THE IMPACT OF PUBLIC DEBT ON ECONOMIC GROWTH IN SOUTH AFRICA: A COINTEGRATION APPROACH

by

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DECLARATION

I declare that the study hereby submitted to the University of Limpopo '**The Impact of Public Debt on economic growth in South Africa: A cointegration approach**' is the work of my own. The study has not been submitted to this institution before, or any other institutions for another degree. In compliance with plagiarism policy, the sources used in this study have been acknowledged both in the text and the bibliography.

Masoga Mamokgaetji Marius…… Date……..

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ABSTRACT

The burden of public debt is an economic issue, dominating debates in different sectors of our society. The post financial crisis era has been marked with an increasing level of public debt at international, national and sub-national level. The study investigates if public debt can affect economic growth in South Africa, for the period 1995 to 2016.

The results for Johansen test of cointegration signposted the existence of cointegration among variables observed in this study. The trace statistic and max-eigen value complimented each other to confirm the cointegration, thus, showing a long run relationship. Furthermore, the Vector Error Correction Model (VECM) is applied to achieve the objectives of the study, complemented by other econometric tests such as, Granger causality, impulse response function and variance decomposition. The VECM results revealed the existence of a short run relationship between public debt and economic growth. Granger causality results have shown that public debt can Granger cause economic growth, and there is bi-direction relationship between the two variables. The results for Variance Decomposition indicate that, a shock to public debt causes 1.509115 % fluctuation in economic growth in the second quarter. In the fourth quarter, a shock to public debt account for 16.39628 % fluctuations in economic growth. This shows that, as time goes on, a shock to public debt account for a high percent of fluctuation in economic growth. The Impulse Response Function has shown that, the period of ten quarters marks a negative response of economic growth to public debt. Thus, one standard deviation shock in public debt will inversely affect economic growth. The diagnostic tests such as serial correlation and heteroskedasticity bode well for the model because, neither serial correlation nor heteroskedasticity has been found. Moreover, the model has shown that the residuals are normally distributed, and also the stability of the model has been confirmed.

The study recommends that, since South Africa is a capital scarce country, it is encouraged to borrow so that there is an increase in the accumulation of capital. However, the later stage of borrowing marked with high debt will lead to subdued economic growth.

Keywords: Public debt, external debt, internal debt, economic growth, South Africa

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ADF: Augmented Dickey Fuller

AIC: Akaike Information Criterion

BRG: Breusch-Pagan-Godfrey

DSF: Debt Sustainability Framework

DOLS: Dynamic Ordinary Least square

EGP: Egyptian pound

FMOLS: Fully Modified Ordinary Least Squares

FPE: Final Prediction Error

G20: Group of twenty countries

GDP: Gross Domestic Product

HQ: Hannan-Quinn information Criterion

IMF: International Monetary Fund

IRF: Impulse Response Function

LICs: Low-Income countries

NDP: National Development Plan

OLS: Ordinary Least Square

PIDS: Philippine Institute for Development

PP: Phillips Perron

SARB: South African Reserve Bank

SC: Schwarz Information Criterion

STATS-SA: Statistics South Africa

STR: Smooth transition regression (STR)

VAR: Vector Auto Regression

VDC: Variance Decomposition

VECM: Vector Error Correction Model

WLS: Weighted Least Square

CHAPTER 1

INTRODUCTION TO THE STUDY

1.1 Introduction and background

In both academia and policy making, the issue of how public debt affects economic growth has remained a concern (Mohanty and Mishra, 2016). The post financial crisis era saw the increasing levels of public debt at international, national and sub-national level. In cases where countries depend heavily on public debt, economic growth and private investment could be deterred. According to Humberto, Tadas and Ausrine (2012), public borrowing is a non-avoidable nor is it a reprehensible phenomenon of economic growth. Rather, it is regarded as a way to boost economic growth. This is because of money injection from foreign investors to the economy, and distribution of assets among those in possession of enough to utilize at present moments and those in need of assets to develop economic initiatives or other needs.

Among the macroeconomic indicators, public debt is the main indicator forming an image of the countries in the international markets (Humberto*, et al*, 2012). In 2008/09, the global financial crisis induced the level of public debt to accelerate across the world, raising concerns on how economic performance may be affected (Jaejoon and Manmohan, 2014). In their study, Jaejoon and Manmohan (2014) focused on advanced economies to examine how economic growth can be affected by high public debt in the long run over the previous four decades. In the previous years, the policy makers in South Africa ensured that policies yielded economic growth so as to restrict government intervention in the economy and reduce budget deficit (Jacobs, Schoeman and Van Heerden, 2002).

According to Hadhek and Mrad (2014), the public debt, particularly foreign debt exists independently outside the public finances and budget. Therefore, public debt is a universal phenomenon that can be found in any economy in the world. This is because a loan is considered mainly as a component of modern public finance. In fact, public debt is closely related to the budget deficit. However, it appears that debt accumulation is necessary to finance investment projects. When the debt is accumulated, the cost

of servicing this debt would come from taxes on future production. As a result, investment would be discouraged, hence crowding out of investment (Hadhek and Mrad, 2014).

The use of high taxation to finance additional expenditure would reduce the effect of higher debt relative to GDP (Ramos, Veronique, Helene and Margaret, 2013). However, an increase in expenditure on investment would ameliorate long term economic growth and lessen the ratios of debt to Gross Domestic Product and deficit to Gross Domestic Product. The economy can benefit from government spending through the level and distribution of income, hence boost economic growth. However, holding everything else constant, an increase in government expenditure will result in greater debt. Consequently, the resulting debt might not be sustained in the long run (Ramos, *et al*, 2013). Therefore, an increase in government expenditure may also require increased taxation in future to restore the initial level of debt to GDP ratio.

South Africa has drafted a National Development Plan (NDP) stating the vision for 2030. In the plan, it seems that the main focus is to reduce poverty and inequality. It is mentioned in the National Development Plan that the growth of the economy must be accelerated in such a way that all South Africans are benefited (National Development Plan, 2011). Therefore, a rapid economic growth is said to be key in broadening opportunities for everyone. As proposed by National Development Plan (2011), the accelerated economic growth is also one of the required priorities to raise employment in order to achieve the objectives of the National Development Plan. However, it seems to appear that the plan does not state much about public debt as an impediment to achieve the anticipated economic growth.

In this study, it is important to bring to light the idea that achieving economic growth rate will reduce poverty and inequality by 2030 and that it requires government to deal with a growing public debt. It is notable that many variables in the economy may restrict the likelihood of achieving some of the objectives of National Development Plan by 2030 (National Development Plan, 2011). However, in this study, the primary focus is on public debt so as to reveal its impact on South Africa's economic growth. The National Development Plan suggests that economy should grow by 5 percent a year to ensure acceleration of employment and economic transformation (National Development Plan, 2011).

1.2 Statement of the problem

Since the dawn of post-financial crises era, South Africa experienced difficulty in consolidating public debt that has been accrued with countercyclical fiscal policy (Mark, 2015). As a result, South Africa experienced a slowdown in the level of economic growth. Recently, public debt approaches the upper limit of sustainability (Medium term budget policy statement, 2014). The cost of servicing debt jeopardises the health of the national budget, and as a result, compromises the expansion of public services and investment. Government is therefore required to safeguard public finances by taking action within its fiscal limits that can be sustainable for a long period (Medium Term Budget Policy Statement, 2014).

The downturn in economic growth that necessitated large government deficit induced South Africa's level of public debt to escalate to 43.9% of Gross Domestic Product (Mark, 2015). The population pressure in South Africa seems to undermine the sustainability of current debt. According to Black, Steenkamp and Calitz (2015), the South Africa's amount of public debt that was due by the end of December 2013 is R1 561 billion, which constitutes 46% of GDP. The implication of this is that if the government were to repay its public debt immediately, the once-off average tax of R29 500 per citizen would need to be imposed (Black, *et al.*, 2015).

The size of the government deficit and the strategy to reduce it remains a tough decision for South Africa and most of the world (Division of Revenue, 2012). According to the Medium Term Budget Policy Statement (2014), the government deficit should not be sustained when the economy is unresponsive because current account deficit would worsen, and result in high inflation and interest rates. The global crisis has left South Africa with a large public debt that is much worse than a degree of crowding out effects (Ramos, *et al*, 2013). Several countries such as Greece, Ireland, Portugal, Spain and Cyprus ended up in situations of sovereign debt default. Therefore, for the economies of these countries to continue functioning, international financial institutions had to bail out these countries (Beirne and Fratzscher, 2013).

Economies with high level of debt to GDP ratio experience subdued economic growth. Japan's economy is an example, with the largest public debt to GDP ratio in the world, but still has not found an easier way to achieve the modest economic growth (Egert, 2015). A public debt ratio of countries like Norway, Sweden and Australia is around

50% (Naraidoo and Raputsoane, 2015). The scenarios given above led to the idea that public debt is a problem for many countries including South Africa. Thus, it necessitated that more investigation be done on the effect of public debt on economic growth focusing mainly in the South African economy.

1.3 Research aim and objectives

The aim of the study is to conduct an investigation on the impact of public debt on South Africa's economic growth in the period 1995-2016.

In order to achieve the above-mentioned aim, the following objectives were set:

- To examine the effects of public debt on economic growth.
- To forecast on how public debt and economic growth will perform in years ahead.

1.4 Research questions

- How does public debt affect economic growth?
- How will public debt and economic growth behave in the future years?

1.5 Definition of concepts

- Public debt is referred to as a government debt that is paid indirectly by the taxpayers, and it can either be external or internal (Bonga, Chirowa and Nyamapfeni, 2015). The public debt makes it possible for government to invest in those areas that are critical for the economy whereby tax revenue is not enough to finance such projects.
- Government deficit is defined as the excess amount of government expenditure to the amount that government collects in the form of taxes in a given period. The government deficit can be financed through foreign borrowing or local borrowing (Philippine, 2004).
- Economic growth, as defined by Mohr (2015), is the aggregated value of final goods and services that has been produced in the economy of a country within a specific period. Therefore, an economy is said to be growing if the total production of goods and services rises from single period to another (Mohr, 2015).

1.6 Ethical considerations

The study uses secondary data, and in compliance with plagiarism policy of the institution (University of Limpopo), this study acknowledges all the sources used to

ensure quality and originality of the results. The data used is treated with honesty and dignity.

1.7 Significance of the study

Different studies that have been completed on the link between public debt and economic growth indicated controversial results. For instance, Baaziz (2015) studied the relationship between public debt and economic growth in South Africa using long historical data including the pre-apartheid era. The findings were that, public debt in South Africa restricts economic growth if it breaches the threshold of 31.37% of Gross Domestic Product. Other studies have found that public debt is inversely impacting on economic growth only when the ratio reaches certain threshold (Tabengwa, 2014). However, Tabengwa (2014) did not mention such threshold. Therefore, this study used the recent data starting after the period of apartheid, which is from 1995 to 2016 in South Africa. This could assist economists, academics and policymakers to evaluate and analyse the improvement in the state of the economy in South Africa. Even though Baaziz (2015)'s study covered nineteen years of the post-apartheid period until 2014, the years 2015 and 2016 have not been covered, which will be covered in this study. Thus, this study will contribute the knowledge to academics, researchers and policy makers on the issue of public debt and economic growth.

1.8 Structure of the dissertation

The structure of the dissertation is as follows: chapter 2 outlines the debt-growth nexus and the detriments caused by public debt, comparing South Africa with other developing and developed countries. In chapter 3, the theoretical framework is provided, the target being on theories concerning public debt and economic growth, followed by empirical literature in the same chapter. The research methodology used in this study is presented in chapter 4. In line with methodology presented in chapter 4, the empirical results and interpretation are provided in chapter 5. The conclusion of the study and policy recommendations are provided in chapter 6.

CHAPTER 2

DEBT-GROWTH NEXUS AND PUBLIC DEBT DETRIMENTS: SOUTH AFRICA VERSUS DEVELOPED & OTHER DEVELOPING COUNTRIES

2.1 Introduction

This chapter outlines how the level of public debt behaves, and its possible damages and consequences to the economy. Furthermore, few countries both advanced and less advanced will be selected to slightly discuss public debt and performance of the economy in those countries. South Africa's public debt will be compared with other selected African countries to analyse whether South Africa is better off compared to its peers.

2.2 The Detriments Induced by Public Debt

The public debt crisis induced various consequences within economic, social and political life (Marek, 2014). The government is less likely to efficiently perform its main functions such as providing public goods when it is bankrupt. According to Tsoulfidis (2007), it is detrimental to the economy when government expenditures are financed through public debt. In addition, this would also distress the capacity of the economy to generate wealth, since borrowing depresses savings directly. In instances where government expenditure is unproductive, that is, expenditure to pay for government employees and expenditure on army maintenance, it follows that public debt undermines the capacity of the economy to gain momentum. However, if such expenditures are compulsory, their source of financing should be through taxation, instead of borrowing (Tsoulfidis, 2007).

The massive debt in the continent of Africa demonstrates that, the burden of public debt in Africa presents a gruesome image associated with hopelessness (Danso, 1990). This burden of public debt crushes and serves significantly as one of the factors that constrain development. The important issue within the context of historical analysis of public debt as highlighted by Deceanu and Ciobanu (2011) is that, previously, inflationary episodes reacted as counterweights to the increasing size of public debt, and negative real interest rates restricted development of such episodes. Nevertheless, the previous two decades saw the emergence of more rigorous

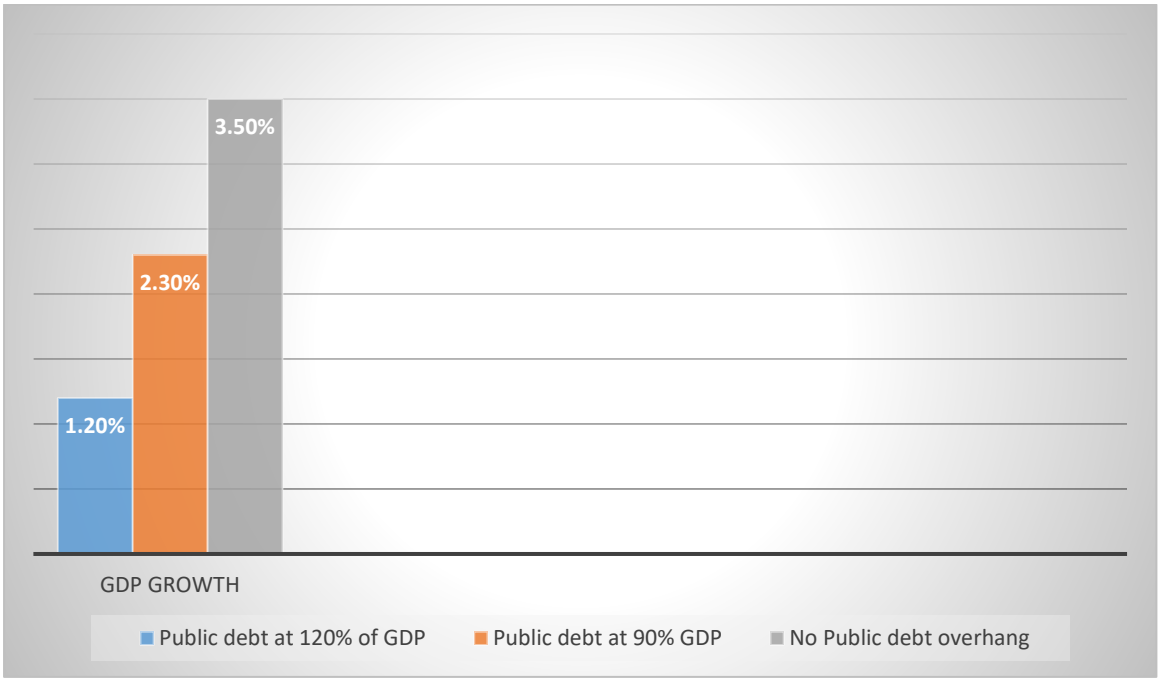
inflationary controls. However, this happened within the context of economic growth that is increasingly fragile, hence, it resulted in some imbalances.

The economic research has recently confirmed that high levels of Federal debt induces a number of economic consequences that are detrimental to the United States, which include deteriorating economic growth, less ability to take care of unexpected challenges and possibly debt driven financial crisis (Boccia, 2013). The Federal government debt has reached the statutory debt ceiling. The International Monetary Fund (IMF) and the intergovernmental organisation, consisting of 188 members, states that intent to promote stability within the international monetary system cautioned that, the United States does not have a credible strategy that will stabilise its escalating levels of public debt.

As found by Reinhart, Reinhart and Rogoff (2012), a growing body of research has shown that vast majority of high debt episodes accord substantially with sluggish economic growth. The high debt episodes are referred to as public debt overhang episodes. The persistent periods of gross country debt of more than 90 percent of GDP for five years or more are referred to by researchers as episodes of public debt overhang (Boccia, 2013). The level of economic growth can significantly be reduced by public debt overhang in three ways as Boccia (2013) highlighted, namely; higher interest rates, higher inflation and crowding out private investment. Taking higher interest rate for instance, creditors may set higher interest rates due to low confidence in the ability of the country to settle its debt. As a result, higher interest rates induce high debt cost, forcing government to impose more tax on the citizens. Therefore, inducing the likelihood of economic doldrums and depress government expenditure in other areas. Most importantly, higher interest rates may result in low investment, leading to sluggish economic growth in the rest of the economy.

Over 110 years of economic data have been observed by Reinhart *et al* (2012) in advanced economies, hence, reached conclusion that, countries with debt levels of more than 90 percent of GDP experience sluggish economic growth. As can be seen in figure 2.1, when public debt is at 120% of GDP, the resulting level of economic growth is 1.20%. However, when public debt as a percentage of GDP moderates to 90%, economic growth gains momentum, hence surged to 2.30%. The absence of public debt overhangs results into a more fuelled level of economic growth of 3.50%.

Figure 2.1 Public Debt levels versus Economic Growth



Source: Boccia (2013)

South Africa is currently experiencing high levels of public debt. Table 2.1 shows the total government debt in South Africa for the financial year 2015/16. It has been pointed out in the 2017 budget speech that, government will borrow R149 billion or 3.1 per cent of Gross Domestic Product. Yet, South Africa's public debt stands at R2.2 trillion, or 50.7 percent of Gross Domestic Product (Gordhan, 2017). The investors and rating agencies observe certain aspects as highlighted by Hilary (2017) to assess the sustainability and affordability of public debt. This includes, amongst others: level of debt, the length of time before it matures, whether the debt is local or foreign and who owns it.

