows a private or public company or a sovereign entity facing cash flow problems and financial distress, to reduce and renegotiate its delinquent debts in order to improve or restore liquidity and rehabilitate so that it can continue its operation. Debt

restructuring may be an alternative arrangement to debt cancellation or a step in a process leading to debt cancellation. This transaction is often set up by government with foreign transactions.

Wright (2010) mentioned that sovereign debt restructuring mechanism will bring in a trade-off between the cost of default ex post and their cost ex ante. If the debt restructuring process is costless, it benefits the sovereign in default. An incentive to avoid default and restructuring will depend on the expected outcome of the debt restructuring. If it favours the creditors over the debtors, it will give the sovereign a strong incentive to avoid default. If participation in the restructuring process is voluntary, the sovereign may not participate in order to attract more favourable borrowing terms. Also, if the process is imposed on country, they will undermine the process so as to make restructuring more costly. Sovereign debt restructuring is quit costly, time consuming in administering the restructuring process and also ineffective at preserving the value of the creditors claim. Creditors always experience losses in debt restructuring, this loss is also known as a haircut on the amount given to the debtor.

CHAPTER 3

METHODOLOGY

3.1 INTRODUCTION
3.2 AREA OF STUDY
3.3 MODEL SPECIFICATION
3.4 DATA DESCRIPTION
3.5. ESTIMATING THE MODEL

3.1 INTRODUCTION

This chapter explains the methods that were used to analyse our data. It starts with our econometric model, definition and justification of variables that affect government debt. This is followed by the explanation of the various techniques that was used to analyse our data.

Firstly, we describe the descriptive statistics of our variables, and then conduct a graphical method of visual inspection. The Augmented Dickey Fuller (ADF) test and Phillips Perron (PP) test is used to test for unit roots. It is followed by lag order selection criteria then the Johansen cointegration test which is followed by weak exogeneneity test, long run exclusion test and linear restrictions. The VECM is estimated, then the conduction of stability and diagnostic tests. Granger causality test based on the Vector Autogression (VAR), variance decomposition and generalized impulse response function (GIRF) analyses will follow subsequently.

3.2 AREA OF STUDY

Greece is located in the southern part of Europe on the southern end of the Balkan Peninsula. Greece has 13.676 km of coastline and it is the most mountainous country in Europe. It has a surface area of 131 960 square kilometres and a population of 11 295 002 inhabitants. The capital of Greece is Athens; its official language is Greek with English being their second language.

According to the World Bank, Greece is the 34th largest economy in the world with 299 billion dollars of nominal gross domestic product for the year 2011. It is the 15th largest economy out of the 27 members of the European Union. In terms of per capital income, Greece is ranked 29th in the world at 27.875 dollars for nominal GDP. The economy mainly revolves around the service sector (85%) and industry (12 %) while agriculture makes up 3% of the national economic output. The service sectors of Greece include the maritime industry, telecommunication and tourism. Currently, Greece has the largest percentage of merchant navy in the world.

3.3 MODEL SPECIFICATION

Our econometric model is based on the debt function which is a complement of theory and other empirically identified factors as outlined in the literature review. From our literature review, we adopt the model of Sinha *et al.* (2011) which is adjusted to fit the Greek situation. In this context, regression analysis is done primarily to analyse the relationship between the dependent and independent variables given below. The independent variables are government deficit (GDEF), current account balance (CAB), inflation (INF) and gross savings (GSAV) while the dependent variable is general government debt (GDEBT). According to Sims (1980), a VAR gives good results when the variables do not exceed a maximum of six. Being cognizant of this fact, we opted to use five variables in our model. Our regression equation takes the form:

$$Y = \beta_0 + \beta_1 X + \varepsilon_t \qquad \textbf{(3.1)}$$

Y is the dependent variable which the equation is trying to predict.

X is the independent variable that is used to predict the dependent variable.

β_0 is the intercept and ε_t is a value called the regression residual.

The relationship between the dependent and the independent variables is proposed in the functional relationship of the form:

$$GDEBT_t = f(GDEF_t, CAB_t, INF_t, GSAV_t) \quad \textbf{(3.2)}$$

In this case, our regression equation now becomes

$$GDEBT_t = \beta_O + \beta_1 GDEF_t + \beta_2 CAB_t + \beta_3 INF_t + \beta_4 GSAV_t + \varepsilon_t \quad \textbf{(3.3)}$$

where $GDEBT_t$ is general government debt, $GDEF_t$ is government deficit, CAB_t is current account balance, INF_t is inflation, $GSAV_t$ is gross savings and ε_t is the residual or error term. The error term represents other variables that can influence $GDEBT$ but are not included in the model.

The debt function is expressed in natural logarithmic form as:

$$\ln(GDEBT_t) = \beta_0 + \beta_1 \ln(GDEF_t) + \beta_2 \ln(CAB_t) + B_3 \ln(INF) + \beta_4 \ln(GSAV) + \varepsilon_t \quad \textbf{(3.4)}$$

This step is important because many economic time series exhibit strong trends that tend to increase with time. Data transformed to logarithmic values will bring about a stable pattern and avoid heteroskedasicity throughout the period of study. Also, logarithmic values eliminate the tendency of fluctuations over time. It makes non-linearity in the parameters of a model to become linear, (Asteriou & Hall, 2006). Since our data is converted to natural logarithms, the coefficient will be interpreted as elasticity.

3.4 DATA DESCRIPTION

This study uses annual data for the period 1976 to 2010. The following authors had the following observations when using VECM to estimates the relationship between their variables: Oh and Lee (2004) used annual data from 1970 to 1999 with 29 observations, Chakluk (2000) had 32 observations, while Babatunde and Adebafi (2005) had 33 observations. This implies that the 34 observations for our study can be analysed using VECM. Our data is secondary and was obtained from the following sources without being adjusted as shown in Table 3.1 below.

Table 3.1 Source of our variables

Variables	Sources
General government debt (based on ESA 1995)	AMECO
Government deficit (millions)	WDB
Current account balance, (% of GDP)	WDB and IMF
Inflation, CPI (annual %)	WDB and IMF
Gross savings (% of GDP)	WDB

AMECO: European Commission data base

WDB: World Development Indicators

IMF: International Monetary Fund

General government debt is defined in the treaty of Maastricht as the total gross debt at nominal outstanding value of the government sector measured on a consolidated basis. The 1994 European System Account (ESA) takes currency and deposits, securities other than shares excluding financial derivatives and loans to determine the government debt into account.

The government deficit is the amount by which government spending exceeds its income over a particular period of time. Our government deficit is gotten by subtracting gross national expenditure from gross national income. Gross national income is the total value of goods and services produced within a country, together with its income received from other countries less similar payment made to other countries. Here, gross national expenditure is the sum of household final consumption expenditure, general government final consumption expenditure and gross capital formation. GDEF is included in the general government debt equation because there is a theoretical and empirical relationship between GDEBT and GDEF as in the intertemporal budget constraint and as used by Buldina *et al.* (2005). This relationship is expected to be positive meaning that GDEBT will increase when GDEF increases.

The current account balance is the net trade in goods and services of a country plus net earnings from rents, interest, profit and dividends and net transfer payment to and from the rest of the world during a certain period of time, World Development Indicators (WDIs). Sinha *et al.* (2011) did a study on debt and current account balance. According to literature, GDEBT is expected to increase when CAB decreases; hence a negative relationship between the variables is expected.

Inflation is the rate at which the general prices for goods and services are rising while the purchasing power of money is decreasing. According to WDIs, inflation is measured by the consumer price index which is a reflection of the average cost for a consumer when acquiring a basket of goods and services that is fixed or changed at specific intervals. It is expected that when INF increases, GDEBT should decrease. Hence a negative relationship is expected as in Sinha *et al.* (2011).

According to WDIs, gross savings is gross national income less total consumption plus net transfer. Checherita and Rother (2010) studied the relationship between savings and debt. According to theory, when GSAV increases, GDEBT decreases. Hence a negative relationship is expected.

3.5. ESTIMATING THE MODEL

This study uses a time series econometric technique called Vector Error Correction Model (VECM) to examine the relationship between general Greek government debt and its independent variables. The VECM is used instead of Vector Autoregression (VAR) because VAR models are misspecified when variables are cointegrated. Also, VAR models suggest short run relationships between variables because long run information is removed when differenced. On the other hand, VECM can distinguish between long and short run relationships between variables and can identify the source of causation that cannot be detected by the usual Granger causality test (Oh & Lee, 2004).

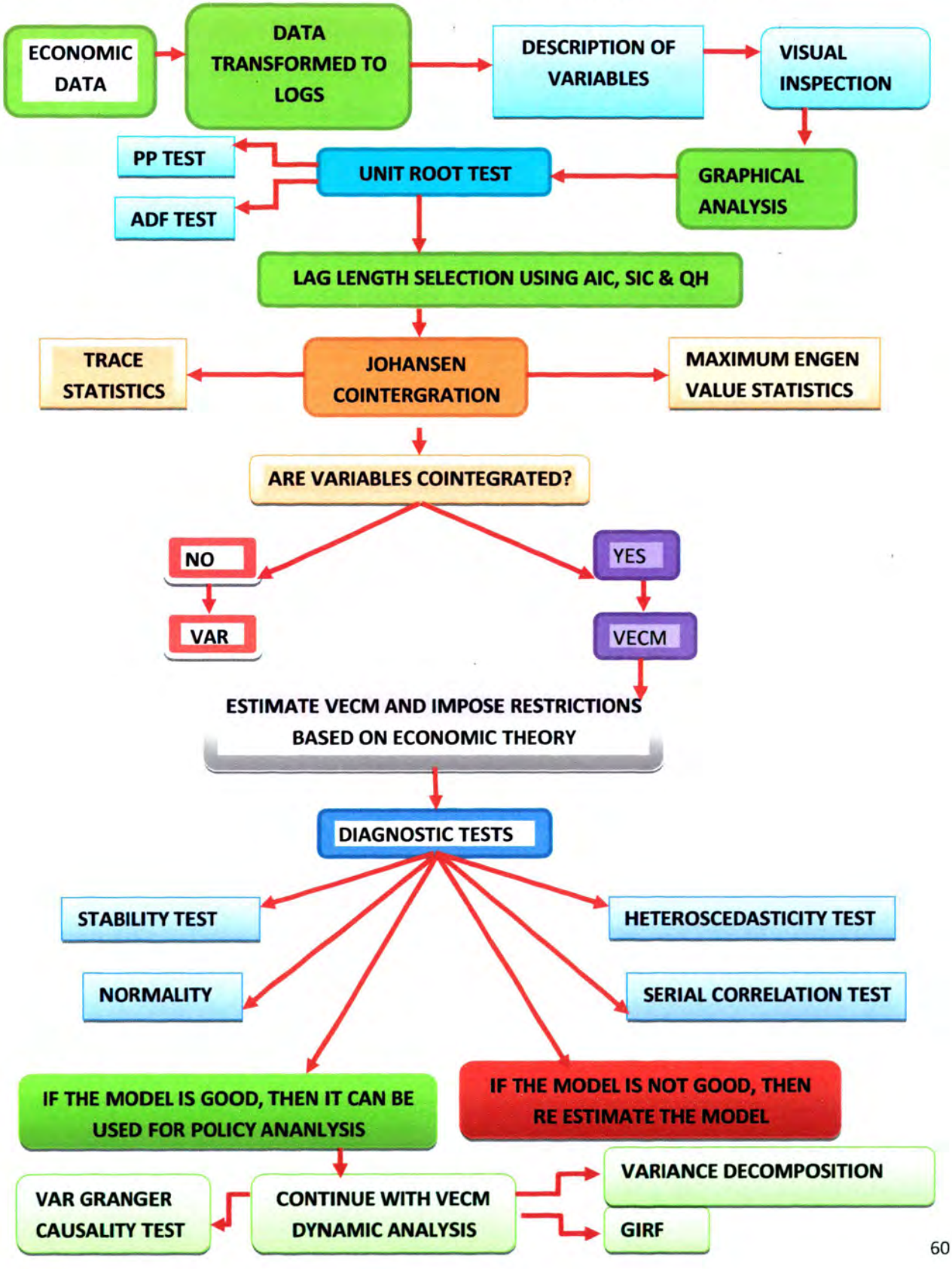
Also, the VECM is preferred over the Ordinary Least Square (OLS) method because VECM deals with multivariate time series data, by contrast to the OLS technique. OLS deals with time

series data which are stationary at that level. If the variables are differenced, the OLS might not give good economic interpretations, thus giving misleading results, (Gujarati & Porter, 2009).

In our VECM, the following techniques are employed: descriptive statistics of our variable, graphical analysis of visual inspection, unit root test, lag order selection criteria, cointegration, VECM estimates and diagnostic tests. It is then followed by VAR Granger causality, Variance Decomposition and Generalised Impulse Response function (GIRF) will also be used to measure the contribution of shocks.

The flowchart in Figure 3.1 below shows the various steps that are followed in our econometric analysis in the sequence indicated by the arrows.

Figure 3.1 A Stepwise Progression of the Econometric Analysis of the Data



3.5.1 Descriptive Statistics

Descriptive statistics give a brief description of our variables using measures of central tendency and variability. The former will include the mean, median and mode while the measures of central variability will include standard deviation, minimum and maximum variables, kurtosis as well as skewness.

Descriptive statistics is advantageous because it evaluates the measurement of each variable for further statistical analysis if it is within the range. Also, it summarises the statistics making it easier to understand than inferential statistics. Finally, positive skewness indicates that observed values of the variables have a long tail to the right, large value or a positive side (Gujarati & Porter, 2009).

3.5.2 Visual Inspection

This is a method used for testing stationarity. Visual inspection can be in the form of graphical analysis or the correlogram test. We prefer the former. Graphical analysis provides a plot of the time series of our variables. This is good because it gives an initial clue about the nature of our time series. In this regard, it shows how the log of our variables over the period of study is increasing, decreasing or being constant. When it is increasing or decreasing, it means that the mean of the log of our variables has been changing over time. In this case, our log variables are not stationary. When it is constant that is fluctuating around the trend line our variables are stationary (Gujarati & Porter, 2009). Hence it is not influence by time.

3.5.3 Unit Root Test

To establish a meaningful relationship between government debt and its independent variables, the latter must satisfy the stationarity condition. According to Gujarati (2004), a series is said to be stationary if its mean and variance are constant over time and the value of covariance between two time periods depends only on the distance or lag between the two time periods and not on the actual time at which the covariance is computed . When a data series is stationary at level form, it may be described as integrated of order zero, denoted as I(0). If non stationary, it will be differenced n-times in order to become stationary, denoted as I(n). When differencing variables

are stationary, it is likely to cause a loss of valuable information about the long-run relationship between the variables.

We also employed the Augmented Dickey-Fuller (ADF) as well as the Phillips Perron (PP) tests to confirm that our variables are stationary. Eviews 7 automatically chooses the lag length and the Schwart information criteria.

3.5.3.1 Dickey-Fuller and Augmented Dickey-Fuller (DF and ADF)

Unit root test is used to test whether a time series variable is stationary or non stationary. In order to establish a non spurious relationship between the natural logarithm of the general government debt (LGDEBT), natural logarithm of government deficit (LGDEF), natural logarithm of current account balance (LCAB), natural logarithm of inflation (LINF) and natural logarithm of gross savings (LGSAV), our variables must be stationary. The most commonly used methods are those adopted from Dickey and Fuller (1979) and the Augmented Dickey-Fuller (ADF). These tests use the existence of a unit root as the null hypothesis. The unit root test is the first step in the estimation. It involves univariate characteristics of the variables used in the estimated equation.

The Dickey-Fuller (DF) test involves running three regressions, one without drift, the second one with drift and the third with drift and trend as follows:

The equation without drift

$$X_t = \rho X_{t-1} + \varepsilon_t \qquad \textbf{(3.5)}$$

The null hypothesis is that $H_0 : \rho = 1$ as opposed to $H_1 : \rho < 1$. An alternative way of writing the above equation is

$$\Delta X_t = (\rho - 1)X_{t-1} + \varepsilon_t$$

$$= \delta X_{t-1} + \varepsilon_t \qquad \textbf{(3.6)}$$

In this particular case the null hypothesis is that $\delta = 0$, suggesting that there is unit root or the process is non-stationary.

The equation with drift is

$$\Delta X_t = \alpha + \delta X_{t-1} + \varepsilon_t \tag{3.7}$$

And equation with drift and trend

$$\Delta X_t = \alpha + \beta t + \delta X_{t-1} + \varepsilon_t \tag{3.8}$$

The Augmented Dickey-Fuller (ADF) test is an improvement on the above method. An ADF test is a version of the Dickey-Fuller test for larger sets of time series models. The ADF statistic, used in the test, is a negative number. The more negative the number, the stronger the rejection of the hypothesis that there is a unit root at some level of confidence. ADF test addresses this unit root by introducing lags of ΔY_t as regressors in the test equation. Such a test is represented by

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^{n} \lambda_i \Delta Y_{t-1} + \varepsilon_t \tag{3.9}$$

The advantage of the ADF test over the DF test is that it allows for the presence of the deterministic trend and drifts to be tested. This means that with the addition of the lagged difference terms, serial correlation is corrected in the residuals. Just like in the case of the DF test, the ADF test also involves three test specifications; the first equation is with both the drift and the trend, the second with drift and the last with without drift only. One experiment will have different specifications because the correct one may not be known. Specifications are given by

$$\Delta Y_t = \alpha + \beta t + \delta Y_{t-1} + \sum_{i=1}^{n} \lambda_i \Delta Y_{t-i} + \varepsilon_t$$

$$\Delta Y_t = \alpha + \delta Y_{t-1} + \sum_{i=1}^{n} \lambda_i \Delta Y_{t-i} + \varepsilon_t \tag{3.10}$$

$$\Delta Y_t = \delta Y_{t-1} + \sum_{i=1}^{n} \lambda_i \Delta Y_{t-i} + \varepsilon_t$$

Here Y is the variable under consideration, Δ is the first difference operator, t is a time trend, n is the number of lags and ε_t is a white noise random error term. The number of difference terms to include is determined through the use of the Schwatz (1978) information criteria. An appropriate lag length would the one that minimizes Schward Information Criteria (SIC). These are not the only procedures recommended. Several authors have presented sequential procedures with the general to specific framework for testing unit root if the data generating process is not known.

If the null hypothesis, that is $\delta = 0$, is not rejected, the variable series contains a unit root and is non-stationary. An appropriate lag length is the one that reduces or eliminates autocorrelation, that is, we choose k such that serial correlation is eliminated. Few series are likely to be stationary at level form, and if not stationary, we proceed to the first and second differences to ensure stationarity. This process of differencing a series Y_t a certain number of times before it becomes stationary is referred to as the order of integration. If found to be stationary at level form, then it is said to be integrated of order zero denoted as $Y_t \sim$I(0) and if differenced d times before becoming stationary, then it is integrated of order d denoted $Y_t \sim$I(d). Thus any time we have an integrated time series of order one or greater, we have a non-stationary series. Though DF/ADF tests are very common, they are found to have a drawback in that their power is likely to be low for series where moving average terms are present or where the disturbances are heterogeneously distributed so we will conduct the Phillips Perron test to confirm our results.

3.5.3.2 Phillips Perron (PP) tests

The Phillips Perron test (Phillips 1987, Phillips & Perron 1988) was also conducted to ensure the stationarity of the data series. This test uses non-parametric correction to deal with any correlation in the error terms and the t-statistics. The Phillips Perron (PP) test addresses the issue that the process generating data for Y_t might have a higher order of autocorrelation than is admitted in the test equation, making Y_{t-1} endogenous and thus invalidating the DF t-test. The advantage of the PP test over the ADF test is that the PP test is robust to general forms of heteroskedasticity in the error term. Another advantage is that the user does not have to specify a

lag length for the test regression. The PP test involves fitting the regression where we may exclude the constant or include a trend term.

$$Y_t = \alpha + \rho Y_{t-1} + \varepsilon_t \tag{3.11}$$

The PP test statistics can be viewed as DF statistics that have been made robust to serial correlation by using heteroskedasticity and autocorrelation constant covariance matrix estimator. The PP test corrects any serial correlation and heteroskedasticity in the errors ε_t of the regression by directly modifying the test statistics. The test regression for the PP tests is

$$\Delta Y_t = \beta_0 X_t + \alpha Y_{t-1} + U_t \tag{3.12}$$

where U_t is I (0) and may be heteroskedastic. The PP tests correct for any serial correlation and heteroskedasticity in the errors U_t of the test regression by directly modifying the test statistics. The PP is based on the following statistics:

$$\bar{t}_\alpha = t_\alpha \frac{(v_0)^{1/2}}{(f_0)^{1/2}} - \frac{T(f_0 - v_0)(se(\bar{\alpha}))}{2 f_0^{1/2} S} \tag{3.13}$$

where $\bar{\alpha}$ = estimate, $\bar{t}_\alpha$ =the t-ratio of α, se($\bar{\alpha}$) is the coefficient of standard error variance, f_0= estimator of the residual spectrum at frequency zero.

The PP test is considered here because it accounts for possible correlation in the first differences of the time-series using a nonparametric correction, and allows for the presence of a non-zero mean and a deterministic time trend. Moreover, PP tests consider less restriction on the distribution of the disturbance term (Enders, 1995). After testing for stationarity, we will proceed to the selection of the best lag length.

3.5.4 Lag Order Selection Criteria

In order to obtain credible results, we need to select a suitable lag for our variables. It is done using an unrestricted VAR. According to Asterious and Hall (2006), lag length selection is good since it will give a lag whereby the error terms will exhibit normality, no autocorrelation, and no heteroskedasticity. Lag lengths are affected by variables that are omitted. This affects the

behaviour of our model in the short run. As such we need to have a good lag. There are various criteria for selecting the appropriate lag length such as the Aikaike's Information Criteria (AIC), Schward Information Criterion (SC), Hanann-Quin Criterion (HQ), sequential modified Likelihood Ratio (LR) and the Final Prediction Error (FPR). They are calculated as follows:

$$AIC = -2\,{}^{l}\!/_{T} + 2\,{}^{k}\!/_{T} \tag{3.14}$$

$$SC = -{}^{2l}\!/_{T} + {}^{(k\log T)}\!/_{T} \tag{3.15}$$

$$HQ = -2({}^{l}\!/_{T}) + 2k\log(\log(T))/T \tag{3.16}$$

$$LR = (T-m)\{\log|\Omega_{n-1}| - \log|\Omega_{n}|\} - X^{2}(k^{2}) \tag{3.17}$$

Where l is the log likelihood.

l Is computed as

$$l = -{}^{T}\!/_{2}(1+\log)2\prod) + \log({}^{e^{\wedge\backslash}e^{\wedge}}\!/_{T})) \tag{3.18}$$

The SC is an alternative to the AIC that imposes a large penalty for additional coefficients. The HQ employs another penalty function. In the sequential modified likelihood ratio (LR) test, m is the number of parameters in the equation under the alternative. The modified LR statistics is compared to the 5% critical value whereby we start from the maximum lag of about 12 then we decrease the lag one at a time until we get a rejection. The selected lag is indicated by an asterisk for each of the criteria, this is the one which minimises the criteria. According to Liew (2004), the AIC and the FPE results are superior when the number of observations are sixty and below than the SC and HQ criterion when wanting to have a good lag length criteria.

3.5.5 Cointegration

Cointegration is an econometric technique for testing the relationship between non-stationary time series variables. The idea behind cointegration analysis is that although macroeconomic

variables may tend to trend up and down over time, groups of variables may drift together. Two or more variables are said to be cointegrated when they move together at the same wavelength. The advantage of a cointegration analysis is that through building an error correction model (ECM), the dynamic co-movement among variables and the adjustment process towards long term equilibrium may be examined. Two methods of conducting cointegration tests are: the Johansen and Engle Granger cointegration test. The Johansen cointegration test is preferred over the Engle-Granger approach because it tests the whole system of equations in one step and without requiring a specific variable to be normalised hence not allowing us to carry the error of the first step into the second as the case of Engle Granger which is a two-step error correction model. Engle-Granger (1987) assumes one cointegrating vector, but there is a possibility that more than one cointegrating vectors may be obtained. According to Chang and Carballo (2011), Johansen technique permits us to have more than one cointegrating relationship, while the Engle Granger gives us just one cointegrating equation.

3.5.5.1 The Johansen Cointegration Test

The Johansen cointegration test is a procedure for testing cointegration of several I(1) time series. This test permits more than one cointegration relationship. The Johansen methodology starts from the vector autoregression (VAR) of order p as follows:

$$Y_t = \mu + A_1 Y_{t-1} + \ldots + A_p Y_{t-p} + \varepsilon_t \qquad \textbf{(3.19)}$$

where Y_t is an n × 1 vector variables that are integrated of the order one, I (1) and ε_t is an n×1 vector of innovations. This VAR can be rewritten as

$$\Delta Y_t = \mu + \prod Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + \varepsilon_t \qquad \textbf{(3.20)}$$

where $\prod = \sum_{i=1}^{p} A_{i-1}$ and $\Gamma_i = -\sum_{j=i+1}^{p} Aj$

There exist an n×r matrices α and β if the coefficient matrix $\prod$ has a reduced rank, r×n. $\prod = \alpha\beta'$ and $\beta' Y_t$ are stationary, r is the number of cointegration relationship, α is the

adjustment parameters 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 thereby the reduced rank of the $\prod$ matrix.

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

$$J_{trace} = -T\sum_{i=r+1}^{n} \ln(1-\bar{\lambda}_i) \quad \textbf{(3.21)}$$

$$J_{max\ Egen} = -T\ln(1-\bar{\lambda}_{r+1}) \quad \textbf{(3.22)}$$

where T is the sample size and $\bar{\lambda}$ is the ith 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 or $r+1$ cointegrating vectors.

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

1. There are no cointegrating relationships; the regression is spurious.

2. There is at most one cointegrating relationship.

3. 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, we must worry that the regression is spurious. If we reject the first hypothesis only, we proceed assuming that there is only one cointegrating relationship. If we reject the first and second hypotheses, we proceed assuming that there are two cointegrating relationships. If we reject all hypotheses, we conclude that none of the variables contain stochastic trends after all. This is because that is the only way that there could be as many cointegrating relationships as variables.

3.5.5.2 Testing for weak exogeneity

After testing for cointegration, our next step was to test for weak exogeneity. According to Bonham *et al.* (2009) this test addresses the problem of over parameterization found in the VECM, that is, many equations in the system will be reduce to one and the number of parameters by ($mk + d$) where d is the number of deterministic component. Our VECM is transform into a conditional model for y_t and a marginal model x_t as:

$$\Delta Y_t = (d_y - wd_x) + w\Delta X_t + (\alpha_y - w\alpha_x)\beta' Z_{t-1} + \sum_{i=1}^{k-1}(\Gamma_{yi} - w\Gamma_{xi})\Delta Z_{t-1} + (\varepsilon_{yt} - w\varepsilon_{xt}) \quad \textbf{(3.23)}$$

$$\Delta X_t = d_x + \alpha_x \beta' Z_{t-1} + \sum_{i=1}^{k-1}\Gamma_{xi}\Delta Z_{t-i} + \varepsilon_{xt}. \quad \textbf{(3.24)}$$

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, we proceed to impose theory based restrictions on the cointegrating vector β.

3.5.5.3 Testing for linear restrictions in the cointegrating vectors

To obtain good long run cointegrating equation, four types of restrictions are relevant. These are restrictions on the rank of the long run matrix, Π, on the long run cointegration vector β, on the short term dynamics coefficient Γ_i, and on the parameter, α. Johansen (1998, 1991, and 1995) proposed these different ways, but Greenslade *et al.* (2002) mentioned that those approaches are not practical when the sample size is small. Also, the short and long run parameters have much effect on the size and power of the statistical test. According to Greenslade *et al.* (2002), in order to obtain a good representation of our long run cointegrating equation from our VECM, we have to impose restrictions on β.

The Johansen approach allows us to obtain estimates of the coefficient of the matrices α and β to test for possible linear restrictions in the matrices especially in β which contains the long run parameters. Restrictions will be imposed using an economic theory point of view (Asteriou & Hall, 2007). If restrictions are not imposed, Eviews 7 will use a default normalization that identifies all cointegrating relations. This default normalization expresses the first r variables in the VECM as a function of the remaining k-r variables, where r is the number of cointegrating relations and k is the number of endogenous variables.

3.5.6 Vector Error Correction Model (VECM) Estimates

Engle and Granger (1998) developed a means of reconciling the short run behaviour of an economics variable with its long run behaviour. The VECM combines long run information with a short run adjustment mechanism. VECM specifications are to estimate the relationship between our general government debt and our independent variables. The VECM overcomes the problems of spurious regression through the use of appropriate differenced variables in order to determine the short term adjustment in the model.

A VECM is a restricted VAR designed for use with non-stationary series at level form that are known to be cointegrated. It may be tested for cointegration using an estimated VAR object. A VECM is parameterized so that the variables tend to revert back to the equilibrium specified by the cointegrating vector.

There are two possible specifications for vector error correction: the long run VECM and the transitory VECM. The long term components of our variables are to obey equilibrium constraints, while short-run components have a flexible dynamic specification. The idea is simply that a proportion of the disequilibrium from one period is corrected in the next period. It involves estimating the model in the first difference form and adding an error correction term as an explanatory variable. The dynamic error correction can be obtained by using the autoregressive distributed lags approach. Error correction term (ECT) values are obtained by conducting a regression on the dependent variables with all the independent variables in the model. Our VECM for vector $m \times n$ of I (1) variables is as follows:

$$\Delta Y_t = -\Pi Y_{t-1} + \sum_{i=1}^{k-1} \Gamma_i \Delta Y_{t-1} + \varepsilon_t \tag{3.25}$$

where t=1, 2, 3, ...T., k is the number of lags in the unrestricted VAR represented by Y_t. $-\Pi$ is the long run coefficient matrix at first differenced when variables are cointegrated. $-\Pi$ breaks down into α and β term where α is the adjustment term and β is the cointegration coefficient.

The vector error correction mechanism allows long term components of variables to obey equilibrium constraints, while short-run components have a flexible dynamic specification. The idea is simply that a proportion of the disequilibrium from one period is corrected in the next period. It involves estimating the model (in 3.3 above) in the first difference form and adding an error correction term as an explanatory variable. In our case the error correction model to be estimated is as follows:

$$\Delta \ln(GDEBT_t) = \beta_0 + \sum_{i=n-1}^{n} \beta_1 \ln(GDEF_{t-i}) + \sum_{i=n-1}^{n} \beta_2 \Delta \ln(CAB_{t-i}) + \sum_{i=n-1}^{n} \beta_3 \Delta \ln(INF_{t-i}) +$$

$$\sum_{i=n-1}^{n} \beta_4 \Delta \ln(GSAV_{t-i}) + \sum_{i=n-1}^{n} \beta_5 \Delta \ln(GDEBT_{t-i}) + \beta_6 EC_{t-1} + v \tag{3.26}$$

The value of n was chosen using the AIC and the SC. *EC* is the error correction component and *V* is the random error term. The error correction term (*EC*) is the lagged values of the error term that has been derived from the regression model. If the coefficient of *EC* is negative and statistically significant, it tells us what proportion of the disequilibrium in GDEBT is corrected in the next period. After estimating our VECM, we will test if our model is good.

3.5.7 Diagnostic Tests

Diagnostic tests are also known as misspecification testing. Their purpose is to assist in deciding whether or not a model has been correctly specified. For stability tests we employed the autoregressive (AR) Root graph. For diagnostic tests we used Autocorrelation Lagrange Multiplier (LM) Test for Serial correlation. For Heteroskedasticity, we employed the White

Heteroskedasticity (no cross terms) and the normality. We considered the econometric criteria for evaluation of our regression results.