Table 2.1 Total government debt for 2015/16 financial year

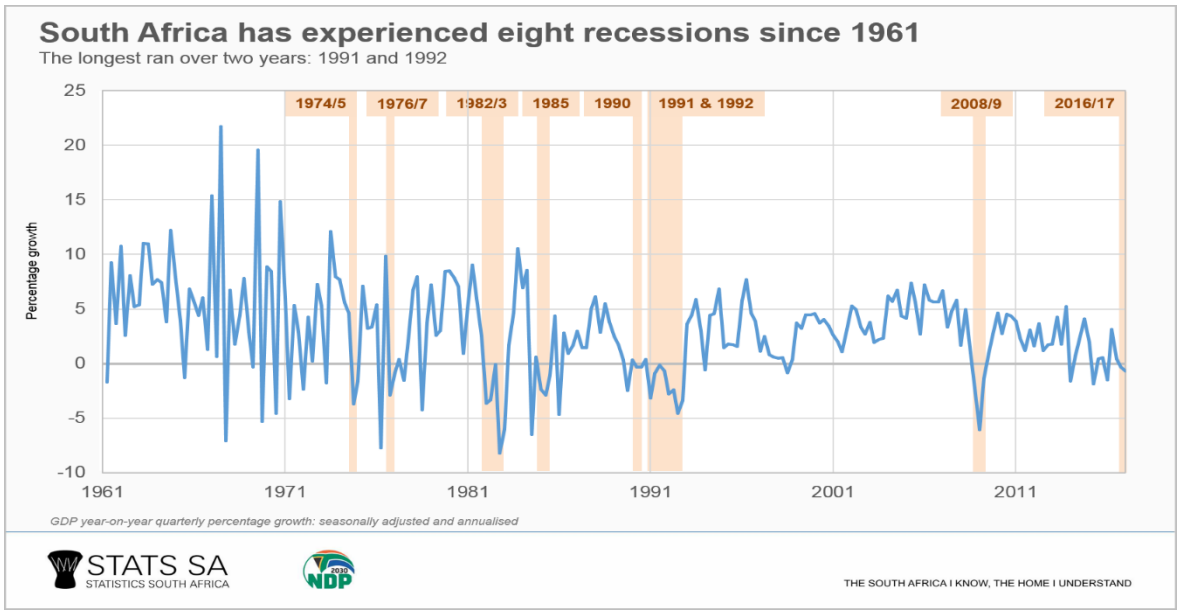
R-billion	Budget	Revised budget	Preliminary outcome
Domestic debt			
Gross loan debt	1 814,5	1 822,9	1 819,3
Cash balances	-112,2	-115,7	-112,2
Net loan debt	1 702,3	1 707,2	1 707,1
Foreign debt			
Gross loan debt	168,6	232,8	199,6
Cash balances	-89,7	-135,6	-102,1
Net loan debt	78,9	97,2	97,5
Total gross loan debt	**1 983,1**	**2 055,7**	**2 018,9**
Total net loan debt	**1 781,2**	**1 804,4**	**1 804,6**
As percentage of GDP:			
Total gross loan debt	47,3	50,5	49,6
Total net loan debt	42,5	44,3	44,3
Foreign debt as percentage of:			
Gross loan debt	8,5	11,3	9,9
Net loan debt	4,4	5,4	5,4

Source: National Treasury (2016)

As can be seen from table 2.1, the end of 2015/16 financial year marked R1.8 trillion amount of net loan debt. This accounts for 44.3 per cent of Gross Domestic Product, and the government's foreign currency deposits at the SARB hedges a greater part of government's foreign debt. The reported net foreign debt ratio for 2015/16 is 5.4 per cent, adding to the total net of loan debt (National Treasury, 2016). In addition to the public debt that hampers South Africa's economy, South Africa has also suffered eight recessions since 1961 as shown by figure 2.2. The 2008/9 recession, for instance, which was the global economic recession caused by global financial and economic crisis is worthy of note. The foremost problem for South Africa as posited by Padayachee (2012), occurred in the form of the impact on employment growth through dwindling tax revenues and on service delivery to the deprived citizens. In consistent to this, Verick and Islam (2010) concurred that, South Africa as one of the hardest-hit African countries, suffered 900 000 loss in employment from 2008 to 2009.

Moreover, the third quarter of 2008 saw an official rate of unemployment rising from 23.2 per cent to 24.5 per cent in the third quarter of 2009 (Verick and Islam, 2010). The areas of the economy that felt the heat of global financial and economic crisis are those that have been deeply in crisis during post-apartheid era (Padayachee, 2012). Nevertheless, the real GDP in South Africa reverted to positive growth in the third quarter of 2009 following three quarters of contraction (Padayachee, 2012). Hence, it recorded an annualised increase of 0.9 percent.

Figure 2.2 The number of Recessions Experienced by South Africa since 1961



Source: Stats-SA (2017)

The economic forecasts for South Africa which includes public debt and economic growth are shown in table 2.2, for the period 2017-2020. Additionally, the forecasts also include a long-term outlook for the coming decades, and anticipations for the medium-term, i.e. four quarters ahead and short-term market predictions for the next release which affect the economy of South Africa. For the purpose of this study, only public debt and economic growth are observed to see their forecasts. As can be seen in table 2.2, the GDP growth rate forecast for 2020 is 2.1 percent as compared to Government debt to the GDP of 53 percent. In total, government debt is anticipated to reach 55800 million dollars by 2020.

Table 2.2 South Africa's Economic Forecasts 2017 to 2020

Overview	Actual	Q4/17	Q1/18	Q2/18	Q3/18	2020		
GDP Growth Rate	2.50	1.2	1.1	1.1	2.8	2.1	Percent (+)	
Unemployment Rate	27.70	27.5	28	27.8	27.2	24	Percent (+)	
Inflation Rate	5.10	4.5	4.7	5	5.1	5.1	Percent (+)	
Interest Rate	6.75	6.5	6.5	6.5	6.5	6	Percent (+)	
Balance of Trade	5940.60	-6639	3004	1992	1332	-1700	ZAR-M (+)	
Government Debt to GDP	51.70	52	54	54	54	53	Percent (+)	
Government Debt	63923.00	49500	67371	67527	67569	55800	USD-M	[+]
Fiscal Expenditure	117920.00	113502	124739	122368	118534	121440	ZAR-M	[+]

Source: Trading Economics (2017)

2.3 Internal Public Debt versus External Public Debt

The public debt can be twofold, first being external debt and second being domestic debt, and both have a distinct impact on economic growth. The justification for depending on domestic debt as mentioned by Beaugrand, Loko and Mlachila, (2002) is that, it eases the adverse external shocks and foreign exchange risk for the home country, and also assists in the domestic financial markets progress. In addition, the plethora of domestic debt benefits as compared to external debt justifies preference for domestic debt (Beaugrand, *et al,* 2002). In Low-Income Countries (LICs), foreign liabilities formed the largest component of public debt. In times of global crisis, LICs have substantially made efforts to make developments on their local public debt and heavily relied on domestic sources to finance budget deficits (Bua, Pradelli and Presbitero, 2014). Their actions sparked the attention of international Financial

Institutions and the academic community. The literature concerning domestic borrowing indicates that, benefits depend on whether there is sound institutional and macroeconomic framework (Bua, *et al*, 2014). There is insufficient data on domestic public debt in LICs, and that hinders the possibility of discussing the rationale for increasing government's domestic borrowing in LICs relative to external public debt. The empirical research has shown that an inverse relationship between economic growth and external debt is ascribed to debt overhang (Stylianou, 2014). The real exchange rate may appreciate because of foreign borrowing, and thus hampering competitiveness and most likely lower investment and economic growth. Typically, external debt is denominated in foreign currency, and this establishes additional constraints on monetary policy and management of exchange rate.

In the case of domestic borrowing, denomination in local currency eases the likely complications associated with external credit flows. However, the prominent concern about issuing domestic debt is the crowding out effect since government would tap private savings that would have been otherwise used to finance private investment (Bua*, et al,* 2014). In cases where the interest rate is determined by the market increases, this would reduce demand for investment. Theoretical literature concerning public debt management and government borrowing in LICs is relatively scarce, especially when compared to developed economies and emerging markets. Furthermore, the literature is inconclusive in terms of costs and benefits of domestic liabilities relative to foreign liabilities (Bua*, et al,* 2014). In developing countries, particularly African countries, the internal public debt is quantitatively not significant as compared to external public debt (Lopes, 2016). As far as tradition is concerned, less developed countries only rely on domestic debt when there are impediments to access external resources. Nonetheless, it does not imply that domestic public debt is neglected.

2.4 South Africa's Public Debt versus four Selected African Countries

The problem of public debt, particularly foreign debt, has persistently been a major challenge and setback for the African economy. Although it is one of the economies that grow faster globally. The reason is that, African countries that are mostly in debt are the ones which are less developed and they rely on foreign loan for sustaining their economies. The following African countries highlighted by Ezebuiro (2015), are amongst those experiencing shocking level of public debt:

1. **South Africa:** in South Africa, the external debt averaged $85603.45 million in the period 2002 until 2015. In the fourth quarter of 2014, an all-time high level of $145082 million has been reached.
2. **Egypt:** Domestic debt in Egypt surged to Egyptian pound (EGP) 2.016 trillion by March 2015. An amount of EGP 1.9 trillion has been declared as the total value of debt in December 2014. The external debt increased persistently as revealed by September's central bank bulletin that the debt has risen by 4.3 percent by end of June 2015. As compared to $46 billion in 2014, the level of debt reached $48 billion, and in general this exceed the nation's debt levels of early 1990's.
3. **Sudan:** because of high level of poverty, Sudan has been found to be a highly-indebted country that considerably accumulated external arrears and since 1994 it has been in non-accrual with the World Bank Group. The external debt stock at the end of 2013 amounted to $45.1 billion in nominal terms, and 85% was in arrears.
4. **Morocco:** as heralded by Ministry of Economy and Finance in Morocco, the external debt surged by 18.3% to 277.7 billion dirhams in 2014 from 234.7 billion dirhams in 2013. As a result, external debt amounted to 30.3% of gross domestic product in 2014 as compared to 26.9% in 2013.
5. **Nigeria:** it has been disclosed that external debt profile in Nigeria increased to $11 billion. In the second quarter of 2015, Nigeria's external debt stock was $10.3 billion, which is increased over 10% as compared to $9.5 billion recorded in the first quarter of 2015.

Table 2.3 Gross Domestic Product (% change)

	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. South Africa	3.19	1.54	3.04	3.21	2.22	2.21	1.53	2.0	2.1
2. Egypt	7.16	4.67	5.15	1.78	2.22	2.1	2.16	4.04	4.26
3. Sudan	3.04	4.69	3.01	-1.15	-3.48	3.71	3.39	3.3	3.93
4. Morocco	5.59	4.76	3.64	4.99	2.67	4.38	2.92	4.37	4.98
5. Nigeria	8.01	8.97	9.97	4.89	4.28	5.39	6.31	4.75	4.95

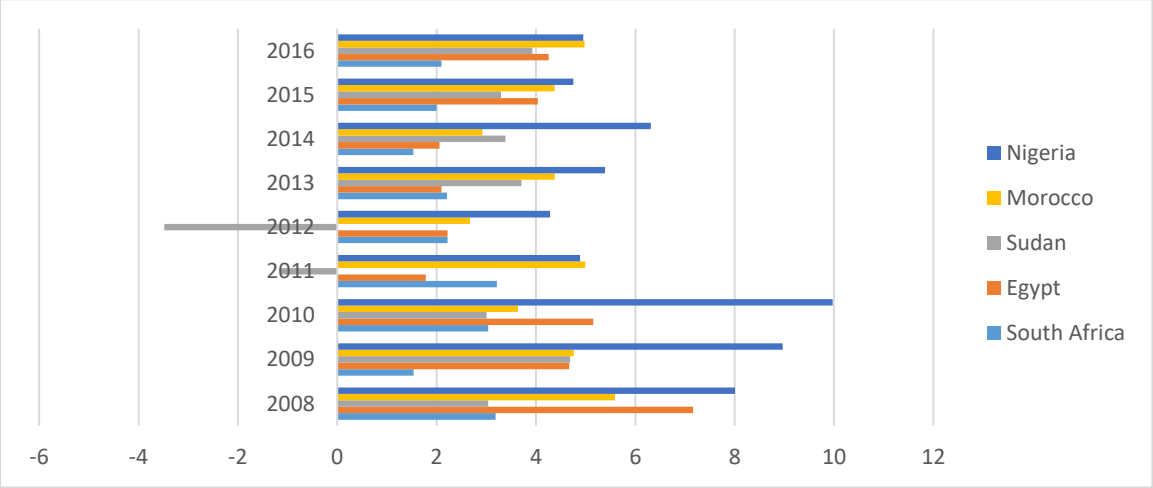
Source: Author compilation-data from IMF (2016)

Table 2.4 General government gross debt (% of GDP)

	2008	2009	2010	2011	2012	2013	2014	2015	2016
1. South Africa	25.94	30.32	34.36	37.64	40.5	43.29	45.87	47.51	48.21
2. Egypt	70.2	73.03	73.17	76.63	78.9	89.03	90.47	90.49	88.52
3. Sudan	68.85	72.11	73.1	70.46	94.72	90.48	74.24	78.47	74.85
4. Morocco	47.3	47.14	50.32	53.69	59.66	63.41	63.89	65.54	64.85
5. Nigeria	7.45	9.57	9.58	10.18	10.4	10.48	10.5	11.48	11.23

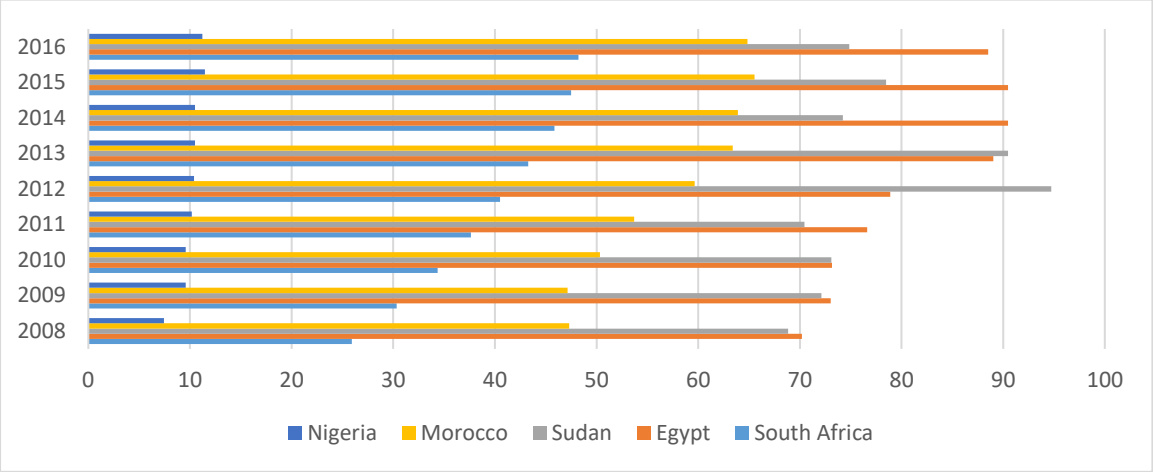
Source: Author compilation-data from IMF (2016)

Figure 2.3 Gross Domestic Product (% change)



Source: Author compilation, data from IMF (2016)

Figure 2.4 General government gross debt (% of GDP)



Source: Author compilation, data from IMF (2016)

Table 2.3 and figure 2.3 shows that the African country that experiences high level of economic growth is Nigeria, making it the biggest economy in Africa. Hence, Nigeria rebased its GDP data, which boosted it to overtake South Africa as the biggest economy in Africa (BBC News, 2014). The worst performing country is Sudan which experienced negative growth for two consecutive years, 2011-2012. Despite the fact that South Africa is the second largest economy in Africa, its GDP growth as shown in figure 2.3 indicates that, in average from 2008 to 2016, Sudan performed better than South Africa.

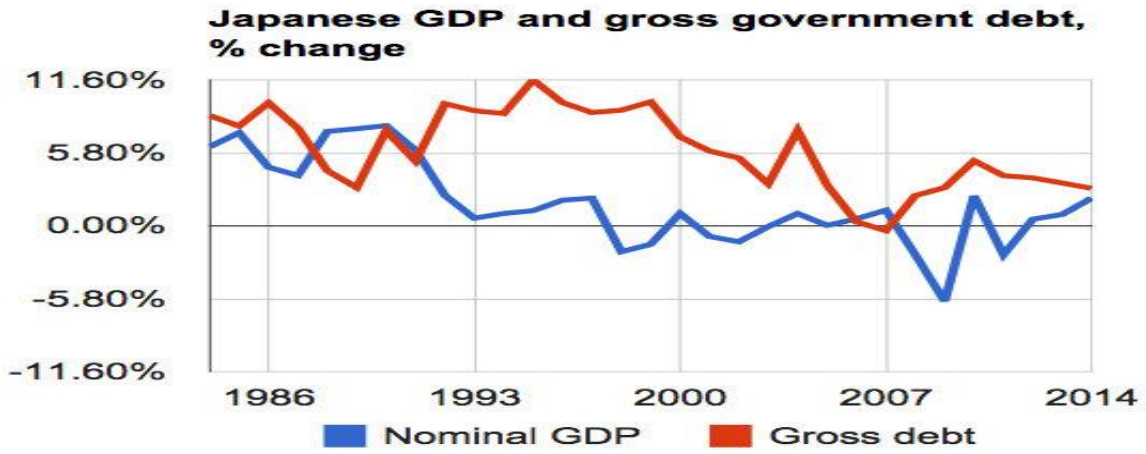
The general government gross debt as a percentage of Gross Domestic Product presented in table 2.3 and figure 2.4 confirms that South Africa is experiencing high levels of public debt. However, South Africa is better off compared to Morocco, Sudan and Egypt. The level of public debt has gone beyond 90% in Egypt during 2014 and 2015. Similarly, Sudan also saw its debt level going beyond 90% during 2012 and 2013. The highest level of debt for South Africa is 48.21% recorded in 2016.

2.5 Lessons from Japan and United States of America

The advanced economies are not an exception to the issue of public debt. Therefore, Japan and the United States of America are taken as examples to indicate how they are faced with vulnerabilities revolving around public debt and economic growth. The protracted episodes of public debt overhang experienced by Japan as mentioned by Boccia (2013), have not yet led Japan to debt crisis. The reason for this is because Japanese citizens are prodigious savers. In view of this, Japanese owe their debt to

themselves since citizens of Japan forgone their consumption to buy government bonds for long period. Hence, enabling Japanese government to accumulate gross debt levels by more than double compared to its size of the economy. As a result, the country persistently suffered weak economic growth (Boccia, 2013). The United States and Japan have been cautioned by IMF against a build-up risk ahead if they do not manage to lower their debt levels. Boccia (2013) further highlighted that, policy makers in United States must react with immediate effect to ensure orderly and controlled mechanisms for public debt reduction.

Figure 2.5 Level of economic growth and public debt in Japan



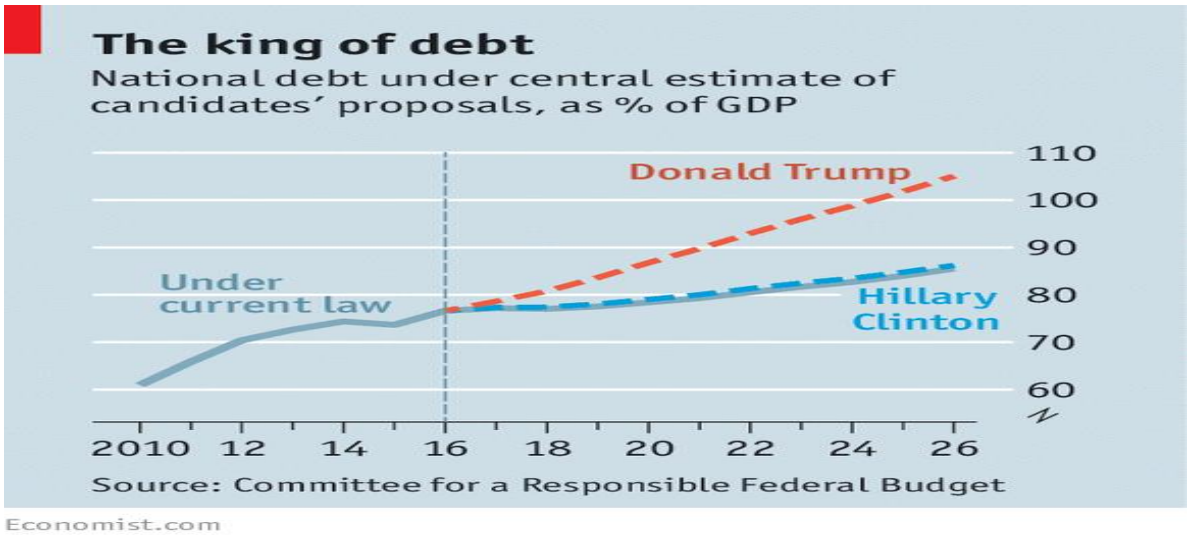
Source: Economist.com (2016)

The economy of Japan shrank at 1.6% annual pave in 2014 third quarter, which was the second consecutive decline in GDP, putting Japan in a technical recession (London, 2014). As it appears in figure 2.5, the level of government debt is higher than nominal GDP. According to London (2014), part of the strategy designed to control government debt in Japan is to increase consumption tax. The readiness of Japan to raise taxes is justified by confidence that, whatever meaningful uptick in costs of government borrowing would further prompt fiscal consolidation. That being said, Japan does not panic or rather have much concern about the debt.

Nevertheless, 2012 marked subdued level of economic growth in Japan since Gross Domestic Product fell in the fourth quarter of 2012 as reported by (Derek, 2013). Since government borrowing hollowed out the economy of Japan, private consumption and investment became weak (Derek, 2013). Japan's economic freedom is bolstered by political stability and rule of law that are well maintained (Heritage Foundation, 2017).

Therefore, it is required to strengthen efforts that challenge long established economic and cultural interests in order to overcome entrenched economic stagnation. According to Heritage Foundation (2017), large public debt which is the highest among the developed countries as a percentage of GDP has taken toll on private sector's economic activity, and this hinders more growth dynamics.