Specification tests are significance tests either of the t or F statistics. The tests are designed to confirm a known specification, given by the model under consideration, against a specific alternative. Misspecification tests, on the other hand, do not involve a specification form of the model. They are essentially used to detect an inadequate specification. The reliability of a specification test depends on the validity of the assumptions. Stability test is necessary for prediction and econometric inferences.

3.5.7.1 Stability Test

Stability test is a test used to test if our model is reliable. This involves an AR roots table and the AR roots graph. For this study, we will employ the AR roots graph only. Our VECM/ VAR model is stable if all the roots inside the unit circle. The necessary and sufficient conditions for stability are:

Inside unit circle, the necessary condition is $\sum_{i=1}^{n} a_i < 1$ **(3.27)**

The sufficient condition is $\sum_{i=1}^{n} |a| < 1$ **(3.28)**

The unit roots process is gotten as: unit root exit, if $\sum_{i=1}^{n} a_i = 1$ **(3.29)**

If some of the roots are found outside the unit circle, then the model is not stable and cannot be used for further analysis.

3.5.7.2 Autocorrelation LM test

This LM test tests hypothesis through augmented residual regression. Autocorrelation is the correlation between a time series variable and its lagged value. The autocorrelation LM test can

be applied in determining whether lagged dependent variables are included or not unlike the Durban-Watson test. Based on

$$Y_t = \beta X_t + \varepsilon_t, \tag{3.30}$$

the augmented regression to test for p-th order serial correlation is

$$\varepsilon_t = \beta X_t + \alpha_1 \varepsilon_{t-1} + \alpha_2 \varepsilon_{t-2} + \ldots + \alpha_p \varepsilon_{t-p} + \gamma_t \tag{3.31}$$

The LM test for autocorrelation is used to test for the presence or the absence of serial correlation in the residuals. The null hypothesis (H_0) is that there is no serial correlation and the alternative hypothesis (H_1) that there is serial correlation of the order ρ and the rejection of the null hypothesis is only possible if the t-statistics is less than the critical probability value ρ=0.05. Under this test, the LM is given as:

$$LM(H) = (TSS - RSS)/(TSS/\ n) = nR^2 \tag{3.32}$$

where TSS is the total sum of squares, RSS is the residual sum of squares and n is the sample size (Seddighi et al., 2000).

3.5.7.3 Heteroskedasticity

Heteroskedasticity is a situation in which the variance of the regression error term conditional on the regressors is not constant, (Stock & Watson, 2012). The test was developed by White in 1980, this helps to test for heteroskedasticity in the residuals where least squares estimates are consistent in the presence of heteroskedasticity. The conventional computed standard errors are no longer valid. If there is evidence of heteroskedasticity, the robust standard errors option is to correct the standard errors of the heteroskedasticity modelled to obtain more efficient estimates using weighted least squares. The test is widely used because it makes few assumptions about the likely form of heteroskedasticity, (Asteriou & Hall, 2007).

The null hypothesis of these tests is that there is no heteroskedasticity so that errors are homoskedastic. If the p-values is less than the level of significance ($p < 0.05$), reject the null hypothesis and conclude that there is a significant evidence of heteroskedasticity.

The test statistics is computed by an auxiliary regression, where the squared residuals are regressed on all possible cross products of the regressors. The test statistics is then based on the auxiliary regression as follows:

$$\varepsilon_t^2 = \beta_0 + \beta_1 X_t + \beta_2 Z_t + \beta_3 X_t^2 + \beta_4 Z_t^2 + \beta_5 X_t Z_t + \gamma_t \quad \textbf{(3.33)}$$

With or without the cross terms ($X_t Z_t$) is limited by the sample size.

3.5.7.4 Normality tests

We will also test whether the residuals are normally distributed or not. A multivariated extension of Jarque-Bera (JB) for residual normality was reported. The most commonly used method is the Jarque-Bera test. This test uses the fact that the normal distribution has a characteristic set of moments. It works by comparing the sample versions of the coefficient of excess skewness and the coefficient of kurtosis. The JB is given as

$$JB = n\left[\frac{S^2}{6} + \frac{(K-3)^2}{24}\right] \quad \textbf{(3.34)}$$

where S represents skewness, K kurtosis and n is the sample size. In large samples, JB follows a chi-square distribution (χ^2). The null hypothesis is that the residuals are normally distributed and the decision criterion is that if the value of the JB is significant, then we reject the null hypothesis and conclude that the residual are normally distributed, (Asteriou & Hall, 2007). Skweness is a measure of the asymmetry of a probability distribution while Kurtosis is a measure of how much mass is contained in the tails of the probability distribution, (Stock & Watson, 2012).

3.5.8 Causality Test

In order for us to know the causal link between government debt and its independent variables, we conducted a special test called the Granger causality test. This test is a procedure for testing

whether current and lagged values of one time series help predict future values of another time series, (Stock & Watson, 2012). According to Gujarati and Porter (2009), the existence of a relationship between variables does not mean causation and also does not prove the direction of causation. We will use the VAR granger causality test. In the bivariate case, the standard Granger causality test amounts to testing whether past values of Y together with past values of X explains the current change in X better than the past values of X alone will do. Failure to reject this null hypothesis leads to the conclusion that Y Granger causes X. This process is repeated interchanging the two variables (Y and X). The Vector Autoregressive bivariate regressions of the form below will be estimated:

$$GDEBT_t = \sum_{i=1}^{n} \alpha_{1i} GDEBT_{t-1} + \sum_{j=1}^{n} \alpha_{2i} GDEF_{t-j} + \mu_t \quad \textbf{(3.35)}$$

$$GDEF_t = \sum_{i=1}^{k} \lambda_{1i} GDEF_{t-1} + \sum_{j=1}^{k} \lambda_{2j} GDEBT_{t-j} + \sigma_t \quad \textbf{(3.36)}$$

where $GDEBT_t$ stands for general government debt and $GDEF_t$, for gross national deficit. μ_t and δ_t are the white noise terms. Using general-to-specific approach, the lag length is chosen such that serial correlation is eliminated between the error terms. The following presents all possible causal relationships between two variables:

a) Unidirectional causality from $GDEF_t$ to $GDEBT_t$ exists if $\sum_{j=1}^{k} \alpha_{2j} \neq 0$ and $\sum_{j=1}^{k} \lambda_{2j} = 0$

b) Unidirectional causality exists from $GDEBT_t$ to $GDEF_t$ if $\sum_{i=1}^{k} \lambda_{2i} \neq 0$ and $\sum_{j=1}^{k} \alpha_{2j} = 0$

c) Bidirectional causality between $GDEBT_t$ and $GDEF_t$ if $\sum_{j=1}^{k} \lambda_{2j} \neq 0$ and $\sum_{j=1}^{k} \alpha_{2j} \neq 0$

d) No causality is established between $GDEBT_t$ and $GDEF_t$ if $\sum_{j=1}^{k} \alpha_{2j} = 0$ and $\sum_{j=1}^{k} \lambda_{2j} = 0$

The Granger causality test results are sensitive to lag lengths. Employing arbitrarily chosen lag lengths may not give good results since choosing a less than optimal lag order may lead to a bias, whereas, applying a more than optimal lag order may lead to a loss of efficiency. To avoid these problems we use the lag chosen from the lag length criterion test as shown above. Knowing the direction of causation will help the policy makers as to which variable to target first.

The formula above in equations 3.35 and 3.36 was for GDEBT and GDEF. We did the same for GDEBT and the other independent variables by extending the bilateral causality through the technique of VAR. According to Gujarati and Potter (2009), the Granger causality test is based on the assumptions that our variables are stationary and that the error terms are uncorrelated.

3.5.9 Variance Decomposition

Variance decomposition shows which shocks are most important in explaining a variable through the period of time. It separates variations in an endogenous variable into a component shocks in a VAR hence providing relative important information about each random innovation affecting the variables in the VAR. Variance decomposition measures the contributions of each type of shocks to the forecast error variance. Variance decomposition determines how much of the forecast error variance of each of the variables can be explained by exogenous shocks to the other variables. According to Enders (2010), suppose a VAR of two variables is written as

$$y_t = \mu + A_1 y_{t+1} + \ldots + A_2 y_{t+2} + \varepsilon_t \tag{3.37}$$

it can be expressed as the Vector Moving Average (VMA) as

$$y_t = \mu + \phi_1 y_{t+1} + \ldots + \phi_p y_{t+2} + \varepsilon_t \tag{3.38}$$

In general, the n-step ahead forecast error is

$$\varepsilon_{t+n} + B\varepsilon_{t+n-1} + B^2\varepsilon_{t+n-2} + \ldots B^{n-1} \tag{3.39}$$

From VMA, if we focus on y_t, the n-step ahead forecast error is

$$y_{t+n} - E(y_{t+n}) = \phi_{11}(0)\varepsilon^s y_{t+n} + \phi_{11}(1)\varepsilon^s y_{t+n-1} + ...\phi_{11}(n-1)\varepsilon^s y_{t+1}$$

$$\phi_{12}(0)\varepsilon^s x_{t+n} + \phi_{12}(1)\varepsilon^s x_{t+n-1} + ...\phi_{12}(n-1)\varepsilon^s x_{t+1} \quad \textbf{(3.40)}$$

Given this, it is possible to decompose the n-step a head forecast error variance due to each one of the shocks in $\varepsilon^s y_t$ and $\varepsilon^s x_t$ respectively given as:

$$\sigma^2 y(\phi_{11}(0)^2 + \phi_{11}(1)^2 + ...\phi_{11}(n-1)^2)/\sigma y(n)^2$$

$$\sigma^2 x(\phi_{11}(0)^2 + \phi_{11}(1)^2 + ...\phi_{11}(n-1)^2)/\sigma y(n)^2 \quad \textbf{(3.41)}$$

The forecast error variance decomposition tells us the proportion of the movement in a sequence due to its own shocks versus shocks to other variables. If the total forecast error variance is explained by shocks in the variable itself, then that variable is exogenous. It is typical for a variable to explain almost all its forecast error variance for short horizons and smaller proportions at longer horizons.

3.5.10 Generalized Impulse Response Function

An impulse response function measures the time profile of the effect of shocks at a given point in time on the future values of variables in a dynamic system. It traces the effects of a shock from one endogenous variable on to the other variables in a VAR. Generalized Impulse Response Function (GIRF) is used in our study and not the Impulse Response Function (IRF) because the IRF is sensitive to the ordering of variables. Also, if important variables are omitted, the IRF may be distorted hence giving a wrong result. This is an analysis used to construct the time path of the dependent variables in the vector autoregressive model to shocks from all the independent variables.

According to Enders (2009), the GIRF starts with a VAR of X_t as shown below:

$$X_t = \theta D_t + \sum_{i=1}^{k} \Pi_i X_{t-1} + \varepsilon_t \quad \textbf{(3.42)}$$

where t=1, … T, D_t is the vector with deterministic variables, ε_t is p-dimensional and assumed to be zero mean with a positive covariance matrix. When the errors of X_t is forecast h steps, equation 3.42 above becomes $X_{t+h} - E[X_{t+h} \mid \lambda_t] = \sum_{j=0}^{h-1} C_j \varepsilon_{t+h-j}$ where λ_t is a set of information which includes the history of X_s up to X_t and the time path for D_t. The matrices C_j is given by $C_0 = 1_p$ and $C_j = \sum_{i=1}^{\min k,j} \Pi_i C_{j-i}$, $j \geq 1$ where by all the C_j matrices is determined from Π_i matrices. The GIRF is given as follows by Koop, Pesaran & Potter (1996):

$$GI_x(h, \sigma, \lambda_{t-1}) = E[X_{t+h} \mid \varepsilon_t = \sigma, \lambda_{t-1}] - E[X_{t+h} \mid \lambda_{t-1}] \quad \textbf{(3.43)}$$

where σ is the known vector. The $GI_x(h, \sigma, \lambda_{t-1}) = C_h \sigma$ **(3.44)**

is a VAR which dependent on λ_{n-1} but depends on the composition of the shocks defined by σ.

CHAPTER 4

EMPIRICAL ANALYSIS AND INTERPRETATION

4.1 INTRODUCTION
4.2 DESCRIPTIVE STATISTICS RESULTS OF VARIABLES USED IN THIS STUDY
4.3 VISUAL INSPECTION RESULTS
4.4 UNIT ROOTS TEST RESULTS
4.5VAR LAG ORDER SELECTION CRITERIA RESULTS
4.6. COINTERGRATION TEST RESULT
4.7 WEAK EXOGENEITY RESULTS ON BETA
4.8 LONG RUN RESTRICTION RESULTS
4.9. VECM ESTIMATES RESULTS
4.10 DIAGNOSTIC AND STABILITY TEST RESULTS
4.11 GRANGER CAUSALITY TEST RESULTS
4.12 RESULTS OF VARIANCE DECOMPOSITION
4.13 RESULT OF GIRF

4.1 INTRODUCTION

This chapter presents and interprets the various tests conducted in order to answer the questions raised in Chapter 1. Specifically, results from descriptive statistics, graphical analysis of visual inspection, stationarity test, lag order selection criteria; cointegration, weak exogeneity test, long run restriction test, VECM estimates, diagnostic tests, Granger causality test, variance decomposition and GIRF are presented and discussed.

The reliability of our data is based on the probability value; we choose 10% to determine our level of significance. Our analysis uses techniques discussed earlier to empirically estimate and analyze the relationship between general government debt, government deficit, current account balances, inflation and gross savings. We used tables and graphs to present our results.

4.2 DESCRIPTIVE STATISTICS OF VARIABLES USED IN THIS STUDY

The nature of the data for the selected variables used in the study is summarized in Table 4.1. The mean, median, mode, minimum and maximum values of our variables are close to each other. This indicates that our data for Greece is symmetric. The residuals for all of the variables at levels form do not all satisfy the normality test. It is observed that the null hypothesis of residuals from LGDEF, LINF and LCAB cannot be rejected at 10 % of significance as indicated by the high probability value of the Jaque-Bera statistics. Therefore, we accept the null hypothesis that the residuals from these variables are normally distributed. This indicates that, in testing for stationarity of such variables, structural breaks and outliers is not accounted for when using conventional unit root test. The residuals of LGDEBT and LGSAV are rejected at 10% hence indicating that these variables are not normally distributed at level form. This means that in testing for stationarity of such variables, structural breaks and outliers will have to be accounted for when using conventional unit root test.

Table 4.1 Summary of the Descriptive Statistics of the Variables at level form

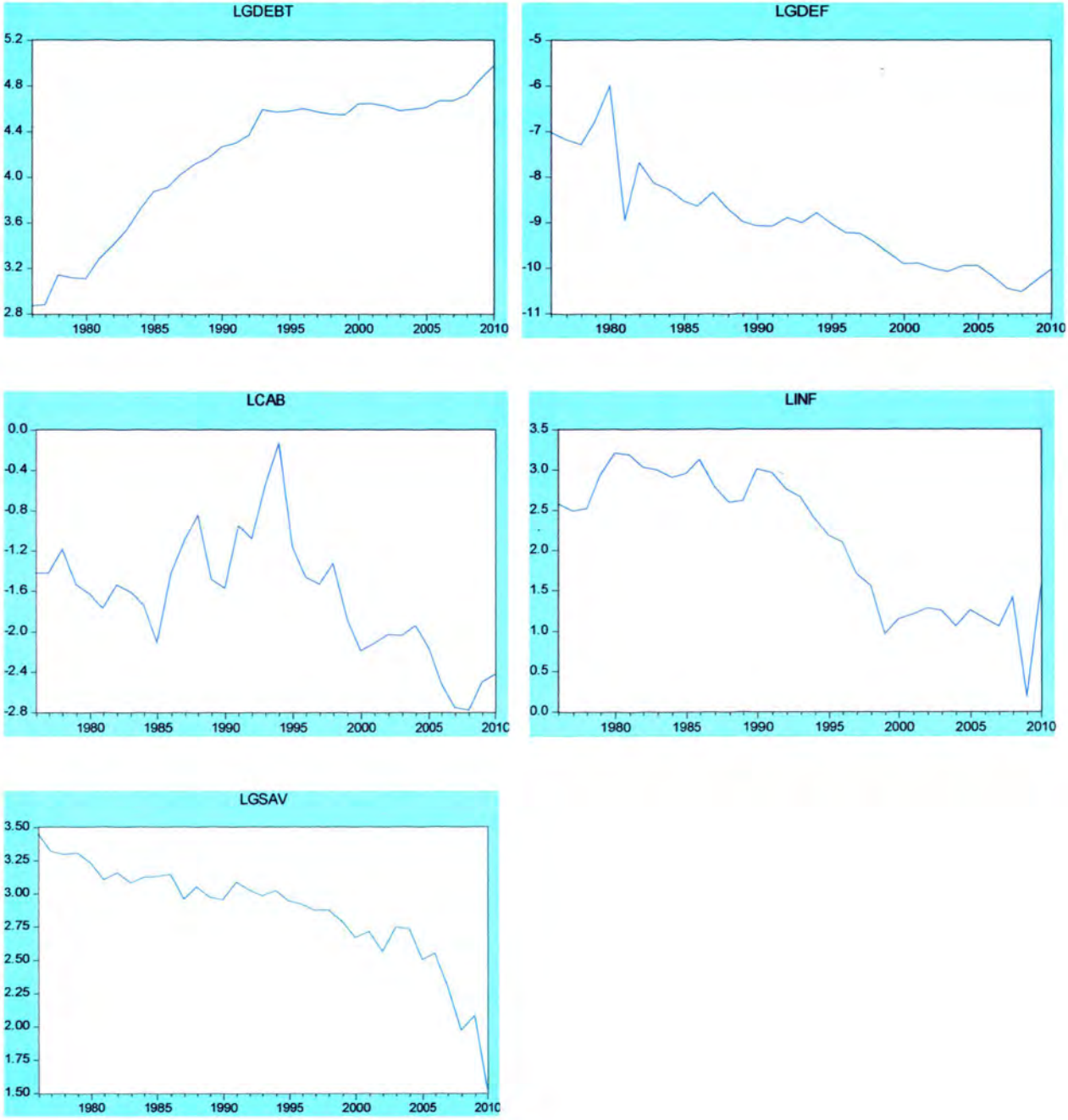
Name of variables	LGDEBT	LGDEF	LCAB	LINF	LGSAV
Mean	4.167903	-8.937578	-1.648621	2.143874	2.865577
Median	4.552392	-9.014565	-1.566322	2.498974	2.961037
Maximum	4.976506	-5.987710	-0.123102	3.213863	3.451637
Minimum	2.875371	-10.51586	-2.775023	0.190620	1.532125
Std. Dev.	0.622117	1.125359	0.597078	0.843808	0.404573
Skewness	-0.842018	0.768060	0.192176	-0.427689	-1.430044
Kurtosis	2.333658	2.985765	3.027121	1.889965	5.164231
Jarque-Bera	4.783319	3.441474	0.216507	2.863947	18.76000
Probability	0.091478	0.178934	0.897400	0.238837	0.000084
Sum	145.8766	-312.8152	-57.70175	75.03559	100.2952
Sum Sq. Dev	13.15900	43.05873	12.12106	24.20841	5.565105
Observations	35	35	35	35	35
Conclusion at level	Not normally distributed	Normally distributed	Normally distributed	Normally distributed	Not normally distributed

4.3 VISUAL INSPECTION RESULTS

The graphical inspection of the time series is beneficiary in identifying the nature of the variables. We were easily able to detect if the time series of our variables were stationary at their level form or after their first difference. In this regard, we look at both opinion of how our stationarity test will look. The visual inspection results shows that the natural logarithms of our variables from 1976 to 2010 of Greece are increasing or decreasing hence the natural log variables are not stationary at level form (Gujarati & Porter, 2009). Specifically, the first impression from Figure 4.1 is that, LGDEBT time series seems to be trending upwards with fluctuations. The drift leads to a series that is more likely to rise over time. It shows that over time LGDEBT has been increasing, suggesting that the mean has been changing. The general

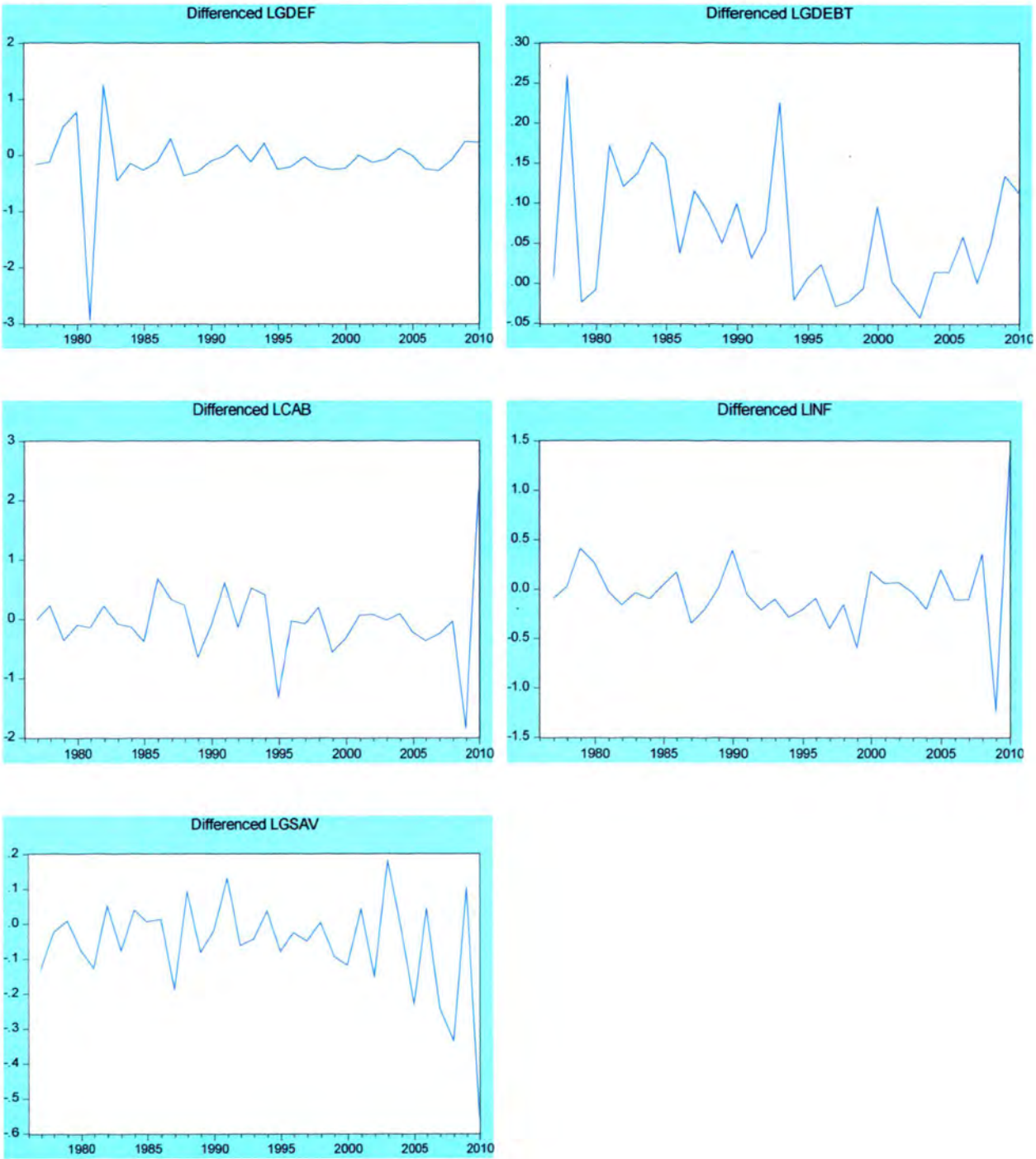
impression is that the time series is non stationary. Similarly, LGDEF decreases over the years. LCAB increases until 1995 and then decreases till 2010. LGSAV and LINF decreases over the years. This is a clear indication that all our variables are non-stationary at level form for Greece. Therefore, we proceed with the visual inspection at first difference.

Figure 4.1 Selected Variables at Level Form



The time series data is then transformed by differencing it to remove the trend component from the time series. The results are illustrated in Figure 4.2 below.

Figure 4.2 Selected Variables at First Difference



Subsequently, the white noise process has no trending behaviour and it frequently crosses the mean value of zero. The impression we get is that stationarity has been achieved at first difference, that is, at *I(1)* because visually variance seems to be time-invariant. The presence of a constant mean and a constant variance are the two characteristics of a stationary series.

4.4 UNIT ROOT TEST RESULTS

Our model developed in Chapter 3 can be estimated by the standard regression method if all variables in the equations are stationary and the errors have a zero mean and infinite variance. As mentioned earlier (see Chapter 3), two unit root testing procedures were employed in this study namely; ADF, and PP tests. These tests helped to determine whether our data were stationary or not. Stationarity test also helps us to establish the order of integration for our variables because it had a direct bearing on the appropriateness and statistical validity of regression results.

Tables 4.2 and 4.3 shows the unit root test results conducted in this study using the ADF and PP tests. The test which is stationary at level form is integrated of order zero I(0) and are carried out on the level form of the variables at intercept, trend and intercept, and none. The test which is stationary at first difference are integrated of order I(1). The first difference is carried out at intercept, intercept and trend, then none. We used the SC criteria since it is given automatically by Eviews 7 and also because if a variable is stationary with SC, then it will be stationary too if we use AIC. When we used these tests in reverse order, the conclusions are not consistent. The tests are carried out at critical values of ADF and PP as follows:

Table 4.2 ADF and PP Test at Level Form

		ADF TEST		P.P TEST		Conclusion
Variables	Model Specification	t-values (lags)	SIC	t-values (Bandwidth)	SIC	
LGDEBT	Intercept	-2.423210(0)	-2.253693	-2.395026(3)	-2.253693	Non stationary
	Trend and Intercept	-1.412788(0)	-2.159315	-1.430592(3)	-2.159315	Non stationary
	None	4.041652(0)	-2.092822	20903323(4)	-2.092822	Non stationary
LGDEF	Intercept	-1.957793(0)	1.900346	-1.720301(2)	1.900346	Non stationary
	Trend and Intercept	-3.282659(1)	1.625447	-5.162968(2)	1.493047	Non stationary
	None	0.614244(0)	1.920369	2.036382(15)	1.920369	Non stationary
LCAB	Intercept	-1.549522(0)	0.895492	-1.473234(5)	0.895492	Non stationary
	Trend and Intercept	-2.146960(0)	0.926465	-2.061768(4)	0.926456	Non stationary
	None	-0.059809(0)	0.870954	0.423921(17)	0.870954	Non stationary
LINF	Intercept	-0.100300(1)	0.962423	-1.060210(1)	1.068402	Non stationary
	Trend and Intercept	-2.576136(1)	0.819300	-2.917762(2)	0.954547	Non stationary
	None	-1.195572(1)	0.859751	-0.917884(3)	0.996958	Non stationary
LGSAV	Intercept	1.900639(3)	-1.223747	2.771237(4)	-0.986548	Non stationary
	Trend and Intercept	2.101834(5)	-1.179047	1.010336(4)	-0.893762	Non stationary
	None	-0.606935(3)	-1.196032	-2.105635**(4)	-0.991601	Stationary
LGCAP	Intercept	-2.119437(0)	-1.665186	1.986776(4)	-1.665186	Non stationary
	Trend and Intercept	-2.709122(0)	-1.643263	-2.723214(3)	-1.643263	Non stationary
	None	-1.320859(0)	-1.643770	-1.570677(5)	-1.643770	Non stationary

Note: Reject at 1 %(***), 5 %(**), 10 %(*) significance level

The null hypothesis of no unit roots for all our time series is accepted at level form since the ADF and PP test statistics values are more than the critical values at 1% level of significances, thus our variables are non stationary with the exception of LGSAV is different at 5 % level of significance and at none.

The results in Table 4.2 above show that, LGSAV is stationary at 5 % and at none when using the PP but non stationary at trend, as well as at trend and intercept. Hence, we conclude that our LGSAV is not stationary since it is non-stationary at trend and intercept which is a reflection of our model.

When using ADF and PP the t-statistics of all our variables are insignificant at 1%, 5% and 10 % for intercept, intercept and trend, and none. Hence we conclude that all our variables are not stationary at level form or our variables have unit roots at level form. This stationarity test results confirms with that of the graphical visual inspection above. We then did the test at first difference to see if our variables will be stationary.

At first differenced, the null hypothesis of no unit roots for all out time series is rejected since the ADF and PP test statistics values are less than the critical values at 1% level of significances. We therefore concluded that our variables are stationary.

The results in Table 4.3 reveal that, when differenced, LGSAV is not stationary when using the ADF at intercept, trend and intercept and none. With the PP, it is stationary at intercept, trend and intercept and none. Since PP is more accurate than ADF as mentioned by Enders (1995) with the reasons being that PP accounts for possible correlation at first difference and considers less restrictions on the distribution of the disturbance term , we concluded that our LGSAV is stationary at first difference hence the order of integration is I(1). For all our other variables, when unit roots were tested using ADF and PP at first difference, the test statistics are significant at 1%, 5% and 10 %. This means that our variables do not have unit roots at first difference; it is integrated of order 1 that is I(1). Results show that our variables are stationary at intercept, intercept and trend and none.

Table 4.3 ADF and PP Test at First Difference

		ADF TEST		P.P TEST		Conclusion
Variables	Model Specification	t-values (lags)	SIC	t-values (Bandwidth)	SIC	
LGDEBT	Intercept	-4.828968***(0)	-2.253693	-5.014051***(4)	-2.085773	Stationary
	Trend and Intercept	-5.520218***(0)	-2.119930	-5.525131***(2)	-2.119930	Stationary
	None	-3.247750***(0)	-1.914752	-3.382627***(4)	-1.944842	Stationary
LGDEF	Intercept	-9.785501***(0)	1.742051	-18.03847***(14)	1.742051	Stationary
	Trend and Intercept	-9.705376***(0)	1.835456	-32.77721***(32)	1.835456	Stationary
	None	-9.511927***(0)	1.702316	-9.823002***(1)	1.702316	Stationary
LCAB	Intercept	-5.568294***(0)	1.001920	-7.421438***(25)	1.001920	Stationary
	Trend and Intercept	-5.102481***(1)	1.138292	-9.673080***(32)	1.101504	Stationary
	None	-5.617074***(0)	0.903112	-6.168508***(18)	0.903112	Stationary
LINF	Intercept	-8.252449***(0)	0.856803	-8.252449***(0)	0.856803	Stationary
	Trend and Intercept	-8.288442***(0)	0.919419	-8.234738***(1)	0.919419	Stationary
	None	-8.125883***(0)	0.798874	-7.996304***(2)	0.798874	Stationary
LGSAV	Intercept	-0.1153686(2)	-1.201123	-6.955911***(4)	-1.019589	Stationary
	Trend and Intercept	-0.886233(2)	-1.218880	-7.422549***(4)	-1.090785	Stationary
	None	0.492616(2)	-1.293255	-6.224500***(4)	-0.885233	Stationary
LGCAP	Intercept	-5.834381***(0)	-1.533167	-5.987060***(5)	-1.533167	Stationary
	Trend and Intercept	-5.744421***(0)	-1.433791	-5.872389***(5)	-1.433791	Stationary
	None	-5.726385***(0)	-1.603544	-5.777936***(4)	-1.603544	Stationary

Note: Reject at 1 %(***), 5 %(**), 10 %(*) significance level

4.5 VAR LAG ORDER SELECTION CRITERIA

Table 4.4 shows that a lag length of two is best for our data in the case of Greece. This is shown by the AIC, HQ, LR and FPE criteria with the asterisk on the lag of the various criteria. As postulated by Liew (2004), the AIC and the FPE results are superior to SC and HQ criterion when results with observations less than sixty are considered. We then proceeded to conduct our other tests with the lag of two. With this lag of two, our error term was normally distributed, no autocorrelation and no heteroskedasticity.