Figure 2.6 Public debt under central estimate of candidates' proposal (% of GDP)



Source: Economist.com (2016)

In America, fiscal policy has stumbled remarkably reckless from the upper level of political agenda. One of the things that dominated the presidency of United States was to control the national debt. This has resulted in national debt spiking from 35% of GDP to over 70% following the recession. In 2009, there was a significant reduction in borrowing from 9.8% of GDP to 2.5% in 2015, thanks to the combination of economic recovery and reduced expenditure.

2.6 Summary

In this chapter, it was shown that South Africa is not the only country that experiences the problem of public debt. The evidence from other countries was provided to reveal that public debt hamper economic growth in every country, especially if there is poor debt management in the country.

CHAPTER 3

LITERATURE REVIEW

3.1 Introduction

The theoretical perspectives concerning this study would be discussed in this chapter. Therefore, different theories neither complementing each other nor contradicting each will be considered to produce evidence based findings of the study. In addition to such theories, the empirical studies will as well be discussed, so that the facts and opinions made in this study have back up and support from other studies. Therefore, consideration of literature would enable this study to identify and fill in the existing gap on the link between public debt and economic growth in South Africa.

3.2 Theoretical Literature

The distinct relationships between public debt and economic growth have been proposed by various schools of thoughts in the literature of economic growth (Mohanty and Mishra, 2016). In the previous decades, the theories of public debt were centred on the contribution of debt management to the macroeconomic stabilization (Medeiros, Cabral, Baghdassarian, and Almeida, 2005). The concern was the possibility of constraints that monetary policy might experience as a result of the structure and the size of the public debt. Governments consider borrowing as an alternative for taxes, thus allows expenditure to increase without immediate changes in tax rates (Pascal, 2012).

3.2.1 The Keynesian Theory of public debt

According to the Keynesian model, a rise in government expenditure fuels the domestic economic activity and crowds-in private investment (Biza, Kapingura and Tsegaye, 2013). As claimed by crude closed economy, the Theory of Keynesian, the increasing government expenditure is linked to higher national output, which leads to employment (Makin, 2015). However, the funds available for investment may be crowded out by increased government expenditure. The requirements to fill the saving-investment gap as provided by the Keynesian framework is foreign investment or foreign aid. In alignment to this, it has been highlighted by Mongale, Petersen, Meniago and Petersen (2013) that, South Africa is depending on foreign savings to back up economic growth because of its large structural savings/investment gap.

3.2.2 Theory of Public Debt Overhang

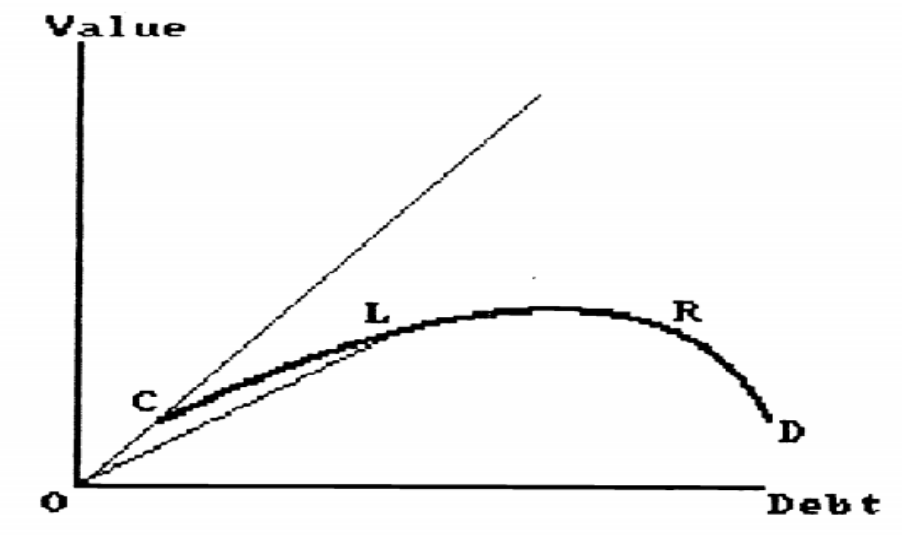
The theory of public debt overhang suggests that unsustainable public debt undermines the credibility of state policy (Reinhart *et al*, 2012). Thus, obstruct commitment of government on policy actions. The implication of that is the possibility of government to sacrifice fiscal consolidation as a result of pressure caused by public debt. There is a tendency of persistent stagnation in those countries with large public debt (Mabugu and Maisonnave, 2012). According to Mohanty and Mishra (2016), the hypothesis of debt overhang expresses that the increased cost of servicing debt can impede investment if the country's ability to repay debt is exceeded by its anticipated external debt. However, there is a possibility of reducing debt when there is debt overhang. The reduction of debt can lessen uncertainties resulting from default risk, deadlines renegotiation and accumulation of arrears. This would ameliorate allocative efficiency and expectations in the state and debtor countries policies (Giovanni, 2013). As far as the theory of debt overhang is concerned, high stock of debt induces variations of incentives for both the creditor and the debtor. Therefore, reduction of debt is in the interest of both the debtor and the creditor.

The debt Laffer curve as shown in figure 3.1, replicates the likelihood of repayment as a function of the debt stock and elucidates on the way both debtor and creditor will benefit from debt reduction. The ordinate axis represents the value of the debt resulting from expected future payments, while abscissas axis describes the current nominal value of the total debt stock. The initial phase where the curve follows 45 degree line, it is when the debt is substantially lower. The debt overhang is indicated by point C, where it turns out to be unlikely for expected payments to be honoured, given high debt. At point R, the curve starts to decline because of the increasing present debt value, hence, it imposes disincentives in the sense that, expected payments for additional loans increases instead of decreasing.

The greatest time for debt reduction as prescribed by theory is when the country is beyond point L before reaching point R. Therefore, point L guarantees benefits to both the debtor and the creditor. That is, the debtor country will pay less debt, while concomitantly the creditor's remaining value of debt will increase. The wrong side of the Laffer curve, which is the right side of point R, marks the amelioration of the creditor

and debtor's condition since debt reduction improves the repayment chances of the debtor.

Figure 3.1 Debt Laffer Curve



Source: Giovanni (2013)

The two related policy recommendations made by David Ricardo are: government expenditure should not be financed by means of borrowing regardless of the circumstances. Secondly, the existing public debt should effectively be dealt with immediately (Churchman, 2001). The preference of Ricardo for tax financed government spending other than public borrowing has been legitimised by the social benefits of capital growth. According to Churchman (2001), Ricardo argues that if public debt were to be used for financing spending by government during war for instance, there would be serious repercussions within the economy after the war time. This is simply because in order to service the accumulated debt, taxation would have to be imposed.

The consequence of today's government borrowing, as stated by Ricardian Equivalence, is the future increase in taxation above normal level. As a result, this would neutralize the impact of public debt on economic growth.

3.2.4 The Classical Theory of Public Debt

According to the classical theory, public debt would unnecessarily inflict a burden on the shoulders of the community. David Ricardo referred to public debt as being one

amongst rotten sources which was designed to distress the nation. The important point made by Ricardo was that the national debt burden was in the annual interest transfer, and in the loss of original capital. In order to cover such interest payments, taxes are raised. However, if tax is levied to cover the obligation of interest, there might be capital flights to other countries.

The neo-classical economist states that public investment will crowd out private investment if the government increases its investment in any economy through public debt and increase in taxes (Njimanted and Mukete, 2013). However, according to Kustepeli (2005), the use of public debt to finance public investment will drain the liquidity from the market. The Ricardian Theorem says that increased budget deficits should be coupled with increase in future taxes. Therefore, the public investment that is financed through public debt is expected to be covered by revenue that is generated from future taxes. However, the private investment and interest rate remain unchanged as economic agents realize that their income will be taxed in future.

3.2.5 The Endogenous Growth theory

The notion of endogenous growth refers to the long run economic growth at a rate that is determined by internal forces to the economic system. In particular, the long run economic growth rate is depending on the rate of growth in total factor productivity, which is determined by the progress in the rate of technological advancement. Giorgio and Giovanni (2003) indicated that in the past few years, the analysis of sustainable economic growth fuelled by technological advancement has received much attention. According to Romer (1994), endogenous growth contradicts with neoclassical growth by emphasizing that economic growth is not an exogenous outcome of an economic system. Since technology is considered by endogenous growth theory as the key driver of economic growth. In this study however, the main concern will be the effect of public debt on economic growth.

Since some authors indicated that public debt might be necessary for the economy to grow. As proposed by Bonga, Chirowa and Nyamapfeni (2015), public debt should not always be considered as a bad thing since sovereign debt can assist less developed countries. The government uses public debt to invest critically in massive infrastructural projects and social sectors of the economy where the capacity of taxation is limited. Therefore, public debt appears to have significant influence over

the economy in the short run and in the long run. However, the entire study would reveal how public debt and economic growth relates and behave in response to each other, hence this study will produce results which will lead to the conclusion at the end of the study.

The question of how public debt affects economic growth, as well as stability in the market economies has been addressed within the context of endogenous growth models (Greiner, 2013). Most importantly, this has taken into account, the expenditure that is productive and unproductive expenditure. For instance, in the case of endogenous growth model which yields positive externalities of capital and unproductive public spending, the balanced rate of growth is higher when the public debt to GDP ratio is smaller. In addition, the economic stability is assured when government is running a balanced budget. However, if permanent public deficit were to hold, the achievement of stability will require government to sufficiently raise primary surplus as public debt surges.

The usual endogenous growth models presuppose that an economy is characterized by full employment (Greiner, 2013). Nonetheless, if unemployment were to be allowed as advocated by Greiner (2013), an economy with high ratio of debt to GDP may experience higher balanced rate of growth. As believed by endogenous growth models, monetary policy and fiscal policy plays major role in determining potential growth, since the technical progress in economic growth can be explained by public debt.

3.2.6 No-Ponzi Game Condition for Public debt and Transversality Condition for Economic growth

The No-Ponzi game condition for public debt refers to the growth of public debt that is lower than real interest rate. The transversality condition for economic growth rate requires that, the GDP growth must be lower than real interest rate.

3.2.6.1 Testing if government can play Ponzi debt game

The Ponzi debt game refers to the roll-over of government debt without increasing taxes. This study applies computations of Blanchard and Weil (2001) to present the situation which tests if government can play a debt Ponzi game or not. This is shown in example 2.1.

Example 2.1: Can government play debt Ponzi game? The following assumptions hold; the negative average riskless rate, the expected debt to GDP ratio under a rollover strategy explodes.

a). A diamond model with logarithmic preferences; In this case an overlapping generation economy is characterised by two period consumers who in-elastically supply a unit of labour when young and retire when old (given constant and normalised population). Consumers are assumed to have time and state addictive logarithmic preferences. Therefore, an individual representative of the generation born at time t maximizes:

$$(1-\beta)In\,C_{1,t} + \beta E_t InC_{2.t+1} \qquad (2.1)$$

Subject to

$$C_{1t} + K_{t+1} = W_{t,} \qquad (2.2)$$

$$C_{2,t+1} = R_{t+1}K_{t+1,} \qquad (2.3)$$

The first and second period consumption of an individual born at t is denoted by $C_{1,\,t}$ and $C_{2,t+1}$. The wage rate and capital rental rate at t, are denoted by Wt and Rt. The capital stock at t is shown by Kt and the discount factor $\beta \in (0,1)$ measures subjective preference of time.

Cobb-Douglas technology is considered to produce the output, which is given at time t by;

$$Yt = \gamma_t K_t^{\alpha}, \qquad (2.4)$$

Where capital per worker at time t is denoted by K_t, and $\varepsilon \in (0.1)$ the constant share of capital is output. The productivity shock γ logarithm is assumed to be distributed independently and identically normal, with mean zero and variance σ^2. Capital depreciates fully in the production.

b). Equilibrium capital accumulation and dynamic efficiency

From utility maximisation, consumption is solved by replacing wages and rental rates by their values form profit maximisation:

$$K_{t+1} = (1-\alpha)\beta\gamma_t K_t^{\alpha}, \tag{2.5}$$

$$C_{1,t} = (1-\beta)(1-\alpha)\gamma_t K_t^{\alpha}, \tag{2.6}$$

$$C_{2,t} = \alpha\gamma_t K_t^{\alpha}. \tag{2.7}$$

The relevancy of this will be applicable at a later stage. At any time, t, the consumption of young and old correlate perfectly. The focus for now is on how capital behave. Hereafter, denote the logarithm of an uppercase variable by its lowercase counterparts. Therefore, have:

$$k_{t+1} = In\left[(1-\alpha)\beta\right] + \alpha k_t + \nu_t. \tag{2.8}$$

Thus, the output behaviour is given by:

$$y_t = \alpha In\left[(1-\alpha)\beta\right] + \alpha y_{t-1} + \nu_{t.} \tag{2.9}$$

The accumulation of capital leads to a serial correlation of capital and output in response to white noise shocks. The question to be asked now is what parameter values show the dynamic efficiency of this economy. The economy like this one, with constant population, the condition is that unconditional expectation of the logarithm of the gross marginal product of capital, Ert, be nonnegative:

$$E_{rt} = In\alpha + (\alpha - 1)Ek_t = In\left[\frac{\alpha}{(1-\alpha)\beta}\right], \tag{2.10}$$

The economy is therefore, dynamically efficient if:

$$\theta \equiv \frac{\alpha}{(1-\alpha)\beta} - 1 \geq 0 \tag{2.11}$$

The assumption that condition (2.11) is satisfied with economy being dynamically efficient, applies in the rest of the section. The determination of riskless rate is now to be dealt with next.

c). The riskless rate

In this case, the first-order condition for utility maximisation must be satisfied by the equilibrium risk-free rate of return, that is required so that people hold safe one period bond paying one unit of the consumption good in every state net at t + 1:

$$(1-\beta)C_{1,t}^{-1} = \beta R_{t+1}^{f} E_t C_{2,t+1,}^{-1} \qquad (2.12)$$

Risk-free rate of return is denoted by R_{t+1}^{f}, in this equation (2.12), replacing 1st and 2nd period consumption by their values from equations (2.6) and (2.7) yield the following:

$$R_{t+1}^{f} = \frac{1}{E_t r_{t+1}^{-1}} \alpha K_{t+1}^{\alpha-1}. \qquad (2.13)$$

In application of the distributional assumption about, this implies:

$$r_{t+1}^{f} = In\alpha + (\alpha-1)k_{t+1} - \sigma^2/2. \qquad (2.14)$$

Taking into use, equations (2.5), (2.14) and (2.11), unconditional mean and the variance of logarithm of the risk-free rate therefore, become:

$$Er_{t+1}^{f} = In(1+\theta) - \sigma^2/2, \qquad (2.15)$$

$$Var\, r_{t+1}^{f} = \frac{1-\alpha}{1+\alpha}\sigma^{2,} \qquad (2.16)$$

Finally:

$$E\, R_{t+1}^{f} = (1+\theta)\, e^{-\alpha\sigma^{2/(1+\alpha)}}. \qquad (2.17)$$

In the presence of certainty, the net riskless rate would be equal θ, therefore, be positive under dynamic efficiency. However, when the variance of the technological shocks is large, the average gross riskless rate under uncertainty might be less than one, and the net rate may likely be negative.

3.2.6.2 Justification that government can play Debt Ponzi game

The assumption in this example is that, underlying parameters are in such a way that, the economy is dynamically efficient. The average net riskless rate is also assumed to be negative, raising a question of whether government can roll its debt persistently,

hence, play Ponzi debt games. In assessing the feasibility of Ponzi debt games, the behaviour of debt is characterised by interest rates corresponding to the case where consumption and dynamics of capital are given by equations (2.5) to (2.7). On the assumption made concerning utility function, which implies that saving is a constant fraction of labour income, Ponzi games crowd out capital accumulation and as a result, all interest rate raise. If under such interest rates Ponzi games are instead feasible, that debt to GDP ratio implodes over time under rollover, this will therefore, be true if government issues small enough debt at time 0.

The debt to GDP ratio under a rollover strategy at time t is expressed as:

$$B_t \big/ Y_t = (R_t^f ... R_1^f) B_0 / Y_t, \tag{2.18}$$

$$= \left[R_t^f / (Y_t / Y_{t-1})\right] .. \left[R_1^f / (Y_1 / Y_0)\right] (B_0 / Y_0). \tag{2.19}$$

By using output and the riskless rate characterization given in equations (2.9) and (2.14), this implies:

$$b_t - y_t = (b_0 - y_0) + t\left[In(1+\theta) - \sigma^2/2\right] - \sum_{s=1}^{t} \upsilon_s. \tag{2.20}$$

The logarithm of debt to GDP ratio follows a random walk with drift, given innovations being equal to the technological shocks. As a result, the expected value of the debt to GDP ratio as express as:

$$E\left[B_t / Y_t = \left[B_0 / Y_0\right](1+\theta)^t. \right. \tag{2.21}$$

Therefore, expected behaviour of debt to GDP ratio grows at rate θ. This is regardless of the value of average riskless rate, hence, implying that, Ponzi game is not feasible. The debt is expected to be larger than saving, thus be proportional to GDP, which is impossible. The riskless rate from t to t+1 known as time t in equation (2.14) varies stochastically through time, which is the reason for negative average riskless rate that is consistent with an exploding expected debt to GDP ratio.

3.3 EMPIRICAL LITERATURE

3.3.1 Analysing the Impact of Public debt on Economic Growth

The widespread of public debt and its burden has led academics, economists, policy makers and the public in general to engage in debate (Lopes, Ferreira-Lopes and Sequeira, 2015). The public debt is understood commonly by policymakers as the cause of subdued economic growth (Bonga, *et al*, 2015). However, the existence of correlation does not mean there is causation. Therefore, what creates link between public debts and economic growth may probably be that low economic growth pushes up the debt levels. The implication of this is that subdued economic growth induces countries to borrow more, and in most cases, it becomes difficult to pay back the loan. Previous studies that attempted to understand the context of public debt and economic growth in South Africa have not effectively dealt with the precise causality of public debt and economic growth, especially in the post-apartheid era. The consensus in general is that the relationship between the two is positive, but the causality of this relationship is not fully known.

This study therefore, attempts to determine the causality between public debt and economic growth. As pointed out by Nantwi and Erickson (2016), the empirical research has ignored the issue of public debt in many countries, which is the key issue for economic development. It is vital to ask a question on how does public debt arise? In answering this question, Lopes (2016) stated that, the budget deficit and inability of tax revenues to cover projected expenditures is the source of public debt. Therefore, public debt serves as an instrument to cover up for budget deficits.

Moss and Chiang (2003) indicated the important channels underpinning the link between public debt and economic growth. The first channel they have shown is debt overhang, which is thought to exist when the burden of country's high debt dampens the incentive for investment because investors expect the future taxes of returns to capital to be imposed for the purpose of servicing debt (Moss and Chiang, 2003). The new investments in heavily indebted countries may be delayed because of unpredictable outcomes of debt rescheduling negotiations. The second channel is liquidity constraint, which is imposed by debt service. The large payments of debt service may induce lower growth through deprivation of the country's foreign exchange needed for the imported capital goods.

According to Baseerit (2009), the earlier stage of borrowing is normally marked with enhanced growth resulting from modest debt level. This view is supported theoretically by neoclassical growth models, in the sense that, capital scarce countries are encouraged to borrow so that they increase their accumulation of capital. The later stage of borrowing marked with high debt as pointed out by Baseerit (2009) leads to subdued growth. Nevertheless, Aizenman, Joshua, Kletzer, Kenneth, Pinto and Brian (2007) pointed out that, public sector borrowing is beneficial depending on the presence of public goods that promotes productivity, that is accumulated capital stock like infrastructure and flow spending on the current law enforcement. Therefore, government expenditure on infrastructure investment may be financed through debt in an optimal fiscal policy, if public sector infrastructure guarantees increased productivity of both private capital and labour.

Additionally, the effectiveness of public expenditure promotes growth depending on the government's capacity to borrow funds so that public goods can be financed without compromising economic growth. However, the situation may turn otherwise given the influence of economic, institutional and political environment (Aizenman, *et al*., 2007). On other hand, the flow of government expenditure enhances productivity, but government should not consider financing such expenditure through borrowing because the resulting increase in public debt induces low growth rate and welfare (Aizenman, *et al*., 2007).

The impact of public debt on economic growth in advanced and less advanced countries is marked by a wide body of literature (Stylianou, 2014). The existence of a negative relationship between public debt (external debt) and economic growth occurs because such a relationship would depress private investment. However, the contradiction found by Cohen (1993) is that, the level of debt in developing countries cannot explain the slowdown of investment. The evolution of market economies is expected to be affected by Fiscal policy and particularly government's debt policy (Greiner, 2013). There are several studies conducted to investigate public debt and economic growth. The recent study of public debt and economic growth conducted in Zimbabwe by Bonga *et al* (2015) has revealed that public debt inversely affect economic growth in Zimbabwe. They have used OLS model on economic growth to run their data for period 1980-2013. Similarly, Qudah (2016) completed the study on the link between Public debt, external debt and economic growth of Jordan. In their

study, the use of unit root test has been applied, coupled with tests such as cointegration, causality test, VAR and VECM, impulse response and variance decomposition to analyse hypothesis of the study.

The results found by Qudah (2016) discovered that economic growth in Jordan is positively affected by external debt, while public debt has significantly found to inversely affect economic growth. The results yielded by cointegration test in that study found an existing long run relationship between external debt, public debt and economic growth. Medeiros, Cabral, Baghdassarian and Almeida (2005) in their study of public debt strategic planning and benchmark in Brazil, stated that if the public debt is managed, the burden of tax could be reduced through the changing return on debt. The important point made by Medeiros *et al*, (2005) is that optimally the structure of the debt would depend on how inflation, changes in government expenditure and revenue interact. The interaction between those three will vary from country to country depending on how the tax system is structured, and also depending on how government is committed to its expenditure and the different types of shocks that may be experienced in the economy.

The other study on how public debt impact on economic growth was done in the Euro area by Checherita and Rother (2010). They mentioned that there is possibility of linear negative impact of economic growth on the ratio of public debt to gross domestic product. It therefore seems that, in most cases there is negative impact of public debt on economic growth found in several studies for several countries. This study however will concentrate on both the external debt and internal debt in South Africa to search for particular findings on how economic growth behaves given the presence of a growing public debt levels.

According to Mark (2015), the rapid increase in South Africa's public debt level has induced concerns about the sustainability of the public debt. In 2014 the government expenditure outstripped government revenue. As a result, fiscal balance has turned into a deficit. Therefore, to finance that deficit public debt was accumulated. The study has been completed in South Africa by Baaziz (2015) on how public debt links with economic growth. However, that study used old data from 1980, which is long before the end of apartheid government. Therefore, in this study only the data for post-apartheid era will be considered, hence it becomes significant for this study to focus

on that special period. Even though Baaziz (2015)'s study also covered nineteen years of the post-apartheid period until 2014, the years 2015 and 2016 have not been covered, which will be covered in this study. In contrast with the methodology used by Baaziz (2015) which is nonlinear Smooth Transition Regression (STR) model, this study applied the Johansen test of cointegration and used the Vector Error Correction Model and Granger causality test to find out how public debt affects the economic growth of South Africa. Moreover, the control variables incorporated by Baaziz (2015) were inflation rate and openness trade. However, this study incorporates investment and government deficit. Thus, strengthening the uniqueness of this study compared to other studies. The ratio of public debt to gross domestic product amounted to 26% in 2009, and since then, South Africa experienced a rapid increase of approximately 70% in public debt/GDP ratio, Hence, it became 43.9% of gross domestic product in 2014 (Mark, 2015).

The studies completed in South Africa concerning the issue of public debt and economic growth have their own different limitations. For instance, Ayadi and Ayadi (2008) conducted a comparative study of Nigeria and South Africa to examine the impact of external debt on economic growth. Mhlaba and Phiri (2017) employed the ARDL model to observe how public debt affects the economic growth of South Africa in the long run and short run. In their study, Mhlaba and Phiri limited their period of study between 2002: q2 and 2016:q4. Nonetheless, this study is not a comparative study, nor does it focus only on the external debt. Therefore, this study overcomes the limitations of Ayadi and Ayadi (2008) by focusing on the impact of public debt (including both external debt and internal debt) on economic growth.

This study applied more than one econometric models such as VECM and Granger causality test, unlike Mhlaba and Phiri (2017) who only employed the ARDL model. Another important aspect discovered through research is that, there are few studies conducted within the context of South Africa concerning public debt and economic growth. Instead, most studies cover South Africa by generally concentrating on the emerging economies, African countries and Sub-Saharan Africa. For example, Hussain, Haque and Igwike (2015) empirically analysed the Sub-Saharan Africa to study the connection between public debt and economic growth. This study overcomes such limitations by contributing more literature of studies concentrating within the context of South Africa to observe how public debt affects economic growth.

The empirical literature exposes diverse evidence on how the public debt affects economic growth. Other studies have found that public debt is inversely impacting on economic growth only when the ratio reaches certain threshold (Tabengwa, 2014). According to the study by Baaziz (2015), public debt in South Africa restricts economic growth if it breaches the threshold of 31.37% of the Gross Domestic Product. There has been a rising level of indebtedness caused by the sovereign debt crisis that shocked European countries and other countries in the world. This has led policymakers, borrowers and lenders to a dilemma in the determination of optimal level of public debt that could possibly jeopardize economic growth. The economies tend to grow slowly in those countries with high public debt (Bonga, *et al*, 2015). The inverse impact of public debt on economic growth from policy viewpoint strengthens the argument for being ambitious that fiscal consolidation will reduce public debt (Checherita and Rother, 2010).

According to Checherita and Rother (2010), it seems that studies on how public debt and economic growth relates are not enough, hence empirical literature is scarce. Therefore, it is important and necessary for this study to inspect the implications of public debt on economic growth in the economy of South Africa. The following channels, amongst others, initiate the influence that public debt has on economic growth; private saving, investing in public projects, the aggregate of factor productivity and real interest rates. As highlighted by Baaziz (2015), there is a strand of thoughts summarizing the old literature on the links of the two main variables investigated in this study, which is economic growth and public debt. In the first instance, public debt determines economic growth via domestic savings and investment. Secondly, huge amounts of public debt impose danger on domestic saving and investment via the crowding out effect, and as a result, cause economic growth to shrink.

The controversies on these theoretical views emerged from Ricardian Equivalence Theory to argue that public debt does not influence economic growth. The argument is based on the view that increasing private saving resulting from more tax cut financed through large amount borrowed will offset the public saving drop. Therefore, according to Baaziz (2015), minor public debt affects economic growth positively; however, when public debt goes beyond a certain limit, it will inversely affect economic growth. The economies in Africa, specifically those in Sub-Saharan Africa have experienced the

debt crisis and fiscal deficit in those countries is commonly a phenomenon because of escalating levels of public expenditures. Therefore, the issue of public debt seems not to be a concern for South Africa only; instead it is a concern for African countries. It has been stated by Lopes, *et al* (2015) that the issue of public debt is a global concern in African countries. The apartheid government substantially had a public debt which resulted in budget deficit that is difficult to sustain.

Mohanty and Mishra (2016) studied the impact of public debt on economic growth in India and found a positive and statistically significant impact of public debt on economic growth. Their study used Dynamic Ordinary Least Square (DOLS) and Fully Modified Ordinary Least Squares (FMOLS). The existing studies that deal with the nexus between external debt and economic growth found a non-linear relationship between the two. This refers to the threshold limit up to which public debt can cause economic growth, and subsequently economic growth would be adversely affected by high public debt. As Reinhart and Rogoff (2010) concluded, advanced economies and emerging market economies experiences a decline in economic growth when debt to GDP ratio is less than 90 percent. The causality between public debt and economic growth was not found in other studies such as Panizza and Presbitero (2014).

3.3.1.1 The role of Policies, Institutions and Shocks in Debt-Growth nexus

One of the critical issues confronting policy agenda of governments and international institutions is the problem of debt relief (Presbitero, 2008). In a study by Agim (2014). It is posited that, surging levels of public debt is a result of fiscal policies that are not sound. Nevertheless, It is recognized broadly that fiscal policy can either promote or deter economic growth (Aizenman*, et al*., 2007). The combination of policies and institutions may simultaneously have an impact on debt accumulation and growth (Presbitero, 2008). The weakening of economic institutions induces the probability of debt distress in the form of persistent weak economic policies and high vulnerability to external shocks (Yasemin, 2017).

The probability of debt crisis as emphasised within empirical literature is positively associated with higher levels of total debt and higher shares of short-term debt, and inversely associated with economic growth. As found by Kraay and Nehru (2006), the debt burden, quality of institutions and policies, as well as the shocks affecting real GDP growth are highly significant predictors of debt distress. In 2005, the Debt

Sustainability Framework (DSF) has been introduced, which then focused on pure debt burden indicators. However, as a result of Kraay and Nehru study (2006), the DSF has shifted to the quality of policies and institutions. The DSF conduct debt sustainability analysis in low income countries through analysis of country's projected debt burden over the next twenty years along with its susceptibility to shocks, so that the risk of debt distress in reference to five debt thresholds is assessed.

The impact of weak institutions would likely be conveyed via weak quality of macroeconomic policies as well as economic structures that are highly exposed to external shocks (Yasemin, 2017). Those shocks eventually hinder sustained economic growth. Asideu (2003) presented a model linking debt relief to the quality of institutions in a country, and the study found that, a country must achieve a minimum threshold of institutional quality, so that it can benefit from debt relief. There are several channels through which weak quality of economic and political institutions could affect the likelihood of debt distress persistently (Yasemin, 2017). Firstly, low income countries that experiences weak institutions tend to have low growth and high macroeconomic instability. In turn, this raises their burden of debt relative to their capacity to repay. As far as the literature on how institutions affect growth is concerned, the sustained growth could be hindered by weak institutions. Secondly, weak institutions are associated with economic structures that are less diversified and typically depends on commodity, resulting in an increased vulnerability to external shocks.

The combination of weak capacity to formulate macroeconomic policies appropriately and adverse external shocks may result in high burden of debt over time (Yasemin, 2017). It is problematic to reform economic institutions since economic institutions depend on the nature of political institutions and how political power is distributed among society (Acemoglu and Johnson, 2005). According to Ferraz and Duarte (2015), when the levels of public debt are high and also accelerating, there could be higher rates of interest and sluggish economic growth. As a result of high public debt, public finances are most likely to be marked by vulnerability to future shocks. In view of this, Ferraz and Duarte (2015) indicated that the government's ability to engage in countercyclical policies may be constrained. Furthermore, the result of high debt is a risk of falling within a bad equilibrium induced by self-fulfilling expectations (Ferraz and Duarte, 2015).

The officials of G20 government came up with policies that are useful to spur economic growth and the G20 government is also devoted to increasing infrastructure expenditure. However, it has been acknowledged by G20 government that levels of public debt would surge even more because of increased expenditure on infrastructure. Therefore, it seems that South Africa's policy decisions may be affected by some decisions taken by G20 government, especially if South Africa's responsible government officials make decisions that are not in favour of South Africa's economy (Makin, 2015).

The transition into democracy in South Africa marks different paths, including economic stabilization and debt reduction by adopting austere fiscal programme (Hamilton & Viegi, 2009). These efforts are exerted to ensure greater policy independence from creditors. Moreover, this may also reveal the image of sound management of fiscus (Hamilton & Viegi, 2009). The adopted fiscal policy measures that seek to increase revenue of the state and reverse the course of growing debt have produced undesirable results, and the socio-economic conditions of the citizens failed to ameliorate. The mechanisms of effective taxation have been affected by uncontrolled proliferation of small informal economic activities in many families as their source of survival and livelihood. Thus, the purpose of fiscal policy measures has been defeated. When countries experience such circumstances, they are obliged to borrow money to breach the revenue and expenditure gap during fiscal periods.

3.3.1.1.1 Maastricht treaty limit on the public debt value

The Maastricht treaty stipulated the role of limits upon public debt growth that is permissible to make price stability possible (Woodford, 1996). This has indicated that, fiscal instability such as discrepancies in the present value of current and future government budgets, inevitably lead to price level instability. The reason behind is the existence of possible monetary policy that results in an equilibrium with prices that are stable. The real output and real interest rate may be distressed by fiscal shocks when the price adjustment is slothful. However, Maastricht-type limit on the public debt value is capable of eliminating those kinds of shocks. The debt limit under frictionless financial markets assumption allow for Ricardian Equivalence to hold, and as a result, fiscal shocks have no effects upon real or nominal variables (Woodford, 1996). In 1992

the Maastricht treaty on European Union obliged EU member states to avert extreme levels of government debt (Pettinger, 2012).

Public debt makes it easier for fiscal authorities to progress in their role of economic stabilization and stimulating aggregate growth (Nantwi and Erickson, 2010). In this case, South Africa is not an exception, given its struggle to meet its revenue targets. Hence, it indicates that, the tax system is not up to the standard at which it can manage to fund government deficit. Therefore, making the country more reliant on the public debt.

Public debt delays taxation, and thus minimizing present distortions (Humberto*, et al*, 2012). Taxation and public debt are the two choices that are available for the government to cover its financial needs. With higher taxes in place, current consumption is compromised, and as a result, economic growth becomes sluggish. On the other hand, debt financing jeopardizes the ability of future generations to maintain financial and economic stability. The burden for future generations will be to pay the borrowed amount plus the costs related to debt financing such as interest and costs of debt management. The sustainability of such debt depends on whether it is used to generate economic growth, and also if marginal benefits are in excess, compared to the costs. Therefore, taxation and debt financing are two crucial factors that need attention, so that the government maintains the equilibrium between them, and hence, maintain financial and economic stability in a long run.

Despite the beneficial side of public debt, it is important not to deviate from the fact that, careless handling of public finance would eventually result in a decelerating economic growth. Simply because higher levels of public debt mean higher costs of debt as compared to benefits. The countries with high government debt experience a fall in private investment when the debt is rising. The opposite happens in the case of countries with low government debt. In view of these, it can be said that, the optimal level of debt is closely related to private consumption. The case of constant growth in private consumption is marked by high sustainable level of debt. On the contrary, the case of declining public consumption, the economy will benefit in the presence of lower level of public debt (Humberto*, et al*, 2012).

As posited by Ismihan and Ozkan (2012), the financial development of the country is likely to be harmed by public debt, hence have implications that are not favourable for

economic activity. This may even exacerbate in cases where a country is having limited financial depth and financial development. The reasonable government should serve public investment needs with tax system instead of debt financing (Humberto*, et al*, 2012). On the other hand, Nantwi and Erickson (2010) coined that, developing countries that experience tax regimes that are weak, coupled with low incomes, consider to finance government budget through debt. Therefore, it is not surprising to see that public debt plays a crucial role in developing countries. In view of this, it seems to be important for countries with high public debt to be rational when making decisions on financing deficit. The reason for that is a key question on how to finance deficit, which confronts policy makers and mostly economist of the government (Nantwi and Erickson, 2010).

3.3.2 Anticipation of Economic Growth Compared to the Public Debt

In recent years, what inconvenienced South Africa is the global financial crisis of 2007/08. In the post, financial crises, global economic slowdown has followed (Naraidoo and Raputsoane, 2015). The economic growth slowed from an average of 4.3% between 2000 and 2007 to 1.9% between 2008 and 2015 (Chirwa and Odhiambo 2015). The estimation of World Bank for 2016 growth was 0.6%. The weak growth performance in 2016 is largely due to the pronounced slow-down in mining as well as manufacturing and agriculture. The economy eventually cooled down, and South Africa has experienced surplus since 1995 (Marek, Shakill, Yashvir and Luchelle, 2016). However, South Africa's overall budget deficit was 3.9% of Gross Domestic Product. In the early 2000s, the public debt was down in South Africa due to primary surpluses that occurred during that time. In 2015/16 the trend was shocking in the sense that public debt doubled and reached 44.3% of Gross Domestic Product. The commitment of government to stabilize public debt was then declared in 2014 medium term budget policy statement (Marek, Shakill, Yashvir and Luchelle, 2016).

The growth of public debt leads to the decline in private investment and causes future economic growth and wages to decline too (Kibet, 2013). The public debt should not always be considered as a bad thing since sovereign debt can assist less developed countries. The government uses public debt to invest critically in massive infrastructural projects and social sectors of the economy where the capacity of taxation is limited (Kourtellos, Stengos and Tan, 2013). Therefore, public debt seems to influence the economy significantly both in the short run and in the long run. Bonga,

et al, (2015) mentioned that, historically, countries with high public debt ended up with high rate of inflation since governments were not willing to pay high interest rates. Therefore, it seems that the effect of public debt goes beyond economic growth (Bonga, *et al*, 2015).

The global economic and financial crises and its influence on the growth and development of economies in less developed countries indicates that high public debt coupled with fragile fiscal positions can decelerate the process of economic growth globally (Tabengwa, 2014). The huge amount of public debt as argued by economists imposes hindrance to the achievement of millennium development goals. This is because the escalating levels of debt and debt service drives away funds that could be used to finance expenditure on poverty reduction, hence diverts resources away from public investments. As a result, majority of less developed countries face less sustainable fiscal options which inversely affect the potential of economic growth. South Africa is therefore no exception.

South Africa's government debt coupled with low growth, financial weakness of state-owned enterprises, and expenditure pressures has induced high vulnerabilities within real and financial sectors. In the International Monetary Fund (IMF) 2016 report, South Africa's economic growth has been projected to 0.1 percent in 2016, and it has been envisaged to recover slightly by 1.1 percent in 2017. However, South Africa experienced a technical recession in the first quarter of 2017, not indicating any optimism about growth in the near term. The emphases made by the Directors of IMF in 2016 was on the need for structural reforms to inter alia, boost growth, create jobs and lessen vulnerabilities. The recommended reforms include inter alia, greater competition in the product market, more inclusive labour markets and ameliorated governance.

The IMF report showed a 0.1 percent growth projected for 2016, and indicated optimism for recovery in 2017. However, the first quarter of 2017 was market with a technical recession instead of recovery as envisaged by IMF. This may also be as a result of neglecting an ever-rising public debt. Although IMF indicated the significance of maintaining public debt, it has mentioned some exception that, given an already subdued growth pressure should not be imposed.

3.4 Summary

The study has provided important points relevant to the topic under investigation, and therefore, such points have been backed by empirical evidence provided in this chapter. The chapter started by paving the discussion with theoretical perspectives concerning both public debt and economic growth. In supplement to the theoretical perspectives, the empirical studies have been discussed to point out different views by other researchers and academics on the issues relevant to public debt and economic growth.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

This chapter describes the research methodology that is applied in this study, which is the quantitative method. In this chapter, the model is specified prior to data estimation given the variables employed in this study which are, Gross Domestic Product, public debt, investment and government deficit. While this study assesses the impact of public debt on economic growth, additional relevant variables such as government deficit and investment are incorporated as explanatory control variables. This would enable elimination of omitted variable bias. The question to be addressed in this study is whether public debt has an impact on economic growth.

4.2 Data

The secondary time series data was used for the study. Quarterly data from 1995 to 2016 was collected from South African Reserve Bank (SARB).

4.3 Specification of the model

The model specified below, with economic growth proxy by Gross Domestic Product (LGDP) being a depended variable, and the other three explanatory variables is expressed as follows:

Yt = α + β1 + β2 +β3 + £t (4.1)

$$LGDP_t = \alpha + \beta_1 LPDBT_t + \beta_2 LINVT_t + \beta_3 GDFT_t + \varepsilon_t \quad (4.2)$$

In the model displayed in equation 4.1, LPDBT denotes public debt, LINVT denotes investment and GDFT denotes government deficit. The three variables in the model are linearized by introducing logarithms (L), hence, log of economic growth, log of public debt and log of investment. The priori expectation between public debt and economic growth should be negative according to the reviewed literature.

4.4 Estimation techniques

The procedure of estimating data consists of, firstly, unit root test, secondly cointegration test and other econometric models such as Vector Error Correction model would follow. The method is adopted to investigate how public debt affects economic growth in South Africa using quarterly time series data from 1995 to 2016. In most economic studies, it is a crucial econometric exercise to estimate the lag length of auto regressive process for a time series (Liew, 2004). In most cases, economic data are time series in nature, and popularly, the kind of time series model known as Autoregressive (AR) model has directly or indirectly been applied in most economic researches.