Table 4.4 Selection of the Lag Length

Lag	LogL	LR	FPE	AIC	SC	HQ	Conclusion
0	-80.68352	NA	0.000124	5.192941	5.419684	5.269233	Not good
1	46.35046	207.8738	2.61e-07	-0.990937	0.369524*	-0.533183	Not good
2	78.23372	42.51101*	1.92e-07*	-1.408104*	1.086075	-0.568889*	Good

** indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion.*

4.6. COINTEGRATION TEST RESULT

The Johansen method of cointegration used gives us the number of cointegration as well as permitting us to impose theory based restrictions. When cointegration is present, it means that our variables share a common trend and long run equilibrium as suggested theoretically. Our cointegration results are analyzed with the trace and maximum eigenvalue presented in Table 4.5.

Table 4.5 Cointegration Results with Trace and Maximum Eigen Values

Hypothesized No. of CE(s)	Eigen Value	Trace Statistic	0.05 Critical Value	Probability	Conclusion
None *	0.819013	102.8624	69.81889	0.0000	Reject Ho
At most 1 *	0.516615	48.16393	47.85613	0.0468	Reject Ho
At most 2	0.369859	24.90181	29.79707	0.1650	Do not reject Ho
At most 3	0.265426	10.12384	15.49471	0.2713	Do not reject Ho
At most 4	0.007874	0.252976	3.841466	0.6150	Do not reject Ho
Hypothesized No. of CE(s)	**Eigen Value**	**Max-Eigen Statistics**	**0.05 Critical Value**	**Probability**	**Conclusion**
None *	0.819013	54.69851	33.87687	0.0001	Reject Ho
At most 1	0.516615	23.26212	27.58434	0.1626	Do not reject Ho
At most 2	0.369859	14.77797	21.13162	0.3047	Do not reject Ho
At most 3	0.265426	9.870863	14.26460	0.2205	Do not reject Ho
At most 4	0.007874	0.252976	3.841466	0.6150	Do not reject Ho

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level. Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level. * denotes rejection of the hypothesis at the 0.05 level.

The results in Table 4.5 above show the cointegration results of the trace and maximum Eigen. In the case of the trace tests, there are two cointegrating equation while with the maximum Eigen value there is one cointegrating equation.

The null hypothesis of no cointegrating vectors of the trace statistics is rejected at none since the test statistics of 102.8624 is greater than the 5 % critical value of 69.81889. This implies that cointegration exists at none. Moving on to the test for the null hypothesis of at most 1 cointegration vector, the trace statistics is 48.16393 that are greater than the critical value 47.85613. Therefore, there is cointegration of variables for at most one. The null hypothesis of no cointegrating vector is not rejected for at most two. This implies that the variables included in this study under the trace statistics are cointegrated at none and at most 1. For the hypotheses of at most 2, the trace statistics of 24.90181 is less than the critical value of 29.79707. Hence the

null hypothesis of no cointegration is accepted and we conclude that there are two cointegrating equations at 5% with the trace statistics. Also we see that the probability of the trace statistics is only significant at none and at most one hence confirming that two long run relationships exist between our variables.

The maximum Eigenvalue tests show that at none, the Max-Eigenvalue is 54.69851 which are greater than the critical value of 33.87687. This indicates one cointegrating equation at the 5% level. However, the Max-Eigen statistic values of at most 1, 2, 3 and 4 are below the level of 5 % indicating that the null hypothesis of no cointegration vector is accepted. Also, the probability of the Maximum Eigen test is significant only at none hence confirming that this test shows one cointegration relationship among the variable. Since the Maximum Eigen test is more powerful than the Trace statistics, we conclude that there is one cointegration vector. This means that there is a unique long run relationship between GDEBT and its determinants in Greece. Since a long run regression model is needed to show the relationship between government debt and its determinants. Our normalised cointegrating coefficients signs from Appendix C below are as follows:

$$LGDEBT + LGDEF - LCAB + LINF + LGSAV \qquad \textbf{(4.1)}$$

where the general government debt long run equation from Johansen cointegration is:

$$LGDEBT = -374485LGDEF + 0.626167LCAB - 0.380628LINF - 0.422749LGSAV \qquad \textbf{(4.2)}$$

The adjustment coefficients are: 0.209504 for LGDEBT, -1.508414 for LGDEF, 1.061339 for LCAB, -1.274131 for LINF and 0.219859 for LGSAV. Since the Johansen test does not give the level of significance, the explanation of our long run equation (4.2) was done under the VECM estimates whereby the significant levels were explained alongside. After our Johansen test, we conducted weak exogeneity tests and impose restrictions in order to obtain a good long run equation.

4.7 WEAK EXOGENEITY RESULTS ON BETA (β)

The results in Table 4.6 help to identify if all our variables are endogenous or exogenous. More specifically, these results show that our variables are all endogenous. The null hypothesis of variables are not weakly exogenous to the system is accepted because the probabilities of the chi-square are highly significant at 1%, thus the variables are endogenous. If the probability was above 10%, we would have concluded that the variables are exogenous.

Table 4.6 Results of the Weak Exogeneity Tests

Variables	Chi-square	Probability	Conclusion
LGDEBT	41.42121	0.000000	Endogenous
LGDEF	36.45597	0.000000	Endogenous
LCAB	39.35416	0.000000	Endogenous
LINF	41.40933	0.000000	Endogenous
LGSAV	39.68111	0.000000	Endogenous

Since the variables for Greece are all endogenous in determining LGDEBT, they therefore explain changes in LGDEBT. After testing for weak exogeneity, we proceed to testing the effect of the imposition of restrictions on our long run equation β.

4.8 LONG RUN RESTRICTION RESULTS

Results in Table 4.7 below, show the correct restrictions signs to impose on our variables according to the theory in our model and in order to get a good long run equation for Greece. The signs of the restrictions on our variables are correctly specified since the probability value is highly significant at 1 % level. Consequently, we imposed these restriction signs on our VECM estimates to get a good long run equation for Greece.

Table 4.7 Results of Restrictions on β

Variables	Chi-square	Probability	Conclusion
LGDEBT - LGDEF+ LCAB + LINF - LSAV	44.82945	0.000000	Correct restrictions signs to be imposed according to theory in VECM estimate

4.9 VECM ESTIMATES RESULTS

The VECM procedure provides a more reliable test of cointegration as well as an unbiased estimate of the long run relations. VECM specifications force the long run behavior of the endogenous variable to converge to their cointegrated relationships, while accommodating short run dynamics. VECM estimates are used to specify the long and short run dynamic model after establishing the cointegration relationship. The main reason for the error correction term in this study is to measure any movement away from the long run equilibrium. With the error correction mechanism, a proportion of the disequilibrium in one period is corrected in the next. The size of the error correction term indicates the speed of adjustment of any equilibrium towards a long run equilibrium state. We present our estimates in Table 4.8 below, after imposing and testing our restrictions, our VECM was estimated. Since we used the natural logarithms of our variables; therefore our coefficients would be interpreted in terms of elasticity.

Table 4.8 Long Run Coefficient and Level of Significance

Variables	LGDEBT	LGDEF	LCAB	LINF	LGSAV	Constant
Coefficient	1.000000	0.374485	-0.626167	0.380628	0.422749	-3.900687
t-statistics		6.57749	-10.4168	7.68836	1.60907	
Conclusion		Negative and significant	Positive and significant	Negative and significant	Negative and insignificant	

The long run equation for Greece is:

$$LGDEBT = 3.900687 - 0.374485LGDEF + 0.626167LCAB - 0.380628LINF - 0.422749LGSAV \quad (4.3)$$

The VECM estimate results for long run relationship of Greece from Table 4.8 and in equation 4.3 above show that there is a significant negative relationship with LGDEBT and LGDEF. A 1% increase in LGDEF will cause LGDEBT to decrease by 0.37% in Greece. This result is not consistent with intertemporal budget constraint since it says when deficit increase LGDEBT should increase as well. Budinal *et al.* (2005) got a negative relationship between LGDEBT and fiscal surplus. This result is in accordance with the Keynesian theory; that postulates that increased deficit spending results in the government having an increase in income in later periods. This negative relationship between LGDEBT and LGDEF in this study could be as a result of the gross capital formation included in the calculation of LGDEF. Therefore, the Greek government should have more deficits and ultimately invest it in an income generating projects. Suggested sector of investment could be their service sector more followed by their industrial sector.

Also, our results from Table 4.8 above show that LGDEBT and LCAB in Greece are significant and positively related. Hence, a 1% increase in LCAB will significantly cause LGDEBT to increase by 0.62%. This result is the same as that of Sinha *et al.* (2011) who had a significant positive relationship between LGDEBT and LCAB for low income countries. This result for Greece could be explained by the negative value in the LCAB in Greece, an increase in this negative LCAB will cause LGDEBT to increase as well. If the Greek government reduce their LCAB, LGDEBT will reduce as well. They can achieve this by exporting much good and services than they import, encourage more earnings from rents, interest, profit, dividends and transfer payments from the rest of the world.

Moreover, a significant negative relationship is found between LGDEBT and LINF. The results in Table 4.8 above show that a 1% increase in LINF will cause LGDEBT to decrease by 0.38% in Greece. This result is confirmed by theory, but, is in contrast to the study by Hsing (2010) who found a positive relationship between LGDEBT and LINF.

Finally, LGDEBT and LGSAV have a negative insignificant relationship from our results for the case of Greece. A 1% increase in savings will cause LGDEBT to decrease by 0.42%. This

relationship corresponds with the theory. However, our result is contrary to the findings of Checherita and Rother (2010) that showed no conclusive relationship between LGSAV and LGDEBT. The negative relationship between LGDEBT and LGSAV is because when LGSAV increases, the government will not have to borrow from abroad. It would use the savings for its expenditures and investments. The error correction terms are discussed as follows:

Table 4.9 Error Correction Term Results

Variables	D(LGDEBT)	D(LGDEF)	D(LCAB)	D(INF)	D(LGSAV)
Error correction term	-0.209504	-1.508414	1.061339	-1.274131	0.219859
T statistics	2.31702	-2.23138	2.36210	-3.47374	1.42841
Conclusion of the error correction term value	Negative and significant	Negative and significant	Positive and significant	Negative and significant	Positive and insignificant

Our result from Table 4.9 above shows that the error correction terms are significant with the exception of GSAV that is insignificant. This provides additional evidence of cointegration in the Greek government debt equation. The estimate of the equation is theoretically correct since the sign of our error correction term of D(LGDEBT) is negative (-0.209504) with a high absolute t-statistics value of 2.31702. The error correction term is expected to be negative for equilibrium to be restored. This confirms that there is a problem in the long run equilibrium relationship between the dependent and independent variables in Greece hence the error correction model is well specified. The adjustment of the model to the previous year's disequilibrium is 79.9 %. This determines the speed of convergence to equilibrium in the presence of a shock.

The results of our short run VECM is as shown in Table 4.10 below. The differenced form is to ensure stationarity of our variables while inclusion of the lagged values of both our dependent and independent variable in the model is to ensure that lagged effect of LGDEBT and its determinants are captured.

Table 4.10 Short Run Error Correction Results

Variables	Coefficient	T statistics	Conclusion
CointEq1	0.209504	2.31702	Insignificant
D(LGDEBT(-1))	0.085639	0.46185	Insignificant
D(LGDEBT(-2))	-0.085871	-0.42496	Insignificant
D(LGDEF(-1))	-0.032192	-1.06179	Insignificant
D(LGDEF(-2))	-0.022569	-0.87671	Insignificant
D(LCAB(-1))	0.043246	0.92369	Insignificant
D(LCAB(-2))	0.098875	2.08032	Significant
D(LINF(-1))	-0.063577	-1.25339	Insignificant
D(LINF(-2))	0.050249	0.77841	Insignificant
D(LGSAV(-1))	-0.189808	-1.45207	Insignificant
D(LGSAV(-2))	-0.068908	-0.48636	Insignificant
R-squared	0.632702		
Adj. R-squared	0.520688		

The results from Table 4.10 above show that when our variables are autoregressed with the lag of one in the short run, D(GDEBT), D(LGDEF) and D(LGSAV) are positive and insignificant in relation to determining LGDEBT. Whereas, D(LCAB) and D(LINF) are negative and insignificant in the short in determining LGDEBT. We concluded that all our variables are insignificant at lag one in determining variation in LGDEBT in the short run.

The coefficient of changes in the lag of two of D(LCAB) and D(LINF) are negative in relation to LGDEBT. In this case, D(LCAB) is significant while D(LINF) is insignificant. D(LGDEF) and D(LGSAV) are positively related to LGDEBT in the short run and are insignificant. We conclude that all variables with lag of two are insignificant except D(LCAB). Hence just D(LCAB) negatively and significantly affect LGDEBT in the short run in Greece.

The goodness of fit variables (R-square) has a value of 0.632702 implying that about 63 % of variation in LGDEBT is explained by our independent variables. Our Adjusted R square is 0.520688; it is confirming that our independent variables explain variation in our dependent variables with about 52%. After we estimated our model, we went further to test if the estimated model for Greece was good.

4.10 DIAGNOSTIC AND STABILITY TEST RESULTS

The diagnostic and stability tests are to assist in deciding whether or not a model is correctly specified and if it is a good model. It is conducted on the VECM model in order to determine whether any of the assumptions about the classical normal linear regression model is violated. We used probability numbers to decide if the null hypothesis should be accepted or rejected. The probability value indicate the probability of obtaining a test statistics whose absolute value is greater than or equal to that of the sample statistics when the null hypothesis is true. Thus, a low probability value (below 5%) leads to the rejection of the null hypothesis.

A summary of the diagnostic and stability test results of our regression model is presented in Table 4.11 below and will be followed by details of each test.

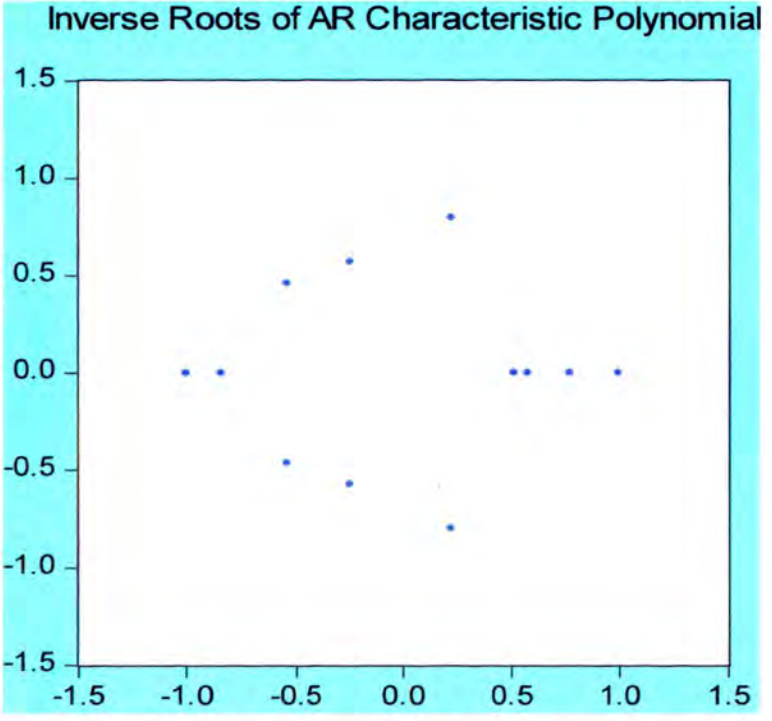
Table 4.11 Summary of Diagnostics and Stability Test Results

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 2, LM stat=26.40175	0.3864	There is no serial correlation
White	No heteroskedasticity	Chi square= 356.4155	0.1520	There is no heteroskedasticity
Jarque Bera	Residual are normally distributed	JB = 8.473953	0.5826	The model is normally distributed

4.7.1 Stability Test Results

In this study, the AR roots graph used to test the stability of a model is shown in Figure 4.3 below. We can found out that just the two unit roots was imposed by the model. Also, all the unit roots lie in the unit circle indicating that this model for Greece is stable. Hence further tests can be conducted from this model of Greece.

Figure 4.3: Stability Test Results



4.7.2 Autocorrelation LM test results

The Autocorrelation LM test is used to tests for serial correlation among our variables. This is show if the error term from one observation is correlated with that of another. The null hypothesis states that there is no serial correlation. If the probability is less than 5 %, we reject the null hypothesis and conclude that the residuals are serially correlated. The results from Table 4.12 below, show that probability of the LM tests is greater than 5 % at lag one up to lag twelve, thus the null hypothesis of is accepted hence we conclude that there is no serial correlation

among our residuals. This is with the exception at lag six, which shows that there is serial correlation. Since our best lag length was two, we therefore do not take the results of lag six into consideration and conclude that the residual are not serially correlated.

Table 4.12 Serial Correlation LM TEST Results

Lags	LM STAT	Probability	Conclusion
1	12.51641	0.9819	No serial correlation
2	26.40175	0.3864	No serial correlation
3	16.54579	0.8976	No serial correlation
4	22.13200	0.6281	No serial correlation
5	17.16337	0.8758	No serial correlation
6	44.62425	0.0092	Serial correlation
7	15.02714	0.9407	No serial correlation
8	20.22898	0.7347	No serial correlation
9	15.27431	0.9347	No serial correlation
10	24.24030	0.5055	No serial correlation
11	22.39253	0.6130	No serial correlation
12	23.49892	0.5485	No serial correlation

4.7.3 White Heteroskedasticity test results

When the residuals are heteroskedastic, it means that variances of error terms are not constant from one observation to another. The null hypothesis states there is no heteroskedasticity in our residual. This hypothesis is rejected when the probability value is less that 5%. Results from Table 4.13 below show that there is no heteroskedasticity among our variables since the

probability of Chi square is greater than 5 %. Hence we accept the null hypothesis of no heteroskedasticity and reject the alternative. We conclude that our residuals are homoskedastic.

Table 4.13 VEC Residual Heteroskedasticity Tests: No Cross Terms

Component	Chi-square	Probability	Conclusion
Joint	356.4155	0.1520	No heteroskedasticity

4.7.4 Normality tests results

Jarque-Bera test statistics are the most often used test for normality. It measure whether the Skewness and Kurtosis test matches with the normal distribution. Its null hypothesis states that residuals are normally distributed. When the probability value is greater than 5%, we accept the null hypothesis and reject the alternative. We can see from Table 4.14 below that our residuals are normally distributed since probability of Skewness, Kurtosis and JB are greater than 5% and being highly insignificant. We therefore accepted the null hypothesis that residuals are normally distributed and reject the alternative.

Table 4.14 VEC Residual Normality Tests

Component	Type	Chi-square	Probability	Conclusion
Joint	Skewness	4.210620	0.5195	Normally distributed
Joint	Kurtosis	4.263330	0.5122	Normally distributed
Joint	Jarque-Bera	8.473953	0.5826	Normally distributed

Since our residuals are stable, there is no serial correlation, no heteroskedasticity and is normally distributed, we conclude that our estimated model for Greece is good and can be used for further analysis and forecasting.

4.8 GRANGER CAUSALITY TEST RESULTS

The Granger causality test is conducted to determine whether the current and lagged values of one variable affect another. According to Granger (1969), a variable (X) is said to Granger cause another variable (Y) if past and present values of X help to predict Y. A simple Granger causality test involves two variables, viz., LGDEBT and LGDEF. We will further explain Granger causality among our variables.

Since integration between variables does not specify the direction of causation if they be any between our variables, we verify the direction of causation between our variables using the granger causality test. The Granger causality test for this study used F-test statistics and probability value to determine the causal relationships between variables. Table 4.15 below shows the results obtained when using the Granger causality test. The null hypothesis is not rejected when the probability value is greater than 10 %, but if less than 10%, then we reject the null hypothesis and accept the alternative.

Our main causality test involves LGDEBT and LGDEF. From Table 4.15 below, the null hypothesis, which states that LGDEF does not Granger cause LGDEBT, is insignificant. As such, we accept the null hypothesis and reject the alternative. Also, the null hypothesis of LGDEBT does not Granger cause LGDEF is insignificant. We therefore accept this null hypothesis and reject the alternative. The results indicate that causality does not occur between LGDEBT and LGDEF. Hence, in Greece, changes in LGDEBT do not affect LGDEF and vice versa. This means that changes in the short term LGDEF cannot reflect on changes in LGDEBT movement and vice versa.

The result also shows that there is also no causality between LCAB and LGDEBT, LGSAV and LGDEBT, LCAB and LGDEF, LGSAV and LGDEF, LGSAV and LCAB. Changes in the short term between our variables cannot reflect in the movement of others. The implication of these results for the Greek government and policy makers is that policies to be implemented will not need to target any of these variables in a particular order. They can start with any variable and it will not cause a change in the other variables.

Table 4.15 Pairwise Granger Causality Test with Lags: 2

Null Hypothesis	Number of Observation	F-Statistics	Probability	Conclusion
LGDEF does not Granger Cause LGDEBT	33	0.75076	0.4813	No causality
LGDEBT does not Granger Cause LGDEF		2.31779	0.1171	No causality
LCAB does not Granger Cause LGDEBT	33	0.39347	0.6784	No causality
LGDEBT does not Granger Cause LCAB		1.25181	0.3015	No causality
LINF does not Granger Cause LGDEBT	33	1.54288	0.2314	No causality
LGDEBT does not Granger Cause LINF		4.14528	0.0265	Causality
LGSAV does not Granger Cause LGDEBT	33	1.69936	0.2011	No causality
LGDEBT does not Granger Cause LGSAV		1.79246	0.1851	No causality
LCAB does not Granger Cause LGDEF	33	0.81577	0.4525	No causality
LGDEF does not Granger Cause LCAB		0.49016	0.6177	No causality
LINF does not Granger Cause LGDEF	33	0.29155	0.7493	No causality
LGDEF does not Granger Cause LINF		2.78470	0.0789	Causality
LGSAV does not Granger Cause LGDEF	33	0.77646	0.4697	No causality
LGDEF does not Granger Cause LGSAV		2.07431	0.1445	No causality
LINF does not Granger Cause LCAB	33	3.58522	0.0411	Causality
LCAB does not Granger Cause LINF		1.50264	0.2399	No causality
LGSAV does not Granger Cause LCAB	33	1.57402	0.2250	No causality
LCAB does not Granger Cause LGSAV		0.43532	0.6514	No causality
LGSAV does not Granger Cause LINF	33	1.21763	0.3111	No causality
LINF does not Granger Cause LGSAV		3.25096	0.0538	Causality

LINF does not Granger cause LGDEBT but LGDEBT Granger causes LINF at a 5 % level of significance as shown by the F-statistics in Table 1.15 above. As such, we reject the null hypothesis and accept the alternative. This result implies that, in Greece, changes to LGDEBT affect LINF but changes in LINF will not affect LGDEBT. The causality is unidirectional, from LGDEBT to LINF. This means that the past values of LGDEBT have a predictive ability in determining the present value of LINF while the past value of LINF does not have a predictive ability in determining LGDEBT. The implication of these results for the Greek government and policy makers is that since LGDEBT affects LINF but LINF does not affects LGDEBT, policies to be implemented should target LGDEBT first. This is because by targeting LGDEBT, it will affect LINF.

From our results in Table 1.15 above, the causality is unidirectional from LGDEF to LINF at a 10 % level of significance hence the past value of LGDEF had a predicting ability in determining the present value of LINF. There is causality from LINF to LCAB at a 5 % level of significant and from LINF to LGSAV at a 10 % level of significance. This shows that the past value of LINF can predict the ability in determining the present value of LCAB and LGSAV. This implies that, for policies to be implemented in Greece, it has to be considered that changes in LGDEBT and LGDEF will affect LINF. Also, change in LINF will affect both LCAB and LGSAV.

There is no bivariated causality between our variables hence, there do not exist a leading lag relationship between our variables. If LGDEBT and LGDEF changes, it will cause a change in LINF which will in turn cause a change in LCAB and LGSAV.

4.9 RESULTS OF VARIANCE DECOMPOSITION

Variance decomposition indicates how much of the predicted error variance can be explained by the exogenous shocks from other variables. Table 4.16 below shows a summary of the effects of variance decomposition results of LGDEBT on our independent variables over a period of ten years. A high proportion of the shocks are explained by their own innovations. That is a shock on LGDEBT as shown below is mostly explained by LGDEBT it self. At the end of 10 years, the forecast error variance of LGDEBT is explained by its own innovations at 93.76%. From Table

4.16 below, during the second period, LCAB is the variable that causes the highest variation in LGDEBT at 2.6%. In the third period, LINF is the highest explanatory variable with 1.99% followed by LCAB in the 4th period with 2.4%. From the 5th period to the 10th, LINF explains the variation in LGDEBT with up to 4.02% in the 10th period.

Appendix F below shows the effect of the variance decomposition among our variables. The variance decomposition of LGDEBT on LGDEF shows that high proportion of shocks is explained by their own innovations with 84.88 % of LGDEF followed by 3.74 % of LGDEBT. The variance decomposition of LGDEBT on LCAB is mostly explained by LGDEBT with 42.31 % followed by 17.575 variations on its own innovation (LCAB). The variance Decomposition of LGDEBT on LINF is 55.96 % by itself (LINF), followed by 29.07 of LCAB. LGDEBT on LGSAV is 55.43% on its own (LGSAV) followed by 30.48 by LINF. We conclude that apart from LCAB, most of the variations of LGDEBT on the LGEBT, LGDEF, LCAB, LINF and LGSAV are explained by their own innovations.

Table 4.16 Variance Decomposition Results of LGDEBT on the Independent Variables

Period	S.E	LGDEBT	LGDEF	LCAB	LINF	LGSAV
1	0.067006	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.115295	96.14786	0.028037	2.608841	0.459410	0.755847
3	0.149169	94.92303	0.115419	1.960608	1.993853	1.007090
4	0.193727	94.56275	0.102519	2.405121	2.242248	0.687360
5	0.238024	93.62563	0.195698	2.700015	3.012058	0.466598
6	0.278575	94.02228	0.150664	2.499837	2.970478	0.356737
7	0.317792	93.92581	0.119690	2.162626	3.509744	0.282126
8	0.354696	93.98535	0.097667	2.104196	3.565022	0.247761
9	0.390214	93.69548	0.083998	1.958639	4.057045	0.204837
10	0.424915	93.75892	0.080623	1.965439	4.020301	0.174715

4.10 RESULTS OF GIRF

According to Figure 4 below, the response of LGDEBT to LGDEBT has an increasing positive effect on itself over the 10 periods. This means that a shock to LGDEBT in the economy of Greece will cause LGDEBT to increase.

The response of LGDEBT to LGDEF and LGDEBT to LCAB has an increasing negative effect over the same periods. This means that shocks to LGDEF and LCAB will cause LGDEBT to decrease. Our GIRF results of a negative relationship between LGDEBT and LGDEF ties with that of the Johansen cointegration results discussed above.

The response of LGDEBT to LINF initially does not have an effect on LINF during the first two periods. After the second period, it gradually has an increasing positive effect on LINF. Hence a shock from LINF will cause LGDEBT to be neutral in the first two years then it later caused LGDEBT to increase.

The response of LGDEBT to LGSAV was increasingly negative over the periods. This means that a shock to LGSAV will cause LGDEBT to decrease hence matching with the Johansen cointegration result above.

A shock to LGDEBT as shown in Figure 4.4 below for Greece has an initial decreasing negative effect on LGDEF during the first two periods. After these periods, it becomes increasingly positive then decreases until it becomes negative in the 4th period. Later it experiences a negative shock up to the 6th period and a negative shock from the 7th to 10th period. We conclude that a shock to LGDEBT will cause LGDEF to decrease since the shock is mostly negative.

The response of LCAB to LGDEBT in Greece initially is negative during the 1st period, after it becomes increasingly positive up to the 10th period meaning that a shock to LGDEBT will cause LCAB to decrease for the first two years then later it will increase up to the tenth year.

The response of LINF to LGDEBT in Greece is positive as well as zero in the 5th, 7th and 9th periods. This means that, when LGDEBT experiences a shock, it will cause LINF to increase mostly.

Response of LGSAV to LGDEBT is negative up to the 4th period then it becomes positive. It shows that, a shock on LGDEBT will cause LGSAV to decrease from the 1th to 4th period, thereafter; LGSAV will increase up to the 10th period.

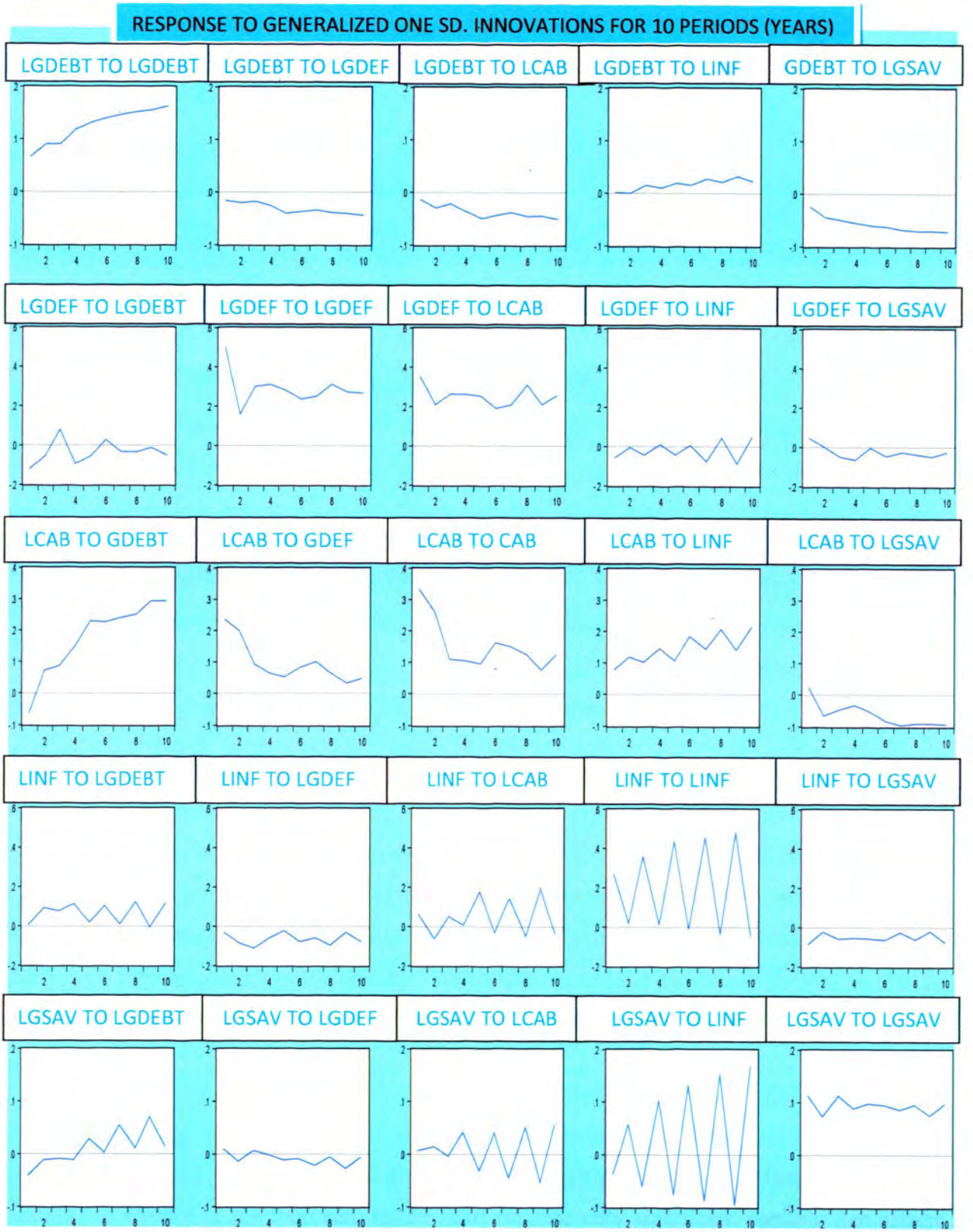
A shock from LGDEF has a positive effect on LGDEF, the positive effect is found by the response of LGDEF to LCAB. This means that, a shock on LGDEF and LCAB will cause LGDEF to decrease over the years. The response of LGDEF to LINF is mostly negative and neutral. Response of LGDEF to LGSAV is positive up to the 2nd period then it becomes negative. This means that, a shock to LGSAV will cause LGDEF to increase during the first and second year, and later it will decrease.