4.4.1 Unit Root Test

The results for Unit root test can be presented both informally and formally. The informal presentation of unit root test results is in the form of visual presentation. However, the well-known formal way of unit root test is through application of Augmented Dickey Fuller test and Phillips Perron test. According to Cheng and Annuar (2012), unit root test as commonly understood, it is known as the test of stationarity. Furthermore, unit root test is applied to ensure that variables are integrated of same order. That being the case, it is an important task in econometric modelling to determine order of integration for analysed time series through unit root tests (Arltova and Fedorova, 2016). Therefore, it is an important phenomenon for a series to be tested for stationarity since this can influence its behaviour (Fadli, Nurul, Nurmadihah, Zuraida, Norazidah and Kamaruzaman, 2011).

The statisticians advocated that transformation of integrated time series into stationary requires that series be differenced successively prior to using models. Their justification, as highlighted by Dolado, Gonzalo and Marmol (1999), is that unit roots must be removed via differencing as this is required to apply regression analysis. In many instances, stationarity is being achieved after the time series is being differenced. As advocated by Bum (2009), if the variables have a unit root, the relationship between the two variables may be spurious. In the case of spurious regression, the results do not have economic significance. The time series is being integrated of same order in more than two cases. That is where there is existence of stationarity, invertible and non-deterministic Autoregressive moving average representation after differencing d times. The series are all tested for stationary either

at level, first difference or second difference using Augmented Dickey Fuller test (ADF) and Phillips-Perron (PP) test Alam and Ahmed (2010).

4.4.1.1 Augmented Dickey Fuller (ADF) Test

The statisticians called Dickey and Fuller are the ones who developed Augmented Dickey-Fuller test in the 1970s (Cheng and Annuar, 2012). This is referred to as the Augmented Dickey Fuller test since it is an augmented version of the Dickey-Fuller test for a set of time series models that is more complicated. The Augmented Dickey Fuller test tests for the presence of unit root in an Autoregressive model (Cheng and Annuar, 2012). In order to check if the series is stationary using ADF, the following equation has been presented by Alam and Ahmed (2010):

$$\Delta Y_t = \beta_1 + \beta_2 t + \delta Y_{t-1} + \alpha_i \sum_{i=1}^{m} \Delta Y_{t-1} + \varepsilon_t \quad (4.3)$$

In the above equation, a pure white noise error term is represented by ε_t , and the situation where ADF test determines if the estimates of δ are equal to zero is shown by: $\Delta Y_{t-1} = (Y_{t-1} - Y_{t-2}), \Delta Y_{t-2} = (Y_{t-2} - Y_{t-3})$ (4.4)

4.4.1.2 Phillips Perron (PP) Test

The Phillips Perron test also detects by a non-parametric method, if time series has a unit root (Cheng and Annuar, 2012). According to Alam and Ahmed (2010), a more comprehensive theory of unit root non-stationarity has been developed by Phillips and Perron, in which the tests are similar to ADF tests. However, the Phillips Perron tests incorporate an automatic correction to the procedure of Dickey-Fuller to allow for autocorrelated residuals. The same conclusions are given by both ADF and PP tests, and calculation of test statistic is complex. Cheng and Annuar (2012) proposed that Phillips Perron can be conducted using the following equation:

$$Y_t = \phi + \alpha Y_{t-1} + \varepsilon_t \quad (4.5)$$

Where, ϕ equals intercept, α equals estimator of the equilibrium parameter, t equals time or trend variable, and ε equals disturbance term.

In both the ADF and PP tests, the null hypothesis and alternative hypothesis are $H_0 : Y_t$ is stationary and $H_1 : Y_t$ is non-stationary.

4.4.2 Johansen test of Cointegration

The Johansen test of cointegration is conducted following the ADF and PP tests of unit root. The Johansen and Juselius Cointegration is the procedure applied to test for Cointegration of the vector process (Fadli, Nurul, Nurmadihah, Zuraida, and Norazidah and Kamaruman 2011). The Johansen test of cointegration requires the determination of Autoregressive (AR) lag length. The process of AR lag length p refers to a time series in which its current value depends on its first p lagged value, and normally it is denoted by AR (p). To know the AR lag length p, various lag length selection criteria are used to estimate lag length p. The selection criteria include, Aikaike's Information Criterion (AIC), Final Prediction Error (FPE), Schwarz Information Criterion (SIC) and Hannan-Quinn Criterion (HQC). The HQC as found by Liew (2004), is better than the rest in correctly identifying true lag length for a large sample such as 120 or more observations. In the case of smaller sample, AIC and FPE are the better choice. Furthermore, AIC and FPE produce the least probability of under estimation among all other criterions.

Nonetheless, there are two general methodologies for cointegration analysis, which are, Engle and Granger, Johansen and Juselius (Bum, 2009). However, in this study, Johansen and Juselius is preferred since Bum (2012) pointed out that there are drawbacks in Engle and Granger such as arbitrary normalization of the variables and find it difficult to estimate the appropriate number of cointegrating vectors. The empirical studies of econometrics that entail time series as reported by Dolado, Gonzalo and Marmol (1999) can be understood as attempts to evaluate long run equilibrium relationships that are generated by market forces and behavioural rules.

The cointegration exists when the entire components of a vector time series process are non-stationary. However, in some cases, if two or more series themselves have a unit root, but a linear combination of them does not have a unit root, then the series are said to be cointegrated (Cheng and Annuar, 2012). Therefore, the linear combination of series is called the cointegrating equation and may be interpreted as a long run equilibrium relationship among the variables. In the instances where two

series are cointegrated, the deviation from long-term equilibrium is corrected over the period through short-term adjustments (Bum, 2009).

The existence of cointegration is firstly realized when the null hypothesis that there is no cointegration at none cannot be accepted. The decision is based on the fact that the trace-statistic is greater than the critical value, and in such cases, the null hypothesis cannot be accepted. The probability value of less than 0.05 percent in that case also indicate rejection of null hypothesis. Secondly, at most 1 in the cointegration results means that there is one cointegrating equation as indicated by the null hypothesis. Similarly, the acceptance or rejection of null hypothesis is based on comparison of trace-statistic and critical value. If the critical value is greater than trace-statistic, the null hypothesis of saying there is one cointegrating equation should be accepted. This means there is one cointegrating equation since probability value as well is more than 0.05, indicating that null hypothesis cannot be rejected. The results of Maximum-Eigen value also apply the same analysis.

4.4.3 Vector Error Correction Model (VECM)

The purpose of VECM is to indicate the speed of adjustments towards long run equilibrium from short run equilibrium state (Mishra, 2011). VECM is a vector Autoregressive model that is not unrestricted, and it has been designed to be used for non-stationary series known to be cointegrated. The VECM is used if there is an existing Cointegration between series (Fadli *et al*, 2011). The presence of Cointegration between the series implies the existence of long-run equilibrium relationship among variables under investigation. The use of VECM is therefore important to check for properties of the cointegrated series in the short run (Mishra, 2011). The general form of the VECM is expressed as:

$$\Delta X_t = \alpha_0 + \lambda_1 EC^1{}_{t-1} + \sum_{i=1}^{m} \alpha_i \Delta X_{t-i} + \sum_{j=1}^{n} \alpha_j \Delta Y_{t-j} + \varepsilon_{1t} \quad (4.6)$$

$$\Delta Y_t = \beta_0 + \lambda_2 EC^2{}_{t-1} + \sum_{i=1}^{m} \beta_i \Delta Y_{t-i} + \sum_{j-1}^{m} \beta_j \Delta X_{t-j} + \varepsilon_{2t} \quad (4.7)$$

Where delta sign (Δ) denotes the first difference operator; EC_{t-1} is the error correction term lagged one period; λ is the short run coefficient of the error correction term (-1< λ <0); and ε is the white noise. The error correction coefficient (λ) is very important

in this error correction estimation since the greater coefficient indicates higher speed of adjustment of the model from the short run to the long run.

4.4.4 Granger Causality test

One of the main objectives of empirical econometrics is to study the causal relationships among economic variables (Jung, 1986). As mentioned by Jung (1986), Granger causality's predictability and exogeneity are quite useful in empirical work. The Granger causality measures if a certain event happens before another, and helps to predict that event (Sorenson, 2005). According to Stern (2011), variables are said to Granger-cause one another if the past values of a certain variable assist in prediction of current level of another variable given the applicable information. The purpose of causality test is to check how the variables react to each other, and it determines whether the paired time series data has a correlation or not (Mohd, Nor and Hussain, 2012). In addition to Granger causality test, Wald test is the complementary test of causality particularly developed to check for short run causality among the variables.

4.4.5 Diagnostic tests and the test of stability

The dynamic specification of the econometric model is examined by several test statistics, such as Wald test, Granger causality test, Vector Error Correction Model and Cointegration test. However, these test statistics become invalid when the model is estimated in the presence of contemporaneous correlation between errors and regressors (Ekaterini, 1998). It is therefore important for a diagnostic check of serial correlation and heteroskedasticity to be done. The purpose of testing for diagnostic and stability is to avert the possibility of spurious results within the model. The diagnostic tests are used to test for the heteroskedasticity, autocorrelation, and misspecification of the functional form.

According to Ekaterini (1998), the modelling of multiple economic time series as a simultaneous system of equations is often known as a common sense in economic theory. In applied econometrics, the pitfalls in linear regression model such as inter alia, heteroskedasticity or serial correlation, structural changes in the regression coefficients, functional misspecification or omitted variables are considered important (Zeilies and Hothorn, 2002). Therefore, a variety of diagnostic tests is being developed for these situations. These diagnostic tests should be seen beyond pure significance

procedures, meaning they should also be viewed as an explorative tool to extract information about the structure of the data.

4.4.5.1 Serial Correlation

This model is the classical linear regression model, and even though this model remains the most popular tool for analysing data because of its appropriateness in many situations, the quality of conclusions drawn from fitted models might be affected by many pitfalls (Zeilies and Hothorn, 2002). In applied econometrics, these pitfalls are considered important. The pitfalls referred to include inter alia, heteroskedasticity, serial correlation, structural changes in the regression coefficients, functional misspecification or omitted variables. In order to deal with such pitfalls, Griliches (1961) observed that, serial correlation can be dealt with using distributed lag model since this would reduce serial correlation and increase Durbin-Watson statistics. Furthermore, Griliches (1961) made a general comment regarding various proposed methods for dealing with serial correlation.

As Griliches (1961) believes, the existence of serial correlation in the disturbances bode that, systematically there is something that is not incorporated in the model. Therefore, according to Griliches (1961), the desirable way is to find economic reasons behind such correlation and incorporate them within the model unlike pursuing a complicated estimation techniques designed to deal with this problem. The research strategy should be directed towards elimination of serial correlation through inclusion of its causes explicitly in the models, unlike to devise new methods of living with it (Griliches, 1961).

Another important point made by Griliches (1961) is that, taking care of serial correlation by particular technique does not provide enough evidence generated by the assumed mechanism. Therefore, since Serial Correlation in disturbances could result from various reasons, its identification with single mechanism need careful investigation and more detailed data than are usually available. According to Francis and Hans (1994), since data frequently have Serial Correlation in climatological applications given the results that t test in its standard form is inapplicable. The solution to this issue is to ensure that t-statistic is scaled by a factor that depends upon the equivalent sample size.

The VEC Residual Serial Correlation LM test is considered. One of the reasons to test for serial correlation is to check whether there should be computation of a robust variance matrix estimator for the Ordinary Least Square estimators. The rejection of null hypothesis whereby probability value is less than 0.05 percent means that serial correlation does exist in the residuals, and that is undesirable. Serial correlation is a statistical term used to describe the situation when the residual is correlated with lagged values of itself which is not desirable. The effectively zero probability within the serial correlation best indicates strongly that, there is serial correlation within the residuals. The existence of serial correlation implies that, Ordinary Least Squares estimators are unbiased, consistent and asymptotically normally distributed (Erdogdu, 2006). However, they are not efficient, meaning that standard errors are estimated in the wrong way and therefore, usual confidence intervals and hypothesis tests are not reliable.

4.4.5.2 Heteroscedasticity

Heteroskedasticity is a term that is used for describing the situation when the variance of the residuals from a model is not constant (Wycliffe and Muriu, 2014). The Diagnostic is testing for heteroskedasticity in disturbance autocorrelation in time series regressions. The test returns an object of class hypothesis test with test statistic, corresponding p value, and additional parameters such as degrees of freedom, the name of the tested model, or the model used (Kleiber and Zeileis, 2008).

The presence of heteroskedasticity is tested using four tests, which are; Breusch-Pegan-Godfrey test, White test, Harvey test and Glejser test. The Breusch-Pagan test is designed for the purpose of detecting any linear form of heteroskedasticity (Williams, 2015). As observed by Williams (2015), Breusch-Pagan-Godfrey (BRG) tests the null hypothesis that the error variances are all equal as opposed to alternative that the error variances are a multivariate function of one or more variables. In addition to BRG test, a white test would also be considered to check for heteroskedasticity. The white test regresses the squared residuals on the cross product of the original regressors and a constant. The White test for heteroskedasticity is a special case of Breusch-Pagan, and it is used in the cases of non-linear forms of heteroskedasticity (Williams, 2015). The other two tests (Harvey and Glejser) will in this case be applied to complement and confirm the results of BRG and white tests.

The problem of heteroskedasticity can be dealt with through transformation of the variables or re-specification of the model. In some cases, heteroskedasticity occurs as a result of improper specification of the model (Williams, 2015). Another better solution to deal with heteroskedasticity is to use Weighted Least Squares (WLS). Hence, the semiparametric approach for homoscedasticity and heteroskedasticity data has been applied by Yu, Liu, & Chen (2013), utilising weighted least-squares equation with synthetic observations weighted by square root of their variances where the variances are estimated via the local polynomial regression.

4.4.5.3 Test of Normality (Distribution of Residuals)

The probability distribution of residual is one of the assumptions underlying the Ordinary Least Squares method. According to Wycliffe and Muriu (2014), Ordinary Least Squares estimators of the regression coefficients are best linear unbiased estimators if the residuals follow the normal distribution with zero mean and constant variance. The test for normality would be conducted using Jarque-Berra statistic. In the test of normality, the Jarque-Bera and corresponding p-value are the important aspects to check. If the p-value is more than 0.05 percent, it means that the residuals of the model are normally distributed, and that is a good indication. However, the problem may arise if it is found that residuals are serially correlated as indicated by test of serial correlation.

4.4.5.4 Cusum and Cusum of Squares tests of stability

There is a possibility that the model may be unstable, and for that reason, the Cumulative Sum (CUSUM) and Cumulative Sum of Squares (CUSUM of Squares) will be conducted to test for stability of the model. Cusum of squares is used as a recursive structural stability test, which is usually applied to observations that run forward from start to finish of a given time interval (Pesaran, 2002).

4.4.6 Variance Decomposition and Impulse Response Function

The analysis of Vector Auto regression often centres on the calculation of Impulse Response Function and forecast error variance decomposition, which track the evolution of economic shock through the system (Swanson and Granger, 1997). Therefore, dynamic interaction among the variables is investigated by generating variance decompositions (VDCs) and impulse response functions (IRFs). Since the

validity of causality tests as postulated by Soytas and Sari (2003), is applicable within the sample period, the variance decomposition is utilized to assess the validity of causality beyond the sample period. The variance decomposition allows for examination of the out-of-sample causality among the variables within VAR system.

The variance decomposition measures the percentage of the forecast error of variable that is explained by another variable. In particular, it indicates the relative impact that one variable is having on another variable (Alam and Ahmed, 2010). The variance of the forecast error of a variable can be partitioned into four with respect to the innovations in each variance within the system, i.e. the variance of the forecast error in GDP can be attributable to innovations to its own innovations, as well as to public debt, investment and government deficit. That being the case, the variance decomposition can be viewed as out of sample causality tests.

The Impulse Response Function is a shock to a VAR system. Impulse responses identify the responsiveness of the dependent variables in the VAR when a shock is put to the Error term. Therefore, a unit shock is applied to each variable and check its effect on the VAR system. Ivanov and Kilian (2005) indicated that, impulse response analysis plays a central role in modern empirical macroeconomics based on Vector Auto Regressions (VARs). Furthermore, the impulse responses in structural or semi-structural VAR model is studied by many researchers based on identification of assumptions about the short-run and long-run responses of the economy to individual structural shocks. The Impulse Response Function enables the possibility of tracing temporal responses of variables to its own shocks and shocks in other variables (Alam and Ahmed, 2010).

4.5 The priori expectations

The expectation of the results, in most cases, depends on the methodology applied by the study (Bilan and Ihnatov, 2015). Concurring with this, Hussain, Haque and Igwike (2015) highlighted that the relationship between public debt and economic growth is very sensitive to the choice of modelling. Nonetheless, Bilan and Ihnatov (2015) postulated that most studies signpost the existence of a negative relationship between the size of public debt and economic growth. In this study, it is expected that economic growth would be negatively affected by public debt.

4.6 Summary

The research methodology applied in this study was indicated in this chapter. However, prior to the methodology, the model used in this study was specified, and the Augmented Dickey Fuller and Phillips-Perron tests of unit root was elaborated. The conclusion of unit root test leads to whether the Johansen test of cointegration can be followed or not. The tests of unit root also pave a way for the correct methodology to be followed, which is the Vector Error Correction Model as discussed in the chapter. The chapter also discussed Granger causality test and the models applied for diagnostic test, stability test and also the variance decomposition and Impulse response function.

CHAPTER 5

THE EMPIRICAL RESULTS AND INTERPRETATIONS

5.1 Introduction

In compliance with the methodology discussed in chapter 4, this chapter presents the empirical analysis and interpretation of the findings. As part of the requirements for time series data analysis, testing for unit root is the start-up point to pave a way to the relevant econometric models such as cointegration and VECM. Therefore, the Augmented Dickey Fuller test and Phillips–Perron test will be applied for unit root test, followed by Johansen test of cointegration prior to Vector Error Correction Model and Granger causality. The model will also go through stability test and diagnostic check to detect any possible statistical errors that may probably exist. In the last two sections, the results for variance decomposition and Impulse Response Function will be presented. In line with this, the Eviews statistical package is used to conduct all the tests.

5.2 Results of the empirical tests

5.2.1 Unit root test results

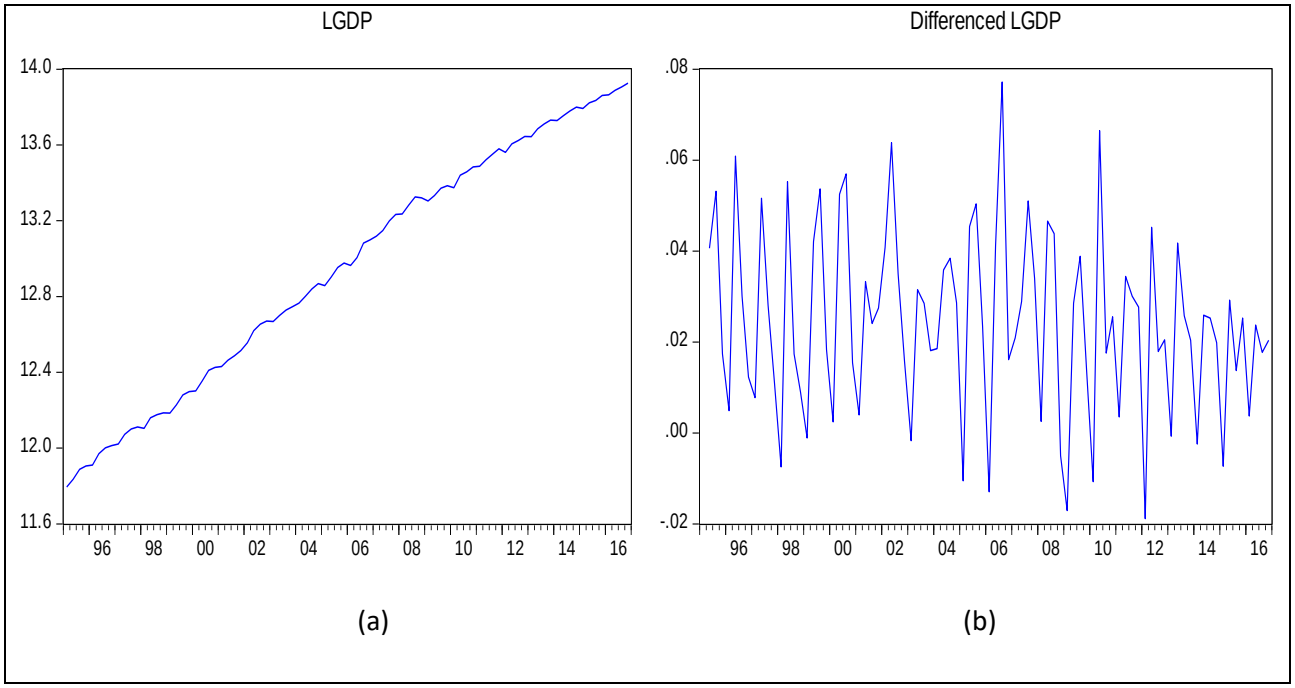
The results for unit root test can be presented both informally and formally. The informal presentation of unit root test results is in the form of visual presentation. However, the well-known formal way of unit root test is through the application of the Augmented Dickey Fuller test and Phillips Perron test.