Response of LCAB to LGDEF is positive although decreasing over the periods. The response of LCAB to LCAB is positive and decreasing over the period. LCAB to LINF is positive and fluctuate over the periods. Hence most of the shocks to LGDEF, LCAB, and LINF will cause LCAB to increase over the periods. LCAB to LGSAV is positive in the 1st period then after it becomes negative over the periods hence a shock on LGSAV will cause LCAB to increase in the first year then decrease from the 2nd to the 10th year.

Response of LINF to LGDEF is negative hence a shock in LGDEF will cause LINF to decrease. The response LINF to LCAB is positive at 1st period then negative in the 2nd, positive in the 3rd, negative in the 7th then positive and negative in the 8th and positive and negative in the 10th. We concluded that the response is mostly positive. Response of LINF to LINF is positive then zero at 2,4,6,8 and 10 periods. We conclude that the response is positive; a shock from LINF will cause LINF to increase over the periods. LINF to LGSAV is negative hence when GSAV experiences a shock; it will cause LINF to decrease.

The response of LGSAV to LGDEF is mostly negative. LGSAV and LCAB is positive, negative at 2nd period, positive at 3rd, zero 4th positive zero 5th, negative zero at 6th positive zero at 7th, negative zero at 8th positive then zero at 9th and positive at 10, hence it is mostly negative. LGSAV to LINF is negative then zero at 5th negative, zero at 7th positive, positive at 8th, we conclude that the shock fluctuating over the years between negative and positive. LGSAV to LGSAV is positive.

Figure 4.4 Generalized impulse response function results



CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

5.1 INTRODUCTION
5.2 SUMMARY AND CONCLUSIONS
5.3 POLICY RECOMMENDATIONS
5.4 FUTURE RESEARCH

5.1 INTRODUCTION

This chapter encapsulates the summary of our findings, interpretation and ultimately culminates into our concluding remarks regarding the ESDC with special reference to the econometric analysis of the Greece debt crisis. Lastly, we recommend some future policy directions.

5.2 SUMMARY AND CONCLUSIONS

Since the start of this crisis in 2008, Greece has so far received bailout twice and had undergone five series of austerity measures as at June 2012, but it is still threatening to default. If it defaults, it will affect Greece, the Eurozone and the world at large in many areas.

The main focus of this study was to investigate the determinants of the Greek debt crisis. Our study was largely quantitative in nature, the analysis and examination was executed subsequent to the extensive review of the literature and theories. The study aimed to answers several research questions such as: What are the main determinants of the high level of sovereign debt in Greece? How are these determinant factors related to government debt in Greece? What is the direction of causation among our variables? How did the debt crisis shocks impact the Greek government debt level? How did the ESDC evolve and what are the causes, consequences and cures?

The results indicate that the significant variables that determined LGDEBT in the long run in Greece were LGDEF, LCAB, and LINF significant. LGSAV does not significantly determine LGDEBT in Greece in the long run. In the short run, the only significant variable that affects

LGDEBT is LCAB at lag two while the others were insignificant. At lag one; all the variables are insignificant in determining LGDEBT. About 63 % of our independent variables explain the variation in our LGDEBT. This implies that the regression is not spurious and therefore the debt model of Greece is identified as having a good fitness.

The relationship between LGDEBT and LGDEF was significant and negative while that of LGDEBT and LCAB was positive and significant. There is a significant negative relationship between LGDEBT and LINF and a negative insignificant relationship between LGDEBT and LGSAV. The negative relationship between LGDEF and LGDEBT could be as a result of the gross capital formation in Greece's gross national expenditure. This model suggests that Greece should spend more especially on investment generating income projects; this will reduce the government debt in future. This is in accordance with the Keynesian theory of public debt; they were of the point of view that deficit spending will make the government to have an increase in the income in the later periods. The positive relationship between LGDEBT and LCAB could be due to the fact that LCAB in Greece has been increasing negatively, hence an increase in this negative LCAB will cause GDEBT to increase a well. The negative relation between LGDEBT and LINF and LGDEBT and LGSAV corresponds with theory. Our model for Greece was stable, with no serial correlation, no heteroskedasticity and it was normally distributed. Based on the outcome of the aforementioned tests we concluded that our model was good and we were able to proceed to other test.

The granger causality test result for Greece shows that LINF does not granger cause LGDEBT but LGDEBT granger cause in LINF at 5 % level of significance. This implies that the pass value of LGDEBT has a predictive ability to determine the present value of LINF while it is not the case with LINF to LGDEBT. Hence changes in LGDEBT affect LINF but changes in LINF will not affect LGDEBT in Greece. The causality is unidirectional, from LGDEBT to LINF in Greece. Also, the causality is unidirectional from LGDEF to LINF at 10 % level of significance. There is causality from LINF to LCAB at 5 % level of significance and from LINF to LGSAV at 10 % level of significance. Furthermore, LGDEF does not Granger cause LGDEBT and LGDEBT does not Granger cause LGDEF. These results indicate that causality does not occur between LGDEBT and LGDEF; hence changes in LGDEBT do not affect LGDEF and vice versa

in Greece. Also the pass values LGDEBT and LGDEF do not have a predicting ability in determining their present values. There was also no causality between LCAB and LGDEBT, LGSAV and LGDEBT, LCAB and LGDEF, LGSAV and LGDEF and lastly LGSAV and LCAB. A change in LGDEBT and LGDEF will affects LINF while a change in LINF will affect LCAB and LGSAV in Greece.

The shock of LGDEBT in Greece was explained by their own innovations. At the end of 10 years, the forecast error variance of LGDEBT is explained by its own innovations at 93.76%. During the second period, LCAB is the variable that causes the highest variation in LGDEBT at 2.6%. In the third period, LINF is the highest explanatory variable with 1.99% followed by LCAB in the 4th period with 2.4%. From the 5th period to the 10th, LINF explains the variation in LGDEBT with up to 4.02% in the 10th period. The forecast error variance of LGDEBT on LGDEF is explained by their own innovations (LGDEF) with 84.88 %. The variation of LGDEBT on LCAB is mostly explained by LGDEBT with a 42.31 % followed by itself with a 17.575 variation by its own innovation (LCAB). The Variance Decomposition of LGDEBT on LINF is 55.96% by its self (LINF), LGDEBT on LGSAV is 55.43% on its self (LGSAV), followed by 30.48 with LINF. We conclude that apart from LCAB, most of the variations in our variables are explained by their own innovations hence most of the shocks are endogenous.

The response of LGDEBT to LGDEBT has an increasing positive effect on itself over the 10 periods; hence a shock to LGDEBT in the economy of Greece will cause LGDEBT to increase. The response of LGDEBT to LGDEF and LGDEBT to LCAB has an increasing negative effect over the same periods hence shocks to LGDEF and LCAB will cause LGDEBT to decrease. A shock from LINF will cause LGDEBT to be neutral in the first two years then it later caused LGDEBT to increase. The response of LGDEBT to LGSAV was increasingly negative over the periods. This means that a shock to LGSAV will cause LGDEBT to decrease. A shock to LGDEBT for Greece has a negative effect on LGDEF; hence a shock to LGDEBT will cause LGDEF to decrease. The response of LCAB to LGDEBT in Greece initially was negative during the 1st period, after it become increasingly positive up to the 10th period hence that a shock to LGDEBT will cause LCAB to decrease for the first two years then later it will increase up to the tenth year. The response of LINF to LGDEBT in Greece is positive hence when LGDEBT experiences a shock; it will cause LINF to increase. Response of LGSAV to LGDEBT is

negative up to the 4th period then it becomes positive. It shows that, a shock on LGDEBT will cause LGSAV to decrease from the 1th to 4th period, thereafter; LGSAV will increase up to the 10th period.

The ESDC has evolved quickly and spread to many countries in Europe with most countries having debt-to-GDP ratios of more than 100 %. This crisis evolved in the PIIGS countries as follows: Portugal had a deteriorating fiscal deficit from 2007 to 2009 which made their debt and public deficit to increase. In May 2012, they had a bailout package of €78 billion. Ireland experienced a real estate bubble which collapsed in 2008 and was followed by a global recession which resulted in Ireland receiving a bailout package of €85 billion in November 2010 and in June 2012. The banks in Ireland can access the rescue funds directly with going through its government. Italy had a high pass debt record from the public sector and a slow GDP growth rate of about 1 % per annum. By September 2011, Italy's rating was downgraded and interest rates were too high to pay their debts. In 2012, Italy will receive bailout funds which will not be added to their country's debt. The starting point of the Greek crisis was the US subprime crisis, an increase in public debt levels as well as the fiscal deficit. In May 2010, Greece got their first bailout package of €110 billion and in March 2012 they received the second bailout package of €130 billion. In June 2012, Greece voted to stay in the Eurozone. Spain, in turn, experienced a decrease in house prices which increased its debt levels. Spain applied for bailout, in June 2012, Spain and Italy will receive bailout funds of about €100 billion which will not be recorded in their countries government but will be put directly in their banks.

The ESDC has many causes like the rapid growth in the level of government debts, trade imbalances, monetary policy inflexibility, loss of confidence and the global recession. The increase in government debt is caused by economics and financial crisis, weak coordination and organization of budget management, budget deficit, deterioration of macroeconomic fundamentals, high government spending, structural rigidities, tax evasion, corruption, adoption of Euro, non-effective enforcement of the EU rules, lack of enforcement of growth and stability pact. Reduction in demand, investment, imports, large current account deficits and decline in competitiveness cause trade imbalances in the Eurozone which leads to the ESDC. On the other hand, loss of confidence was as a result of deterioration of government finances, fake statistics,

bailout packages while monetary policy inflexibility and global recession was another cause of the ESDC.

ESDC has various consequences both in Greece, the Eurozone and globally. It has an effect on the bond market and the banking sector. Also ESDC has a contagion effect, it increases interest rates, increase imports while decreasing export and depreciating the Euro as a currency. Furthermore, this crisis decreases remittances sent to developing countries, it affects foreign currency, and makes investors to lose confidence, tightens the fiscal policies, affects the political system and decreases the economic growth of the country and others. These consequences are so severe both to the country involved and the world at large that measures need to be put in place to reduce the effects of this crisis.

At the beginning of the crisis, the first measures taken were the creation of the European Financial Stability Facility, European Financial Stabilisation Mechanism and the Brussels agreement and aftermath. It was then followed by ECB intervention and some economic reforms being put in place. Also bailout has been the ways recently used for stopping the crisis in the Eurozone where may Greece received its second bailout and voted to stayed in the Eurozone. Some authors proposed that the following measures be put in place to reduce this crisis: stabilising the Eurobond, creation of a Eurozone stability mechanism, Euro monetary fund should manage Eurozone public finances, as well as the use of the Euro as a common currency. Further cures involve the creation of Trichet bonds and sovereign debt tribunals, solving current account imbalances, a European fiscal union which will reinforce fiscal policies, the revision of the Lisbon Treaty and finally the writing off of debt or third party rescue packages, financial market restrictions and sovereign debt restructuring. Some of these cures were implemented while others are proposed to mitigate the rapid spread of this crisis in Greece, the Eurozone and the world at large.

5.3 POLICY RECOMMENDATIONS

From the results of this study, policy makers in Greece should increase gross national expenditures which will increase their LDEF since gross capital formation in included in it; this will help build the economy in future. Furthermore, much of the expenditure should target income generating projects, either in their service sector, industrial and/or agricultural sector.

LCAB of Greece should be reduced since its decrease will cause LGDEBT to decrease. This means that Greece should improve on their net trade in goods and services, net earnings from rents, interest, profit and dividends and net transfer payment to and from the rest of the world.

Also LINF should increase to facilitate the decrease of LGDEBT. Fiscal, monetary and trade policy are the best policies to be implemented in Greece. Specifically, it will contribute to reducing the rising government debt in Greece. Since LGSAV is insignificant in determining LGDEBT in Greece, the LGSAV should be invested in the secondary and tertiary sectors in order to generate income.

The Greek government and policy makers should first target LGDEBT and LGDEF since it will affect LINF. However, LINF does not affect LGDEBT and LGDEF. If they target LINF first, it will not have any effect on LGDEBT and LGDEF. Furthermore, they should target LINF first if they want to cause a change in LCAB and LGSAV in Greece.

Based on the outcome of our research, we postulate that if the measures recommended above are implemented in Greece, then it will cause the rising Greek government debt (even after the second bailout and fifth austerity measure in June 2012) to reduce, ceteris paribus. In particular, these measures will reduce their cost funding, decrease export prices, appreciation of the Euro, decreased in unemployment, increase remittances sent to developing countries and fiscal policy measure will be soften. Furthermore, it will encourage inflows of foreign direct investment, and growth in Greece.

5.4 FUTURE RESEARCH

On the basis of our findings, several areas of potential future research are indicated below:

To determine how gross national income, gross national expenditure, imports, exports, foreign direct investment, gross capital formation, interest rates, exchange rates affects Greece Government debt. Also, to assess the implementation and effects of the bailout out and other rescue measures that was implemented to alleviate the debt crisis in Greece.