5.2.1.1 Informal presentation of unit root test results

Figure 5.1 to 5.4 report the informal inspection of variables in both level form and first difference prior to the unit root test using Augmented Dickey Fuller test and Phillips Perron test. In panels (a) and (b) of figure 5.1, the log of economic growth is shown at level form and at 1st difference. Panel (a) demonstrates that, the sample period is mostly marked by an explosive trend of LGDP instead of wavering of LGDP around the mean. The variable needs to be differenced so that it becomes stationary. As shown by panel (b), the log of economic growth transited into stationary after being subjected to 1st difference. The 1st difference means that the variable is integrated of

the 1st order. The stationarity of the variable demonstrates that the log of economic growth is wavering around the mean. In section 5.1.2, the Augmented Dickey Fuller test (ADF) and Phillips – Perron (PP) test are applied to confirm these results.

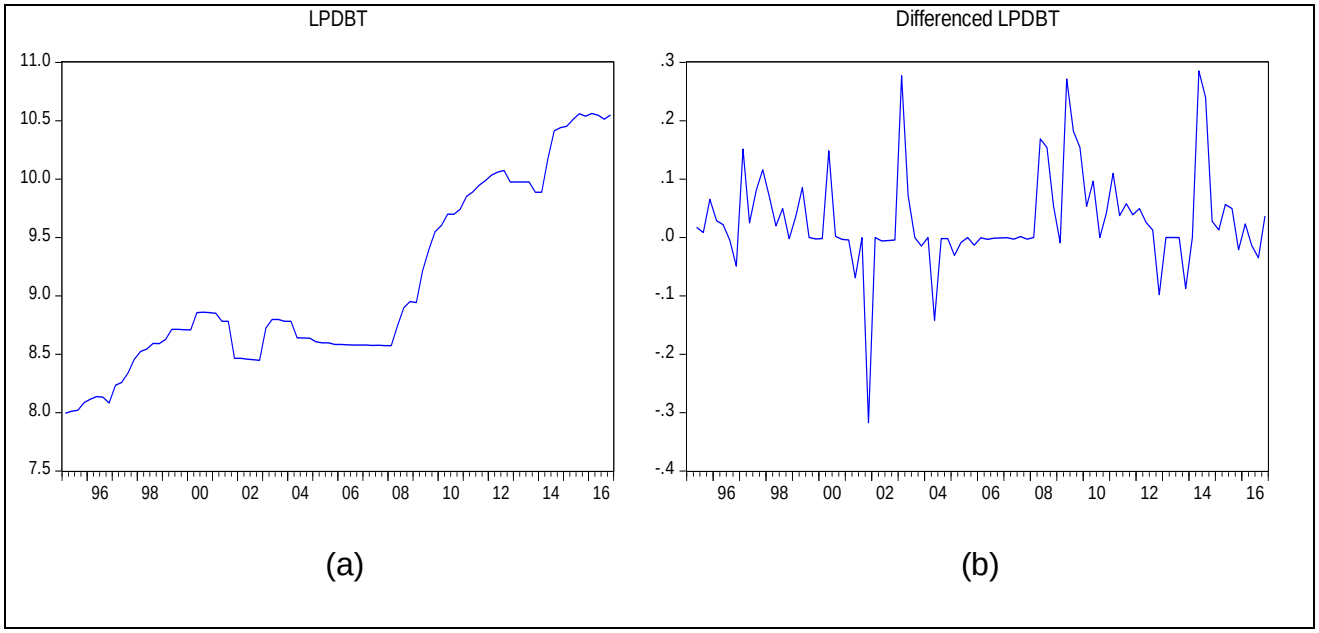
Figure 5.1 Economic growth variable (LGDP)



Source: Author Compilation

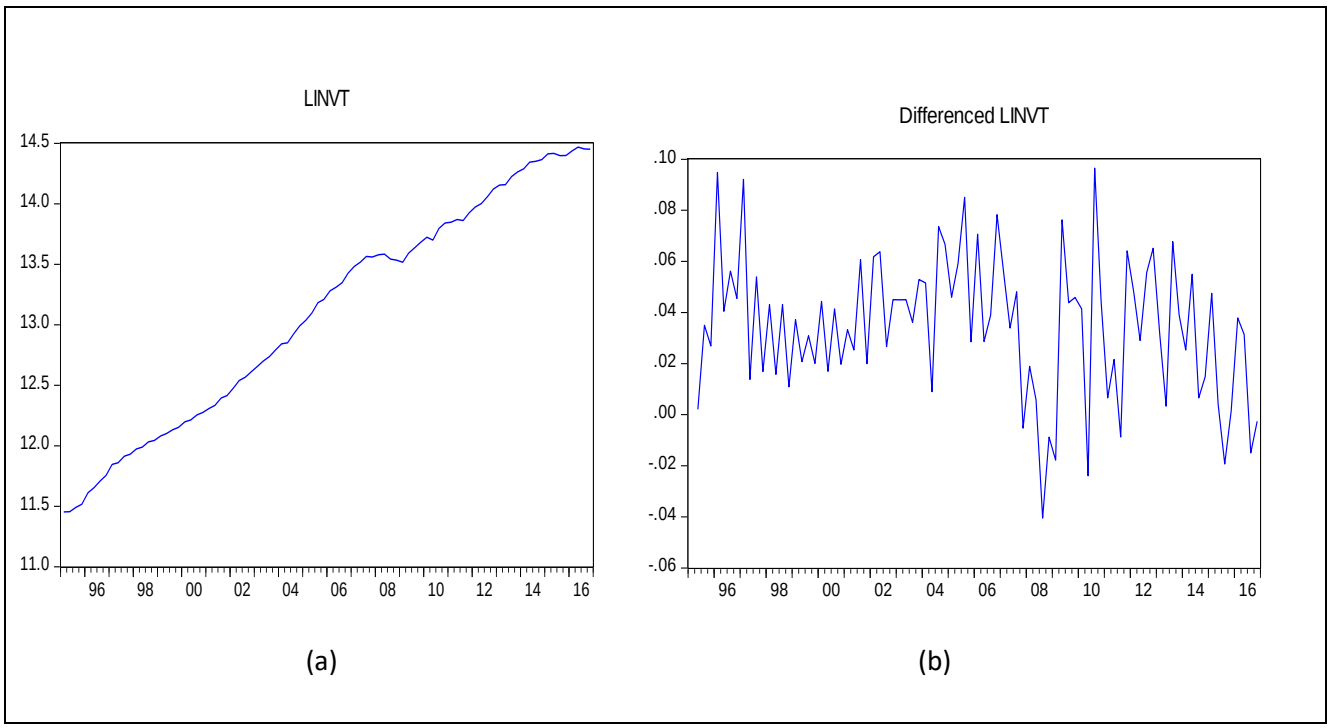
The log of public debt variable in panel (a) and panel (b) of figure 5.2 is in both level form and first difference. The level form is demonstrated by panel (a), indicating non-stationary, because of the sample period marked by the trend that is influenced by time. Hence, the trend is positive, that is, it increases overtime. In order to remove the influence of time on the time series trend, the variable is subjected to 1st difference, so that LPDBT wavers around the mean. In panel (b), the variable is stationary since it has been differenced. Hence, it is integrated of 1st order, showing that LPDBT is wavering around the mean unlike the in panel (a). The results would be formally confirmed using the ADF test and PP test in section 5.1.2.

Figure 5.2: Public debt variable (LPDBT)



Source: Author Compilation

Figure 5.3: Investment variable (LINVT)

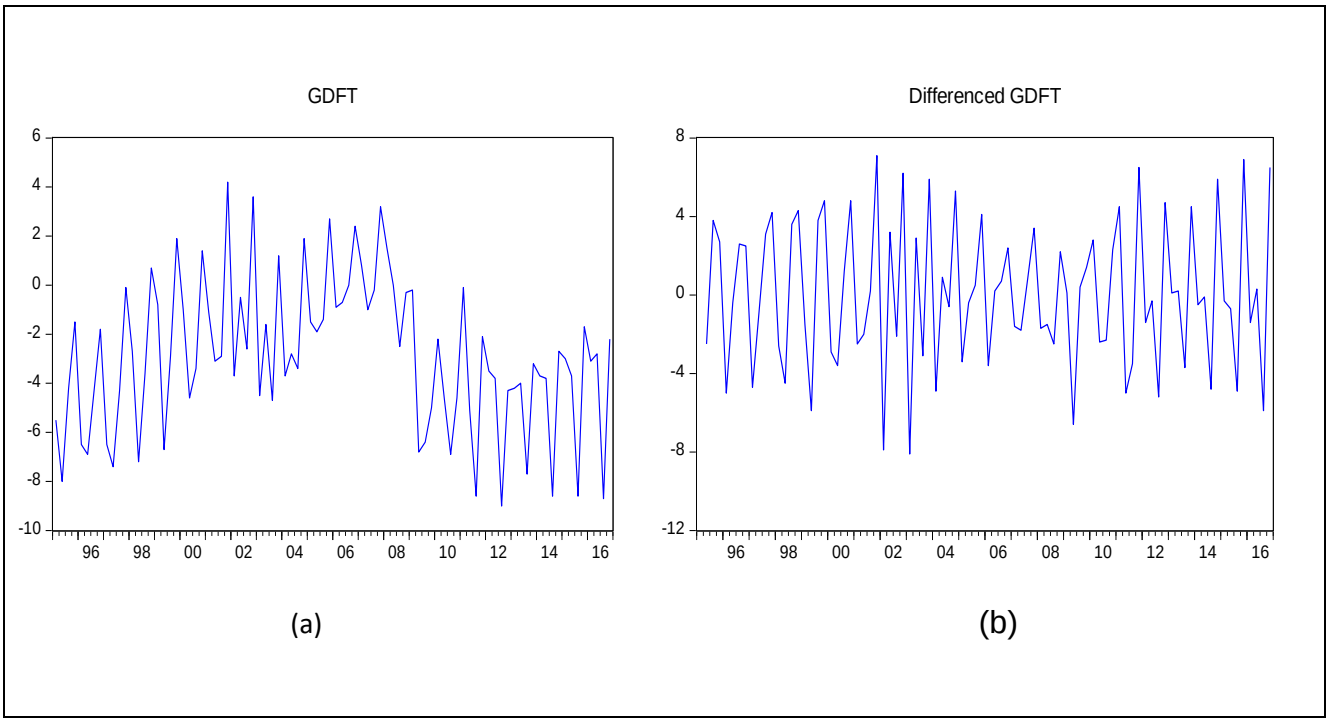


Source: Author Compilation

The stationarity and non-stationarity of log investment variable is shown in figure 5.3, on panels (a) and (b). The similar analysis such as the one in figure 5.1 and 5.2 is also applicable in this case. Therefore, the above-mentioned variable cannot be subjected to other econometric models if it is non-stationary. Therefore, the variable needs to be

differenced to 1st order, so that it becomes stationary as appears in panel (b). The ADF and PP tests will confirm this results in section 5.1.2.

Figure 5.4 Government deficit variable (GDFT)



Source: Author Compilation

As shown by figure 5.4, Panel (a) indicates government deficit at level form, and panel (b) shows the 1st difference of government deficit. In both panels, the variable is stationary as demonstrated that the sample period of GDFT is wavering. This is different from other variables such as LGDP, LPDBT and LINVT which became stationary after being subjected to 1st difference since they were not stationary at their level form. In order to confirm if government deficit is stationary at both level form and 1st difference, ADF and PP tests will be applied in section 5.1.2.

5.2.1.2 Formal presentation of unit root test results

The Augmented Dickey Fuller test and Phillips Perron results reported in tables 5.1 and 5.2 are the abridged version which has been extracted from the Eviews results, as presented in appendix B.

Table 5.1: Unit root test results for ADF and PP at level form

Variables	Model specification	ADF t-statistic	PP Adj. t-statistic	Conclusion
LGDP	Intercept	-1.826444 (0.3654)	-2.845057 (0.0562)	Non-stationary
	Trend and Intercept	-0.363093 (0.9874)	0.245894 (0.9980)	Non-stationary
LPDBT	Intercept	-0.121547 (0.9430)	-0.057372 (0.9499)	Non-stationary
	Trend and Intercept	-1.513058 (0.8177)	-1.469216 (0.8327)	Non-stationary
LINVT	Intercept	-2.048878 (0.2659)	-1.780101 (0.3880)	Non-stationary
	Trend and Intercept	-0.240382 (0.9912)	-0.705552 (0.9692)	Non-stationary
GDFT	Intercept	-2.022433 (0.2769)	-7.019704 (0.0000) ***	Non-stationary
	Trend and Intercept	-2.311689 (0.4228)	-7.057093 (0.0000) ***	Non-stationary

Source: Author compilation

Rejection of null hypothesis at 5% is indicated by ***

Rejection of null hypothesis at 1% is indicated by **

Rejection of null hypothesis at 10% is indicated by *

As reported in table 5.1, the null hypothesis for non-stationary cannot be rejected at level form, given more than 0.05 probability values in all variables at both intercept and trend with inclusion of intercept. Nonetheless, government deficit is the only variable which does not have a unit root according to Phillips Perron test at both intercept and trend with inclusion of intercept. Hence, the null hypothesis for non-stationarity cannot be accepted. In view of this situation, all variables will be subjected to 1st difference for both ADF and PP tests, so that all variables become stationary.

Table 5.2: Unit root test results for ADF and PP at first difference

Variables	Model specification	ADF t-statistic	PP Adj. t-statistic	Conclusion
ΔLGDP	Intercept	-3.088148 (0.0313) ***	-9.914533 (0.0000) **	Stationary, I (1)
	Trend and Intercept	-3.610293 (0.0350) ***	-12.07652 (0.0000) **	Stationary, I (1)
ΔLPDBT	Intercept	-6.724670 (0.0000) **	-6.719467 (0.0000) **	Stationary, I (1)
	Trend and Intercept	-6.724772 (0.0000) **	-6.724772 (0.0000) **	Stationary, I (1)
ΔLINVT	Intercept	-8.234685 (0.0000) **	-8.452990 (0.0000) **	Stationary, I (1)
	Trend and Intercept	-8.670737 (0.0000) **	-8.787905 (0.0000) **	Stationary, I (1)
ΔGDFT	Intercept	-3.596093 (0.0079) ***	-23.83152 (0.0001) **	Stationary, I (1)
	Trend and Intercept	-3678871 (0.0294) ***	-25.03272 (0.0001) **	Stationary, I (1)

Source: Author compilation

Rejection of null hypothesis at 5% is indicated by ***

Rejection of null hypothesis at 1% is indicated by **

Rejection of null hypothesis at 10% is indicated by *

Delta sign Δ, denotes that the variables are being differenced

In table 5.2, the evidence shows that all variables are stationary after being subjected to 1st difference. Therefore, the null hypothesis of non-stationarity cannot be accepted, given the probability values of less than 0.05 percent. The stationarity requirement has been satisfied using ADF test and also confirmed by PP test at intercept and at trend with inclusion of intercept. As can be seen from tables 5.1 and 5.2, only two model specifications have been applied.

The third model, which is neither a trend nor intercept is not applied because of its insignificance. According to Belloumi (2010), the model with an intercept and time

trend is the most general model, while the model with an intercept and the model without either intercept or trend are restrictive models. Similarly, Elder and Kennedy (2001) highlighted that, including intercept, or an intercept plus time trend is required to enable representation of the alternative hypothesis competing against the unit root null. However, they left out the situation of neither intercept nor intercept plus time trend, suggesting that, such a situation does not have a significant impact on the outcome of unit root test. Since all variables became stationary after being differenced, it can therefore, be concluded that the variables are integrated of first order. That being the case, Johansen test of cointegration can be applied, starting with lag order selection criteria shown by table 5.3.

Table 5.3 Summary of Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-206.7632	N/A	0.001580	4.901470	5.015626	4.947412
1	314.4744	981.8662	1.25e-08	-6.848242	-6.277464*	-6.618530
2	345.7678	56.03703*	8.77e-09*	-7.203903*	-6.176502	-6.790421*

Source: Author compilation

The lag order selected by the criterion is indicated by *.

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

The lag order selection followed by this study is Schwarz Information Criteria (SC) as indicated in table 5.3. Although, other criterion such as LR, FPE AIC and HQ, recommended lag 2, this study follows SC which selected lag 1. This decision is based on the following reasons; firstly, HQC cannot be followed because it is better than the rest in correctly identifying true lag length for a large sample such as 120 or more observations. However, the number of observations in this study is 86, which is less than 120 observations. Therefore, HQC does not fit well for the number of observations used in this study, hence, this study cannot use lag 2 as selected by

HQC. In view of that, other criterions seem to be supporting HQC by also selecting lag 2. That being the case, failure to follow HQC may somewhat lead to failure to also follow other criterions such as LR, FPE and AIC which also selected lag 2.

5.2.2 Johansen test of Cointegration results

As mentioned earlier, the ADF and PP tests showed that all variables within the model are integrated in the same order, which is I (1), therefore, this allows for cointegration to be tested using Johansen test of cointegration. The results reported in table 5.4 are the abridged results from the detailed results presented in appendix C in the section of appendices.

Table 5.4 Trace statistic and Max-Eigen test of cointegration

Hypothesized No of CE (s)	Eigenvalue	Trace statistic	0.05 Critical value	Max-Eigen statistic	0.05 Critical value
None	0.397252	64.75296	47.85613	43.53796	27.58434
At most 1	0.112987	21.21500	29.79707	10.31102	21.13162
At most 2	0.082987	10.90398	15.49471	7.450528	14.26460
At most 3	0.039361	3.453454	3.841466	3.453454	3.841466

Source: Author compilation

The Johansen test of cointegration results reported in table 5.4 reveal the existence of cointegration among the variables under investigation. The trace statistic and Maximum-Eigen value indicates one cointegrating equation. In the first instance, the null hypothesis indicates that there is no cointegration at none. However, such null hypothesis has been rejected based on the fact that the trace-statistic is greater than the critical value. Furthermore, the probability value is less than 0.05. Secondly, for at most 1, critical value is greater than trace statistic, and probability value is more than 0.05, hence the null hypothesis of one cointegrating equation cannot be rejected. Similarly, the Max-Eigen value yield same results which indicate one cointegrating equation.

Therefore, both trace-test and Maximum-Eigen value test results indicate one cointegrating equation, which shows that there is long run relationship between economic growth, public debt, investment and government deficit. To further explain this long run relationship, the long run cointegrating model is presented by normalized equation as reported in table 5.5.

Table 5.5 Normalized cointegrating equation

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LPDBT	LINVT	GDFT
1.000000	-2.385763	0.725745	-0.584953
	(0.50828)	(0.36889)	(0.08103)

Source: Author compilation

The Log of gross domestic product (LGDP) is normalized to unity as endogenous variable of the regression. The coefficients associated with the estimated cointegrated vector represent the long run elasticity of a given series to Gross Domestic Product. The expression of cointegrated vector is as follows:

$$LGDP - 2.385763LPDBT + 0.725745LINVT - 0.584953GDFT = 0 \quad (5.1)$$

$$LGDP = 2.385763LPDBT - 0.725745LINVT + 0.584953GDFT \quad (5.2)$$

In this long run cointegration model in equation (5.2), public debt and government deficit have positive signs, which indicate that, economic growth is positively related to both public debt and government deficit. Therefore, when economic growth increases by 1 percent, public debt will increase by 2.385763 percent and government deficit will increase by 0.584953. Since the usual endogenous growth models presuppose that an economy is characterized by full employment, Greiner (2013) allowed for unemployment to exist. Hence, revealed that, an economy with high ratio of debt to GDP may experience higher balanced rate of growth. Likewise, endogenous growth models depicted that, monetary policy and fiscal policy play a major role in determining potential growth, since the technical progress in economic growth can be explained by public debt.