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APPENDIX

APPENDIX A: Johansen Cointergration Results

Date: 09/03/12 Time: 10:19
Sample (adjusted): 1979 2010
Included observations: 32 after adjustments
Trend assumption: Linear deterministic trend
Series: LGDEBT LGDEF LCAB LINF LGSAV
Lags interval (in first differences): 1 to 2

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.819013	102.8624	69.81889	0.0000
At most 1 *	0.516615	48.16393	47.85613	0.0468
At most 2	0.369859	24.90181	29.79707	0.1650
At most 3	0.265426	10.12384	15.49471	0.2713
At most 4	0.007874	0.252976	3.841466	0.6150

Trace test indicates 2 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 *	0.819013	54.69851	33.87687	0.0001
At most 1	0.516615	23.26212	27.58434	0.1626
At most 2	0.369859	14.77797	21.13162	0.3047
At most 3	0.265426	9.870863	14.26460	0.2205
At most 4	0.007874	0.252976	3.841466	0.6150

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):

LGDEBT	LGDEF	LCAB	LINF	LGSAV
7.633481	2.858623	-4.779835	2.905516	3.227047
-9.065075	-3.942132	1.829034	1.972073	-7.067362
-10.15332	-7.526505	4.745556	0.610508	6.343519
1.702773	3.265139	-0.085355	-0.419295	-4.083242
1.571553	3.155195	2.842801	0.256119	-15.71526

Unrestricted Adjustment Coefficients (alpha):

D(LGDEBT)	0.027445	0.035584	-0.000524	0.006909	0.000252
D(LGDEF)	-0.197605	0.019478	0.040397	-0.194731	-0.001276
D(LCAB)	0.139037	-0.004166	-0.048641	-0.114673	-0.008442
D(LINF)	-0.166913	0.017462	-0.099760	0.011144	-0.009742
D(LGSAV)	0.028802	-0.024322	0.037566	-0.000769	-0.004848

1 Cointegrating Equation(s): Log likelihood 86.10951

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGDEF	LCAB	LINF	LGSAV
1.000000	0.374485	-0.626167	0.380628	0.422749
	(0.05693)	(0.06011)	(0.04951)	(0.26273)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	0.209504
	(0.09042)
D(LGDEF)	-1.508414
	(0.67600)
D(LCAB)	1.061339
	(0.44932)
D(LINF)	-1.274131
	(0.36679)
D(LGSAV)	0.219859
	(0.15392)

2 Cointegrating Equation(s): Log likelihood 97.74057

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGDEF	LCAB	LINF	LGSAV
1.000000	0.000000	-3.258115	4.090247	-1.790444
		(0.68896)	(0.62401)	(1.62339)
0.000000	1.000000	7.028181	-9.905925	5.909967
		(1.76453)	(1.59819)	(4.15775)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	-0.113070	-0.061822
	(0.10399)	(0.04273)
D(LGDEF)	-1.684987	-0.641665
	(1.04822)	(0.43071)
D(LCAB)	1.099103	0.413878
	(0.69748)	(0.28659)
D(LINF)	-1.432423	-0.545979
	(0.56756)	(0.23321)
D(LGSAV)	0.440344	0.178216
	(0.23010)	(0.09455)

3 Cointegrating Equation(s): Log likelihood 105.1296

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGDEF	LCAB	LINF	LGSAV

1.000000	0.000000	0.000000	-0.209719	2.539907
			(0.19367)	(0.52781)
0.000000	1.000000	0.000000	-0.630334	-3.431169
			(0.28749)	(0.78351)
0.000000	0.000000	1.000000	-1.319771	1.329097
			(0.21354)	(0.58197)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	-0.107751	-0.057879	-0.068586
	(0.13692)	(0.07865)	(0.06124)
D(LGDEF)	-2.095151	-0.945713	1.171852
	(1.37310)	(0.78875)	(0.61410)
D(LCAB)	1.592968	0.779973	-0.903023
	(0.90264)	(0.51851)	(0.40369)
D(LINF)	-0.419529	0.204864	0.356341
	(0.66135)	(0.37990)	(0.29578)
D(LGSAV)	0.058920	-0.104527	-0.003882
	(0.27318)	(0.15692)	(0.12218)

4 Cointegrating Equation(s): Log likelihood 110.0650

Normalized cointegrating coefficients (standard error in parentheses)

LGDEBT	LGDEF	LCAB	LINF	LGSAV
1.000000	0.000000	0.000000	0.000000	2.863799
				(0.48748)
0.000000	1.000000	0.000000	0.000000	-2.457677
				(0.69240)
0.000000	0.000000	1.000000	0.000000	3.367363
				(1.69860)
0.000000	0.000000	0.000000	1.000000	1.544408
				(1.24719)

Adjustment coefficients (standard error in parentheses)

D(LGDEBT)	-0.095987	-0.035320	-0.069176	0.146701
	(0.13558)	(0.08240)	(0.06028)	(0.03100)
D(LGDEF)	-2.426733	-1.581536	1.188473	-0.429419
	(1.20025)	(0.72945)	(0.53367)	(0.27439)
D(LCAB)	1.397707	0.405551	-0.893235	0.414146
	(0.81390)	(0.49464)	(0.36189)	(0.18607)
D(LINF)	-0.400553	0.241251	0.355390	-0.516111
	(0.66412)	(0.40362)	(0.29529)	(0.15183)
D(LGSAV)	0.057612	-0.107037	-0.003816	0.058976
	(0.27479)	(0.16700)	(0.12218)	(0.06282)

APPENDIX B: Vector Error Correction Estimates Result

Vector Error Correction Estimates
Date: 08/18/12 Time: 12:32
Sample (adjusted): 1979 2010
Included observations: 32 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LGDEBT(-1)	1.000000
LGDEF(-1)	0.374485
	(0.05693)
	[6.57749]
LCAB(-1)	-0.626167
	(0.06011)
	[-10.4168]
LINF(-1)	0.380628
	(0.04951)
	[7.68836]
LGSAV(-1)	0.422749
	(0.26273)
	[1.60907]
C	-3.900687

Error Correction:	D(LGDEBT)	D(LGDEF)	D(LCAB)	D(LINF)	D(LGSAV)
CointEq1	- 0.209504	-1.508414	1.061339	-1.274131	0.219859
	(0.09042)	(0.67600)	(0.44932)	(0.36679)	(0.15392)
	[2.31702]	[-2.23138]	[2.36210]	[-3.47374]	[1.42841]
D(LGDEBT(-1))	0.085639	1.065972	0.805307	2.588886	0.161394
	(0.18543)	(1.38630)	(0.92144)	(0.75219)	(0.31565)
	[0.46185]	[0.76893]	[0.87396]	[3.44179]	[0.51131]
D(LGDEBT(-2))	-0.085871	2.986301	-1.048565	2.092422	-0.576824
	(0.20207)	(1.51071)	(1.00413)	(0.81969)	(0.34397)
	[-0.42496]	[1.97675]	[-1.04425]	[2.55269]	[-1.67694]
D(LGDEF(-1))	-0.032192	-0.486220	-0.198813	0.381935	-0.080921
	(0.03032)	(0.22667)	(0.15066)	(0.12299)	(0.05161)
	[-1.06179]	[-2.14506]	[-1.31960]	[3.10546]	[-1.56791]
D(LGDEF(-2))	-0.022569	-0.198203	-0.127751	0.182853	-0.051502
	(0.02574)	(0.19246)	(0.12793)	(0.10443)	(0.04382)
	[-0.87671]	[-1.02983]	[-0.99864]	[1.75100]	[-1.17525]
D(LCAB(-1))	0.043246	-0.202251	0.257777	-0.848677	0.103703
	(0.04682)	(0.35003)	(0.23266)	(0.18992)	(0.07970)
	[0.92369]	[-0.57781]	[1.10797]	[-4.46855]	[1.30118]

D(LCAB(-2))	0.098875	-0.204317	-0.005671	-0.534773	0.200685
	(0.04753)	(0.35533)	(0.23618)	(0.19280)	(0.08091)
	[2.08032]	[-0.57500]	[-0.02401]	[-2.77372]	[2.48047]
D(LINF(-1))	-0.063577	0.280964	-0.133788	-0.433667	0.267586
	(0.05072)	(0.37922)	(0.25206)	(0.20576)	(0.08635)
	[-1.25339]	[0.74089]	[-0.53078]	[-2.10762]	[3.09901]
D(LINF(-2))	0.050249	-0.021538	0.198557	0.822995	-0.189824
	(0.06455)	(0.48261)	(0.32078)	(0.26186)	(0.10989)
	[0.77841]	[-0.04463]	[0.61898]	[3.14290]	[-1.72747]
D(LGSAV(-1))	-0.189808	0.197509	-0.628930	0.744481	-0.096406
	(0.13072)	(0.97726)	(0.64956)	(0.53025)	(0.22251)
	[-1.45207]	[0.20210]	[-0.96824]	[1.40402]	[-0.43326]
D(LGSAV(-2))	-0.068908	0.325900	0.074565	1.448041	-0.087307
	(0.14168)	(1.05925)	(0.70406)	(0.57474)	(0.24118)
	[-0.48636]	[0.30767]	[0.10591]	[2.51948]	[-0.36199]
C	0.043734	-0.367125	-0.075939	-0.211949	-0.028632
	(0.02127)	(0.15901)	(0.10569)	(0.08628)	(0.03620)
	[2.05628]	[-2.30884]	[-0.71851]	[-2.45663]	[-0.79085]
R-squared	0.632702	0.585557	0.470277	0.701027	0.595080
Adj. R-squared	0.520688	0.357613	0.178929	0.536592	0.372373
Sum sq. resids	0.089797	5.019111	2.217410	1.477636	0.260206
S.E. equation	0.067006	0.500955	0.332972	0.271812	0.114063
F-statistic	1.386801	2.568863	1.614141	4.263239	2.672039
Log likelihood	48.60904	-15.76630	-2.695695	3.798645	31.58624
Akaike AIC	-2.288065	1.735394	0.918481	0.512585	-1.224140
Schwarz SC	-1.738414	2.285045	1.468132	1.062236	-0.674489
Mean dependent	0.057265	-0.086021	-0.038722	-0.030570	-0.055211
S.D. dependent	0.071457	0.625029	0.367466	0.399288	0.143977

Determinant resid covariance (dof adj.)	3.32E-08
Determinant resid covariance	3.16E-09
Log likelihood	86.10951
Akaike information criterion	-1.319344
Schwarz criterion	1.657932

APPENDIX C: Autocorrelation LM test

VEC Residual Serial Correlation LM Tests
Null Hypothesis: no serial correlation at lag order h
Date: 09/03/12 Time: 10:52
Sample: 1976 2010
Included observations: 32

Lags	LM-Stat	Prob
1	12.51641	0.9819
2	26.40175	0.3864
3	16.54579	0.8976
4	22.13200	0.6281
5	17.16337	0.8758
6	44.62425	0.0092
7	15.02714	0.9407
8	20.22898	0.7347
9	15.27431	0.9347
10	24.24030	0.5055
11	22.39253	0.6130
12	23.49892	0.5485

Probs from chi-square with 25 df.

APPENDIX D: WHITE Heteroskedasticity Results

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 09/03/12 Time: 10:54
Sample: 1976 2010
Included observations: 32

Joint test:

Chi-sq	df	Prob.
356.4155	330	0.1520

Individual components:

Dependent	R-squared	F(22,9)	Prob.	Chi-sq(22)	Prob.
res1*res1	0.891664	3.367051	0.0321	28.53326	0.1587
res2*res2	0.879049	2.973195	0.0472	28.12957	0.1714
res3*res3	0.676598	0.855869	0.6388	21.65113	0.4809
res4*res4	0.914139	4.355480	0.0137	29.25245	0.1378
res5*res5	0.686010	0.893786	0.6094	21.95231	0.4627
res2*res1	0.751339	1.236083	0.3869	24.04284	0.3450
res3*res1	0.723439	1.070114	0.4843	23.15003	0.3933
res3*res2	0.833627	2.049790	0.1329	26.67607	0.2238
res4*res1	0.849171	2.303186	0.0981	27.17346	0.2047
res4*res2	0.676886	0.856996	0.6379	21.66034	0.4803
res4*res3	0.729800	1.104937	0.4622	23.35359	0.3820
res5*res1	0.736794	1.145169	0.4377	23.57740	0.3698
res5*res2	0.642752	0.736028	0.7350	20.56808	0.5476
res5*res3	0.626182	0.685267	0.7760	20.03782	0.5807
res5*res4	0.782978	1.475928	0.2793	25.05529	0.2944

APPENDIX E: Normality Results

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 09/03/12 Time: 10:54
Sample: 1976 2010
Included observations: 32

Component	Skewness	Chi-sq	df	Prob.
1	-0.214203	0.244709	1	0.6208
2	-0.651654	2.264814	1	0.1323
3	-0.504256	1.356129	1	0.2442
4	-0.180603	0.173959	1	0.6766
5	-0.179065	0.171010	1	0.6792
Joint		4.210620	5	0.5195

Component	Kurtosis	Chi-sq	df	Prob.
1	2.336649	0.586712	1	0.4437
2	4.243591	2.062026	1	0.1510
3	2.643975	0.169005	1	0.6810
4	1.970779	1.412395	1	0.2347
5	2.842216	0.033194	1	0.8554
Joint		4.263332	5	0.5122

Component	Jarque-Bera	df	Prob.
1	0.831421	2	0.6599
2	4.326839	2	0.1149
3	1.525134	2	0.4665
4	1.586354	2	0.4524
5	0.204204	2	0.9029
Joint	8.473953	10	0.5826

APPENDIX F: Variance Decomposition Results

Variance Decomposition of LGDEBT:

Period	S.E.	LGDEBT	LGDEF	LCAB	LINF	LGSAV
1	0.067006	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.115295	96.14786	0.028037	2.608841	0.459410	0.755847
3	0.149169	94.92303	0.115419	1.960608	1.993853	1.007090
4	0.193727	94.56275	0.102519	2.405121	2.242248	0.687360
5	0.238024	93.62563	0.195698	2.700015	3.012058	0.466598
6	0.278575	94.02228	0.150664	2.499837	2.970478	0.356737
7	0.317792	93.92581	0.119690	2.162626	3.509744	0.282126
8	0.354696	93.98535	0.097667	2.104196	3.565022	0.247761
9	0.390214	93.69548	0.083998	1.958639	4.057045	0.204837
10	0.424915	93.75892	0.080623	1.965439	4.020301	0.174715

Variance Decomposition of LGDEF:

Period	S.E.	LGDEBT	LGDEF	LCAB	LINF	LGSAV
1	0.500955	5.733901	94.26610	0.000000	0.000000	0.000000
2	0.548696	5.752583	86.31481	6.351356	0.950402	0.630851
3	0.653689	5.579567	86.46158	5.852396	1.223651	0.882802
4	0.735425	5.996522	84.89335	5.278447	1.062628	2.769055
5	0.795223	5.596599	84.86344	5.471308	1.347949	2.720707
6	0.836712	5.179328	85.81356	5.103839	1.280790	2.622487
7	0.881773	4.789331	85.40772	4.852111	1.910586	3.040254
8	0.947403	4.270299	85.08562	6.026627	1.731486	2.885964
9	0.995595	3.878604	85.02366	5.513713	2.131969	3.452050
10	1.037539	3.799242	84.88182	5.897090	2.135999	3.285849

Variance Decomposition of LCAB:

Period	S.E.	LGDEBT	LGDEF	LCAB	LINF	LGSAV
1	0.332972	3.556971	46.80554	49.63749	0.000000	0.000000
2	0.448873	4.633936	50.58008	42.05454	2.573377	0.158070
3	0.486765	7.179158	48.93952	37.65068	5.937056	0.293587
4	0.547827	13.05927	42.25948	32.43000	10.13842	2.112832
5	0.620974	23.98988	36.18398	27.33970	9.655512	2.830935
6	0.710606	28.56206	31.71041	25.50767	11.40794	2.811926
7	0.787312	32.72249	30.21542	23.14987	11.40939	2.502830
8	0.867759	35.34886	27.14601	20.96144	13.78297	2.760713
9	0.936976	40.19556	24.62671	18.74649	13.54291	2.888330
10	1.019115	42.30659	22.30839	17.57522	14.61362	3.196168

Variance Decomposition of

LINF:

Period	S.E.	LGDEBT	LGDEF	LCAB	LINF	LGSAV
1	0.271812	0.074126	1.183995	20.35759	78.38428	0.000000
2	0.295037	10.39053	5.164890	17.28333	66.68409	0.477165
3	0.482313	6.485352	5.714766	21.69067	62.93312	3.176096
4	0.503214	11.12398	5.609259	21.99568	58.13048	3.140609
5	0.677022	6.235018	3.153650	28.65959	58.77637	3.175378
6	0.690315	8.349196	3.602430	27.83233	56.79765	3.418392
7	0.840704	5.649878	2.864918	28.55864	58.32399	4.602568
8	0.856820	7.579868	3.331285	27.62339	56.76704	4.698417
9	0.996696	5.602908	2.550526	29.77057	56.91354	5.162457
10	1.010350	6.786686	2.707779	29.07083	55.96229	5.472415

Variance Decomposition of LGSAV:

Period	S.E.	LGDEBT	LGDEF	LCAB	LINF	LGSAV
1	0.114063	13.10248	0.002774	0.000458	11.54830	75.34598
2	0.162708	6.899096	1.072667	4.592695	13.63518	73.80036
3	0.202405	4.630225	0.763570	3.322977	17.64219	73.64104
4	0.263512	2.918386	0.467828	7.189280	20.98743	68.43707
5	0.293048	3.352254	0.395829	6.985876	22.83509	66.43095
6	0.356830	2.267528	0.310368	8.144414	25.52333	63.75436
7	0.383259	4.053737	0.312667	8.125473	26.64490	60.86322
8	0.445523	3.067417	0.232609	9.158915	28.47879	59.06227
9	0.469262	5.069528	0.249396	9.247951	29.09966	56.33347
10	0.528942	4.069499	0.197022	9.809160	30.48492	55.43940

Cholesky Ordering:
LGDEBT
LGDEF
LCAB
LINF
LGSAV