The cointegration results are consistent with prior expectations and other studies findings such as Mohanty and Mishra (2016) who studied the impact of public debt on economic growth in India. In their study, they found a positive and statistically significant impact of public debt on economic growth. Moreover, Egbentunde (2012) concluded that, long run relationship exists between public debt and economic growth, and the two variables are positively related, assuming that the government use the obtained loan to develop the economy unlike channelling the funds to personal benefit (Egbetunde, 2012).

According to Soytas and Sari (2003), the existence of cointegration implies that there is Granger causality. However, the direction of such a causality relationship is not indicated. Therefore, Granger causality test will be focused on later to check the causal link between the variables under investigation. Since the long run relationship has now been determined, Vector Error Correction Model would follow to check for a short run relationship.

5.2.3 Vector Error Correction Model (VECM) results

Table 5.6 Summary of the VECM estimates

Variables	Coefficients	Standard Error	t – statistics
D(LGDP)	0.018086	0.09714	0.18619
D(LPDBT)	-0.045609	0.02278	-2.00251
D(LINVT)	0.132296	0.06641	1.99217
D(GDFT)	-0.004104	0.00071	-5.74199
EC	**-0.002311**	**0.00177**	**-1.30658**
C	0.020444	0.00411	4.97234

Source: Author compilation

The long run relationship was found among the variables under investigation, hence, cointegration exists among those variables. Then, this allows for estimation of VECM and results in table 5 show that there is a short run relationship between economic growth and public debt. The error correction term denoted by EC, has a negative sign, indicating that the system will eventually revert to equilibrium. Thus, long run disequilibrium will be corrected through short run adjustments, and lead the system to equilibrium in the short run at a speed of 0.23%. The consequential elasticities in the model are statistically significant given the supporting literature supplemented by theory.

The results show that, economic growth is inversely related to public debt and government deficit. In alignment to these results, strong evidence for significant inverse relationship between economic growth and public debt has been found by (Fincke and Greiner, 2015). Additionally, the accumulation of public debt as a result of fiscal measures taken to drive economic activity during 2008 global financial and economic crises, can be associated with the potential negative effect on future economic growth and stability (Mencinger, Aristovnik and Verbic, 2015). On other

hand, Dao (2013) found that, government deficit inversely affects economic growth. However, the effect is not significant, but this agrees with Ricardian Equivalence Theory (Dao, 2013).

Economic growth is positively related to investment. Hence, Chirowa and Nyamapfeni (2015) coined out that, government uses public debt to invest critically in massive infrastructural projects and social sectors of the economy where the capacity of taxation is limited. Therefore, public debt appears to have significant influence over the economy in the short run and in the long run (Chirowa and Nyamapfeni, 2015). However, in some instances, other factors that affect economic growth may occur at the same time with public debt and this may appear as if resulting sluggish rate of economic growth is due to public debt, because public debt as well affects economic growth. For example, the 2008 financial crisis led most economies to collapse. Ngwenya and Zini (2008) reported that, in the pre-crisis era, South Africa's GDP growth averaged 5.1% for 2004-2007, surging from 3.6% recorded during 2000-2003.

Additionally, the economy has been doing well overall since inflation rate moderated to single digits accompanied by maintained stability of macroeconomy. However, South Africa's economic growth fell to 1.8% in the fourth quarter of 2008, and further deteriorated to start the first quarter of 2009 with -6.4% and -3.2% in the second quarter (Padayachee, 2012). Hence thrust the economy into technical recession, and public debt is not the ideal culprit in this situation. The relationship among the variables is explained taking into account, one quarter lag for all variables. The detailed outcome for the VECM are presented in the appendices section. The stationarity of the VECM model will be presented in section 5.2.5.4 of stability test, and it is checked or tested using the AR roots graph.

5.2.4 Granger Causality test results

Table 5.7 The results of Granger Causality test

Null Hypothesis	Obs	F-statistic	P-value	Decision
LPDBT does not Granger Cause LGDP	84	6.63207	0.0001	Reject the Null Hypothesis
LGDP does not Granger Cause LPDBT		3.59543	0.0098	Reject the Null Hypothesis
LINVT does not Granger Cause LGDP	84	2.85010	0.0295	Reject the Null Hypothesis
LGDP does not Granger Cause LINVT		1.80440	0.1369	Accept the Null Hypothesis
GDFT does not Granger Cause LGDP	84	9.16750	4.E-06	Accept the Null Hypothesis
LGDP does not Granger Cause GDFT		3.410824	0.0128	Reject the Null Hypothesis

Source: Author compilation

The results of Granger causality test as presented in table 7 show evidence that five variables Granger cause one another, while two variables do not Granger cause one another. The null hypothesis that, for instance, Public debt does not Granger cause Gross Domestic Product is rejected based on the probability value, which is less than 0.05%. Therefore, rejection of null hypothesis denotes that, public debt can Granger cause economic growth. In correspondence to this outcome, Rajan (2005) argued that, countries with weak economic growth are likely to run large government deficit, which leads to more borrowing. Hence, causality running from low economic growth to high public debt. In such cases, where the causality runs from low growth to high public debt, the debt relief will fail to spur more growth (Yasemin, 2017). However, this depends on the way the borrowed funds are utilized. For instance, if the borrowed funds are being spent on productive investments, it is then most likely that economic growth would accelerate, resulting from public debt. Similarly, the Granger Causality results indicate that investment can cause Gross Domestic Product. There is bi-directional relationship between public debt and economic growth. However, in the case of investment and economic growth, as well as government deficit and economic growth, there is unidirectional relationship.

5.2.5 The Diagnostic tests and the test of stability results

The diagnostic and stability tests include testing for serial correlation, heteroskedasticity, test of normality and Cusum and Cusum of squares tests of stability.

Table 5.8 Summary of Diagnostic test results

Diagnostic test	Null Hypothesis	Statistic	P-value	Decision
VEC Residual Serial Correlation LM Test	There is no Serial Correlation	F-LM-statistic: 24.13630	0.8660	Accept Null Hypothesis
Jarque-Bera:	Residuals are normally distributed	JB Statistic: 1.791332	0.408336	Accept Null Hypothesis
White test:	There is Homoskedasticity	F-statistic: 0.842541 Obs*R-Squared: 7.797030	0.5795 0.5547	Accept Null Hypothesis
Breusch-Pagan Godfrey	There is Homoskedasticity	F-statistic: 1.905349 Obs*R-Squared: 5.606714	0.1349 0.1324	Accept Null Hypothesis
Harvey	There is Homoskedasticity	F-statistic: 0.653178 Obs*R-Squared: 2.006049	0.5832 0.5712	Accept Null Hypothesis
Glejser	There is Homoskedasticity	F-statistic: 1.409969 Obs*R-Squared: 4.218885	0.2456 0.2388	Accept Null Hypothesis

Source: Author compilation

5.2.5.1 Serial correlation results

The VEC Residual Serial Correlation LM Test of serial correlation shown in table 5.8 shows that the model does not have serial correlation. The decision is based on the probability value of 0.8660, which is more than 5%, indicating the acceptance of null hypothesis. Since the model does not have serial correlation, it means that this model is desirable. However, it should also be checked if there is heteroscedasticity in this model or not.

5.2.5.2 Heteroskedasticity results

As shown in table 5.8, the four tests used to check for Heteroskedasticity complemented each other to confirm that the model does not have Heteroskedasticity. The p-values for both F-statistic and Observed R-squared in Breusch-Pegan-Godfrey test (BRG test), White test, Harvey test and Glejser test are more than 5%, indicating the presence of Homoskedasticity, instead of Heteroskedasticity. This implies that the residuals have constant variance, which is desirable or good indication.

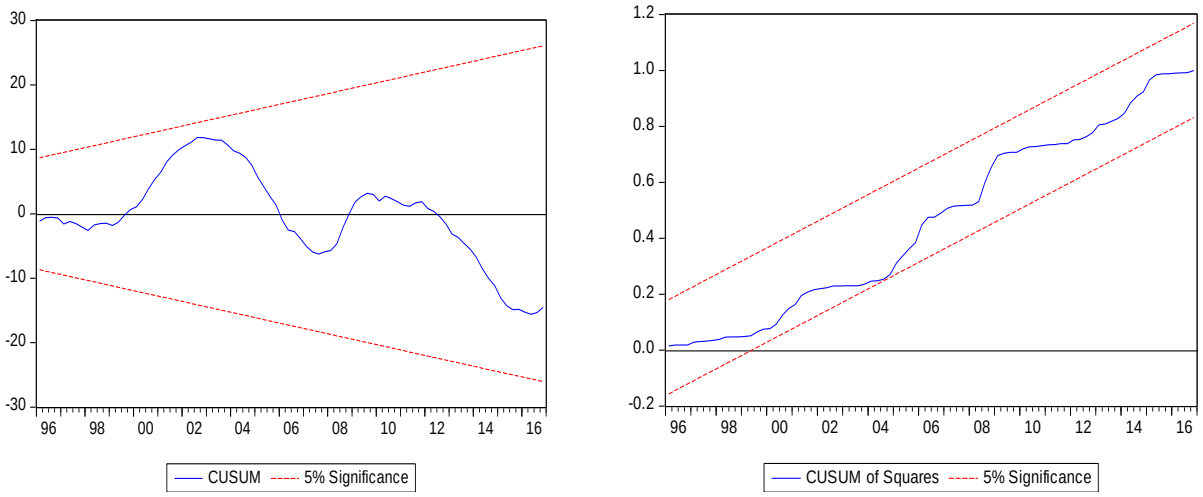
5.2.5.3 Test of Normality

As shown in table 5.8, Jarque-Bera statistic is 1.791332, and the corresponding probability value is 0.408336, which is more than 5%, showing that residuals of the model are normally distributed, which is a good indication. Hence, the null hypothesis that residuals are normally distributed cannot be rejected.

5.2.5.4 Stability tests

The stability test results are shown in figures 5.5 panels (a) and (b) respectively. As mentioned earlier in chapter 4, the Cusum and Cusum of squares are the tests used to check stability within the model. Additionally, the AR roots graph for VECM is eke applied to check for stability of the VECM model – see figure 5.6.

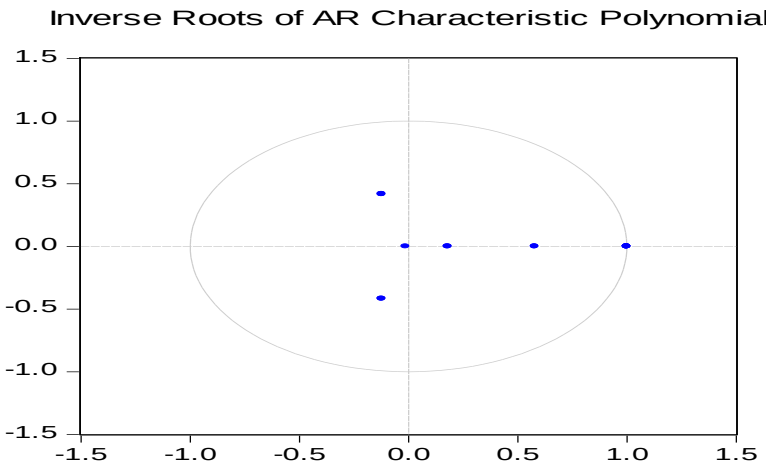
Figure 5.5 Cusum test and Cusum of squares



(a) (b)

Source: Eviews output

Figure 5.6 AR Roots graph for stationarity in VECM



Source: Eviews output

The results of stability test as reported in figures 5.5 panels (a) and (b) show evidence that the model is stable. This is indicated by a movement of blue lines located within the critical lines (two-red dotted lines) in the figures. Therefore, at 5% level of significance, the Cusum and Cusum of Squares stability tests confirm good performance of the model. The AR roots graph for VECM as can be seen in figure 5.6, indicate the stationarity / stability of the VECM model. Thus, complementing the Cusum and Cusum of Squares tests of stability. As highlighted by Marius (2012), the estimated VAR is stable (stationary) if all roots have modulus less than one and remain within the unit circle. Therefore, it can be confirmed from figure 5.6 that all roots have modulus less than one and also remains in the unit circle.

5.2.6 Variance Decomposition results

The variance of the forecast error in economic growth is attributable to innovations to its own innovations, as well as to public debt, investment and government deficit. As shown in table 5.9, four quarters have been chosen to explain variance decomposition. Firstly, when the variance of the forecast error in economic growth is attributable to its own innovations, economic growth account for 94.57 percent variation of the fluctuation in economic growth (own shock) in the second quarter. This means that, the shock in the economic growth can cause about 94.57 % variation of the fluctuation in economic growth. In the fourth quarter, shock in the economic growth account for 66.56 % fluctuations.

Secondly, a shock to public debt causes 1.51 % fluctuation in economic growth in the second quarter. In the fourth quarter, a shock to public debt account for 16.39628 % fluctuations in economic growth. Thirdly, quarter two shows that, a shock to investment account for 3.30 fluctuations in economic growth, while in quarter four, a shock to investment account for 12.79 % fluctuations in economic growth. Lastly, a shock to government deficit in quarter two account for 0.62 fluctuations in economic growth, and in the fourth quarter a shock to government deficit account for 4.25 % fluctuations in economic growth. As a result, the total fluctuation in all cases becomes 100%.

Table 5.9 Variance Decomposition of LGDP

Period	S.E.	LGDP	LPDBT	LINVT	GDFT
1	0.013815	100.0000	0.000000	0.000000	0.000000
2	0.016541	94.57103	1.509115	3.301186	0.618668
3	0.019081	79.74685	10.64767	7.283508	2.321978
4	0.021430	66.55502	16.39628	12.79736	4.251339

Source: Author Compilation

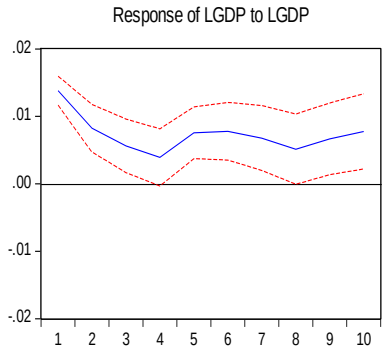
5.2.7 Impulse Response Function (IRF) results

The results of Impulse Response Function as presented in figure 5.7 indicate how one standard deviation shock to the residual, induces the reaction of variables towards each other. As demonstrated in panel (a), one positive standard innovation to economic growth leads to a positive reaction to economic growth in the selected ten quarters. Secondly, the period of ten quarters also marked a negative response of economic growth to public debt as shown in panel (c). Thus, one standard deviation shock in public debt will inversely affect economic growth, as demonstrated by the blue line located in the negative area, showing a downward trend or negative trend. This is in line with what Bonga *et al* (2015) posited: commonly, policymakers understand public debt as the cause of subdued economic growth. The Impulse Response Function results are consistent with the prior expectation. Thus signposting negative relationship between economic growth and public debt. Panel (b) shows that economic growth reacts positively to investment as a result of one standard deviation shock. Lastly, it is demonstrated in panel (d) that, one standard deviation shock within the model induces a positive reaction of economic growth to government deficit. However, although the impact is positive, some quarters are marked with exacerbating

movement, while some quarters are marked by ameliorating movement of economic growth to government deficit.

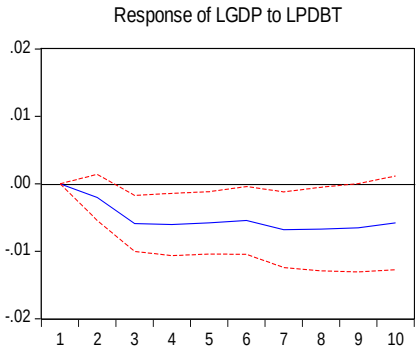
Figure 5.7 Impulse Response Function results

Response to Cholesky One S.D. Innovations ± 2 S.E.



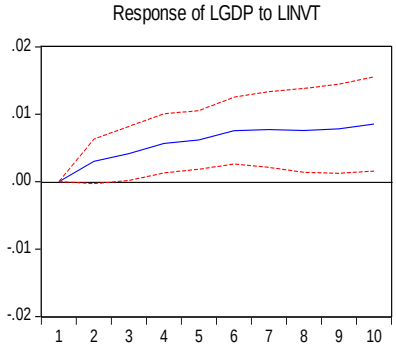
(a)

Response to Cholesky One S.D. Innovations ± 2 S.E.



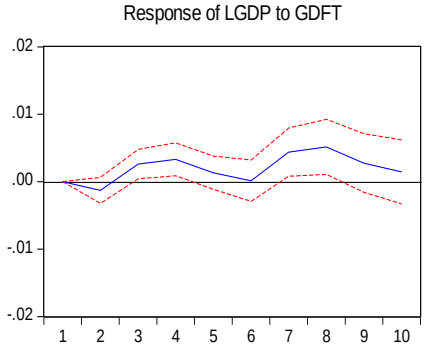
(c)

Response to Cholesky One S.D. Innovations ± 2 S.E.



(b)

Response to Cholesky One S.D. Innovations ± 2 S.E.



(d)

Source: Eviews output

5.3 Summary

This chapter presented the results revealed by econometric techniques that were discussed in chapter 4. The variables under investigation were subjected to unit root test, and they were found not to have unit root at first difference. The Johansen test of cointegration has confirmed the long run relationship among the variables investigated in this study. On other hand, the results for VECM showed that economic growth and public debt have a short run relationship. The empirical results found in the study have been backed by other studies so that the results are based on evidence. The diagnostic tests such as serial correlation and heteroskedasticity bode well for the

model applied in this study. This is because, neither serial correlation nor heteroskedasticity was found. Moreover, the model showed that the residuals are normally distributed, and also the model was found to be stable.

CHAPTER 6

SUMMARY, CONCLUSION AND RECOMMENDATIONS

6.1 Summary and Interpretation of the Findings

The study aimed to investigate if public debt has an impact on economic growth in South Africa. The Johansen cointegration, Vector Error Correction Model (VECM), Granger causality, variance decomposition and impulse response functions were employed in the analysis. In order to achieve the stated objectives, the South African quarterly data was obtained from the South African Reserve Bank in the period from 1994 to 2016.

The cointegration test found the existence of long-run relationship among the investigated variables. It turns out that in the long run there is a positive relationship between public debt and economic growth. The VECM confirmed that, there is short-run relationship among those variables in the series, and the system can adjust to equilibrium at a speed of 0.23%. There is bi-directional Granger causality relationship between public debt and economic growth. The impulse response function has found that, one standard deviation shock in public debt inversely affects economic growth. Variance decomposition results indicate that a shock to public debt account for 16.39 % fluctuations in economic growth.

6.2 Conclusion

Looking at the results that were found in the analysis, it can be concluded that public debt has a short and long run relationship which has a positive impact on economic growth. Therefore, it is concluded that a capital scarce country like South Africa can be encouraged to borrow so that there is an increase in the accumulation of capital. However, the later stage of borrowing marked with high debt will lead to subdued growth.

6.3 Recommendations

The study recommends that, since South Africa is a capital scarce country, it is encouraged to borrow so that there is an increase in the accumulation of capital. However, South Africa needs to improve its productive capacity and infrastructure to raise exports, which in turn will increase investment resources and reduce reliance on debt, and the economy should grow without reliance on debt. The policy makers should closely and significantly consider a route of investing in capital as a technique to expand the production capacity of the South African economy.

The study also echoes the policy recommendation made by David Ricardo which states that, government expenditure should not be financed by means of borrowing regardless of the circumstances. Nevertheless, an exception is slightly made for South Africa, to accord with Baseerit (2009), who pointed out that capital scarce country must borrow. However, South Africa should only borrow more if, and only if the funds borrowed are channelled into productive infrastructure projects to grow and develop the economy. In circumstances where public debt does not seem to benefit the economy, it becomes advisable to consider David Ricardo's recommendation that, existing public debt should effectively be dealt with immediately (Churchman, 2001). In line with this view, it was mentioned in chapter 2 that, the International Monetary Fund cautioned policy makers in the United States to react with immediate effect to ensure an orderly and controlled mechanisms for public debt reduction (Boccia, 2013). South Africa is not an exception, given the tough economic environment.

6.4 Contributions of the study

In addition to the results found in the study, other contributions made by the study include the issue of fiscal policy which has been raised in the context of this study. Since public debt is part of fiscal policy, it is important to revisit fiscal policy more regularly to ensure effectiveness and its positive contribution to economic growth. The academic literature and economic research are marked by debate concerning connection between fiscal policy and economic growth. This is because of its complexity and critical importance. The study made an important contribution by using post-apartheid era to investigate nexus between public debt and economic growth because there is no other study in South Africa which considered the period after transition into democracy to investigate how public debt influence economic growth.

6.5 Limitations of the study

The study limited its concentration on the post-apartheid era, that is, 1995 to 2016 to assess how public debt influenced economic growth during that period. Therefore, any circumstances that may have affected data beyond the above-mentioned period were not taken into account in this study. In addition, the study used the VECM model and Granger causality tests to produce the desired results. That being said, it means it is possible for future research to consider different models and possibly obtain different results.

6.6 Areas of future research

This study discovered an important issue concerning the impact of public debt on economic growth shown by Megersa and Cassimon (2015) in their study titled; “Public Debt, Economic Growth, and Public Sector Management in Developing Countries: Is there a Link?”. The important issue discovered in that study is the quality of public sector management such as property rights, budget management and transparency, which affect economic growth. The quality of the public sector may affect debt-growth nexus through different channels. For instance, countries with a low quality of public sector, such as those with lower rate of mobilizing revenue, low transparency and poor budget management, are more prone to a high rate of public debt because they have a tendency of borrowing more (Megersa and Cassimon, 2015). Therefore, the above-mentioned issues bode well for future research, especially the quality and management of public sector, including fiscal policy reform.

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APPENDICES

APPENDIX A: DATA

Period	LGDP	LPDBT	LINVT	GDFT
1995Q1	11.8	8.0	11.5	-5.5
1995Q2	11.8	8.0	11.5	-8.0
1995Q3	11.9	8.0	11.5	-4.2
1995Q4	11.9	8.1	11.5	-1.5
1996Q1	11.9	8.1	11.6	-6.5
1996Q2	12.0	8.1	11.7	-6.9
1996Q3	12.0	8.1	11.7	-4.3
1996Q4	12.0	8.1	11.8	-1.8
1997Q1	12.0	8.2	11.8	-6.5
1997Q2	12.1	8.3	11.9	-7.4
1997Q3	12.1	8.3	11.9	-4.3
1997Q4	12.1	8.5	11.9	-0.1
1998Q1	12.1	8.5	12.0	-2.7
1998Q2	12.2	8.5	12.0	-7.2
1998Q3	12.2	8.6	12.0	-3.6
1998Q4	12.2	8.6	12.0	0.7
1999Q1	12.2	8.6	12.1	-0.8
1999Q2	12.2	8.7	12.1	-6.7
1999Q3	12.3	8.7	12.1	-2.9
1999Q4	12.3	8.7	12.2	1.9
2000Q1	12.3	8.7	12.2	-1.0
2000Q2	12.4	8.9	12.2	-4.6
2000Q3	12.4	8.9	12.3	-3.4
2000Q4	12.4	8.9	12.3	1.4
2001Q1	12.4	8.9	12.3	-1.1
2001Q2	12.5	8.8	12.3	-3.1
2001Q3	12.5	8.8	12.4	-2.9
2001Q4	12.5	8.5	12.4	4.2
2002Q1	12.6	8.5	12.5	-3.7
2002Q2	12.6	8.5	12.5	-0.5
2002Q3	12.7	8.5	12.6	-2.6
2002Q4	12.7	8.4	12.6	3.6
2003Q1	12.7	8.7	12.7	-4.5
2003Q2	12.7	8.8	12.7	-1.6
2003Q3	12.7	8.8	12.7	-4.7
2003Q4	12.7	8.8	12.8	1.2
2004Q1	12.8	8.8	12.8	-3.7
2004Q2	12.8	8.6	12.9	-2.8
2004Q3	12.8	8.6	12.9	-3.4
2004Q4	12.9	8.6	13.0	1.9
2005Q1	12.9	8.6	13.0	-1.5
2005Q2	12.9	8.6	13.1	-1.9
2005Q3	13.0	8.6	13.2	-1.4
2005Q4	13.0	8.6	13.2	2.7
2006Q1	13.0	8.6	13.3	-0.9
2006Q2	13.0	8.6	13.3	-0.7
2006Q3	13.1	8.6	13.3	0.0

2006Q4	13.1	8.6	13.4	2.4
2007Q1	13.1	8.6	13.5	0.8
2007Q2	13.1	8.6	13.5	-1.0
2007Q3	13.2	8.6	13.6	-0.2
2007Q4	13.2	8.6	13.6	3.2
2008Q1	13.2	8.6	13.6	1.5
2008Q2	13.3	8.7	13.6	0.0
2008Q3	13.3	8.9	13.5	-2.5
2008Q4	13.3	9.0	13.5	-0.3
2009Q1	13.3	8.9	13.5	-0.2
2009Q2	13.3	9.2	13.6	-6.8
2009Q3	13.4	9.4	13.6	-6.4
2009Q4	13.4	9.5	13.7	-5.0
2010Q1	13.4	9.6	13.7	-2.2
2010Q2	13.4	9.7	13.7	-4.6
2010Q3	13.5	9.7	13.8	-6.9
2010Q4	13.5	9.7	13.8	-4.6
2011Q1	13.5	9.9	13.8	-0.1
2011Q2	13.5	9.9	13.9	-5.1
2011Q3	13.6	9.9	13.9	-8.6
2011Q4	13.6	10.0	13.9	-2.1
2012Q1	13.6	10.0	14.0	-3.5
2012Q2	13.6	10.1	14.0	-3.8
2012Q3	13.6	10.1	14.1	-9.0
2012Q4	13.6	10.0	14.1	-4.3
2013Q1	13.6	10.0	14.2	-4.2
2013Q2	13.7	10.0	14.2	-4.0
2013Q3	13.7	10.0	14.2	-7.7
2013Q4	13.7	9.9	14.3	-3.2
2014Q1	13.7	9.9	14.3	-3.7
2014Q2	13.8	10.2	14.3	-3.8
2014Q3	13.8	10.4	14.4	-8.6
2014Q4	13.8	10.4	14.4	-2.7
2015Q1	13.8	10.5	14.4	-3.0
2015Q2	13.8	10.5	14.4	-3.7
2015Q3	13.8	10.6	14.4	-8.6
2015Q4	13.9	10.5	14.4	-1.7
2016Q1	13.9	10.6	14.4	-3.1
2016Q2	13.9	10.5	14.5	-2.8
2016Q3	13.9	10.5	14.5	-8.7
2016Q4	13.9	10.5	14.5	-2.2

APPENDIX B: UNIT ROOT TEST

AUGMENTED DICKEY FULLER TEST (ADF)

Gross domestic product (intercept)

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Lag Length: 3 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.088148	0.0313
Test critical values:	1% level	-3.511262	
	5% level	-2.896779	
	10% level	-2.585626	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 05/05/17 Time: 19:45
Sample (adjusted): 1996Q2 2016Q4
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LGDP (-1))	-0.784480	0.254029	-3.088148	0.0028
D (LGDP (-1),2)	-0.297596	0.202274	-1.471254	0.1452
D (LGDP (-2),2)	-0.479317	0.143215	-3.346833	0.0013
D (LGDP (-3),2)	-0.559714	0.093158	-6.008198	0.0000
C	0.018680	0.006421	2.909265	0.0047

R-squared	0.752483	Mean dependent var	0.000187
Adjusted R-squared	0.739790	S.D. dependent var	0.030099
S.E. of regression	0.015354	Akaike info criterion	-5.456570
Sum squared resid	0.018387	Schwarz criterion	-5.310856
Log likelihood	231.4476	Hannan-Quinn criter.	-5.398030
F-statistic	59.28243	Durbin-Watson stat	1.850980
Prob(F-statistic)	0.000000		

Public debt (intercept)

Null Hypothesis: D(LPDBT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.724670	0.0000
Test critical values:	1% level	-3.508326	
	5% level	-2.895512	
	10% level	-2.584952	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LPDBT,2)
Method: Least Squares
Date: 05/05/17 Time: 19:49
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LPDBT (-1))	-0.699829	0.104069	-6.724670	0.0000
C	0.020717	0.009294	2.229091	0.0285

R-squared	0.349952	Mean dependent var	0.000224
Adjusted R-squared	0.342213	S.D. dependent var	0.100393
S.E. of regression	0.081423	Akaike info criterion	-2.155334
Sum squared resid	0.556897	Schwarz criterion	-2.098256
Log likelihood	94.67937	Hannan-Quinn criter.	-2.132363
F-statistic	45.22119	Durbin-Watson stat	2.008027
Prob(F-statistic)	0.000000		

Investment (intercept)

Null Hypothesis: D(LINVT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.234685	0.0000
Test critical values:	1% level	-3.508326	
	5% level	-2.895512	
	10% level	-2.584952	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINVT,2)
Method: Least Squares
Date: 05/05/17 Time: 19:52
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LINVT (-1))	-0.895896	0.108795	-8.234685	0.0000
C	0.031201	0.004831	6.459193	0.0000

R-squared	0.446677	Mean dependent var	-5.47E-05
Adjusted R-squared	0.440090	S.D. dependent var	0.037029
S.E. of regression	0.027708	Akaike info criterion	-4.311233
Sum squared resid	0.064488	Schwarz criterion	-4.254155
Log likelihood	187.3830	Hannan-Quinn criter.	-4.288262
F-statistic	67.81004	Durbin-Watson stat	2.017341
Prob(F-statistic)	0.000000		

Government deficit (intercept)

Null Hypothesis: D(GDFT) has a unit root
Exogenous: Constant
Lag Length: 4 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.596093	0.0079
Test critical values:	1% level	-3.512290	
	5% level	-2.897223	
	10% level	-2.585861	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDFT,2)
Method: Least Squares
Date: 05/05/17 Time: 19:54
Sample (adjusted): 1996Q3 2016Q4
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (GDFT (-1))	-1.793279	0.498674	-3.596093	0.0006
D (GDFT (-1),2)	0.017544	0.443081	0.039594	0.9685
D (GDFT (-2),2)	-0.411423	0.325761	-1.262959	0.2105
D (GDFT (-3),2)	-0.828542	0.209284	-3.958927	0.0002
D (GDFT (-4),2)	-0.354186	0.107937	-3.281416	0.0016
C	0.012245	0.171692	0.071320	0.9433

R-squared	0.941645	Mean dependent var	0.084146
Adjusted R-squared	0.937806	S.D. dependent var	6.230203
S.E. of regression	1.553737	Akaike info criterion	3.789558
Sum squared resid	183.4715	Schwarz criterion	3.965660
Log likelihood	-149.3719	Hannan-Quinn criter.	3.860260
F-statistic	245.2740	Durbin-Watson stat	2.066979
Prob(F-statistic)	0.000000		

Gross domestic product (trend and intercept)

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 3 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.610293	0.0350
Test critical values:	1% level	-4.072415	
	5% level	-3.464865	
	10% level	-3.158974	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 05/05/17 Time: 19:47
Sample (adjusted): 1996Q2 2016Q4
Included observations: 83 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LGDP (-1))	-1.015959	0.281406	-3.610293	0.0005
D (LGDP (-1),2)	-0.124408	0.221327	-0.562100	0.5757
D (LGDP (-2),2)	-0.362492	0.155338	-2.333568	0.0222
D (LGDP (-3),2)	-0.501675	0.097315	-5.155157	0.0000
C	0.030793	0.009229	3.336614	0.0013
@TREND("1995Q1")	-0.000141	7.79E-05	-1.803679	0.0752

R-squared	0.762517	Mean dependent var	0.000187
Adjusted R-squared	0.747096	S.D. dependent var	0.030099
S.E. of regression	0.015137	Akaike info criterion	-5.473855
Sum squared resid	0.017642	Schwarz criterion	-5.298999
Log likelihood	233.1650	Hannan-Quinn criter.	-5.403608
F-statistic	49.44663	Durbin-Watson stat	1.822532
Prob(F-statistic)	0.000000		

Public debt (trend and intercept)

Null Hypothesis: D(LPDBT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.724772	0.0000
Test critical values:	1% level	-4.068290	
	5% level	-3.462912	
	10% level	-3.157836	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LPDBT,2)
Method: Least Squares
Date: 05/05/17 Time: 19:50
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LPDBT (-1))	-0.705402	0.104896	-6.724772	0.0000
C	0.011482	0.018167	0.632032	0.5291
@TREND("1995Q1")	0.000211	0.000356	0.592383	0.5552

R-squared	0.352689	Mean dependent var	0.000224
Adjusted R-squared	0.337091	S.D. dependent var	0.100393
S.E. of regression	0.081740	Akaike info criterion	-2.136297
Sum squared resid	0.554552	Schwarz criterion	-2.050681
Log likelihood	94.86079	Hannan-Quinn criter.	-2.101841
F-statistic	22.61134	Durbin-Watson stat	2.005210
Prob(F-statistic)	0.000000		

Investment (trend and intercept)

Null Hypothesis: D(LINVT) has a unit root
Exogenous: Constant, Linear Trend
Lag Length: 0 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-8.670737	0.0000
Test critical values:	1% level	-4.068290	
	5% level	-3.462912	
	10% level	-3.157836	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LINVT,2)
Method: Least Squares
Date: 05/05/17 Time: 19:53
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LINVT (-1))	-0.941362	0.108568	-8.670737	0.0000
C	0.044319	0.007702	5.753963	0.0000
@TREND("1995Q1")	-0.000259	0.000120	-2.157561	0.0339

R-squared	0.476062	Mean dependent var	-5.47E-05
Adjusted R-squared	0.463437	S.D. dependent var	0.037029
S.E. of regression	0.027124	Akaike info criterion	-4.342546
Sum squared resid	0.061063	Schwarz criterion	-4.256930
Log likelihood	189.7295	Hannan-Quinn criter.	-4.308090
F-statistic	37.70785	Durbin-Watson stat	2.020522
Prob(F-statistic)	0.000000		

Government deficit (trend and intercept)

Null Hypothesis: D(GDFT) has a unit root

Exogenous: Constant, Linear Trend
Lag Length: 4 (Automatic - based on SIC, maxlag=11)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.678871	0.0294
Test critical values:	1% level	-4.073859	
	5% level	-3.465548	
	10% level	-3.159372	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GDFT,2)
Method: Least Squares
Date: 05/05/17 Time: 19:56
Sample (adjusted): 1996Q3 2016Q4
Included observations: 82 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (GDFT (-1))	-1.883962	0.512103	-3.678871	0.0004
D (GDFT (-1),2)	0.095395	0.454295	0.209985	0.8342
D (GDFT (-2),2)	-0.355158	0.333755	-1.064128	0.2907
D (GDFT (-3),2)	-0.794436	0.213913	-3.713825	0.0004
D (GDFT (-4),2)	-0.342620	0.109112	-3.140094	0.0024
C	0.294637	0.387825	0.759716	0.4498
@TREND("1995Q1")	-0.006053	0.007450	-0.812499	0.4191

R-squared	0.942154	Mean dependent var	0.084146
Adjusted R-squared	0.937526	S.D. dependent var	6.230203
S.E. of regression	1.557222	Akaike info criterion	3.805185
Sum squared resid	181.8706	Schwarz criterion	4.010637
Log likelihood	-149.0126	Hannan-Quinn criter.	3.887671
F-statistic	203.5911	Durbin-Watson stat	2.057317
Prob(F-statistic)	0.000000		

PHILLIPS PERRON TEST (PP)

Gross domestic product (intercept)

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant
Bandwidth: 55 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-9.914533	0.0000
Test critical values:	1% level	-3.508326	
	5% level	-2.895512	
	10% level	-2.584952	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000411
HAC corrected variance (Bartlett kernel)	0.000344

Phillips-Perron Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 05/14/17 Time: 06:41
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LGDP (-1))	-1.065802	0.108497	-9.823357	0.0000
C	0.025937	0.003462	7.491534	0.0000

R-squared	0.534622	Mean dependent var	-0.000235
Adjusted R-squared	0.529082	S.D. dependent var	0.029878
S.E. of regression	0.020503	Akaike info criterion	-4.913510
Sum squared resid	0.035311	Schwarz criterion	-4.856432
Log likelihood	213.2809	Hannan-Quinn criter.	-4.890538
F-statistic	96.49834	Durbin-Watson stat	2.058027
Prob(F-statistic)	0.000000		

Public debt (intercept)

Null Hypothesis: D(LPDBT) has a unit root
Exogenous: Constant

Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.719467	0.0000
Test critical values:	1% level	-3.508326	
	5% level	-2.895512	
	10% level	-2.584952	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006476
HAC corrected variance (Bartlett kernel)	0.006444

Phillips-Perron Test Equation
Dependent Variable: D(LPDBT,2)
Method: Least Squares
Date: 05/14/17 Time: 06:45
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LPDBT (-1))	-0.699829	0.104069	-6.724670	0.0000
C	0.020717	0.009294	2.229091	0.0285

R-squared	0.349952	Mean dependent var	0.000224
Adjusted R-squared	0.342213	S.D. dependent var	0.100393
S.E. of regression	0.081423	Akaike info criterion	-2.155334
Sum squared resid	0.556897	Schwarz criterion	-2.098256
Log likelihood	94.67937	Hannan-Quinn criter.	-2.132363
F-statistic	45.22119	Durbin-Watson stat	2.008027
Prob(F-statistic)	0.000000		

Investment (intercept)

Null Hypothesis: D(LINVT) has a unit root
Exogenous: Constant

Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.452990	0.0000
Test critical values:	1% level	-3.508326	
	5% level	-2.895512	
	10% level	-2.584952	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000750
HAC corrected variance (Bartlett kernel)	0.000988

Phillips-Perron Test Equation
Dependent Variable: D(LINVT,2)
Method: Least Squares
Date: 05/14/17 Time: 06:48
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LINVT (-1))	-0.895896	0.108795	-8.234685	0.0000
C	0.031201	0.004831	6.459193	0.0000

R-squared	0.446677	Mean dependent var	-5.47E-05
Adjusted R-squared	0.440090	S.D. dependent var	0.037029
S.E. of regression	0.027708	Akaike info criterion	-4.311233
Sum squared resid	0.064488	Schwarz criterion	-4.254155
Log likelihood	187.3830	Hannan-Quinn criter.	-4.288262
F-statistic	67.81004	Durbin-Watson stat	2.017341
Prob(F-statistic)	0.000000		

Government deficit (intercept)

Null Hypothesis: D(GDFT) has a unit root
Exogenous: Constant

Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-23.83152	0.0001
Test critical values:	1% level	-3.508326	
	5% level	-2.895512	
	10% level	-2.584952	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11.53924
HAC corrected variance (Bartlett kernel)	2.186748

Phillips-Perron Test Equation
Dependent Variable: D(GDFT,2)
Method: Least Squares
Date: 05/14/17 Time: 06:59
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (GDFT (-1))	-1.407523	0.101481	-13.86978	0.0000
C	0.052278	0.370656	0.141042	0.8882

R-squared	0.696060	Mean dependent var	0.104651
Adjusted R-squared	0.692442	S.D. dependent var	6.197759
S.E. of regression	3.437147	Akaike info criterion	5.330142
Sum squared resid	992.3743	Schwarz criterion	5.387220
Log likelihood	-227.1961	Hannan-Quinn criter.	5.353113
F-statistic	192.3707	Durbin-Watson stat	2.281954
Prob(F-statistic)	0.000000		

Gross domestic product (trend and intercept)

Null Hypothesis: D(LGDP) has a unit root
Exogenous: Constant, Linear Trend

Bandwidth: 24 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-12.07652	0.0000
Test critical values:	1% level	-4.068290	
	5% level	-3.462912	
	10% level	-3.157836	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000398
HAC corrected variance (Bartlett kernel)	0.000133

Phillips-Perron Test Equation
Dependent Variable: D(LGDP,2)
Method: Least Squares
Date: 05/14/17 Time: 06:43
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LGDP (-1))	-1.096562	0.109088	-10.05205	0.0000
C	0.033186	0.005616	5.908897	0.0000
@TREND("1995Q1")	-0.000146	8.95E-05	-1.629640	0.1070

R-squared	0.549051	Mean dependent var	-0.000235
Adjusted R-squared	0.538184	S.D. dependent var	0.029878
S.E. of regression	0.020304	Akaike info criterion	-4.921749
Sum squared resid	0.034217	Schwarz criterion	-4.836132
Log likelihood	214.6352	Hannan-Quinn criter.	-4.887292
F-statistic	50.52807	Durbin-Watson stat	2.088502
Prob(F-statistic)	0.000000		

Public debt (trend and intercept)

Null Hypothesis: D(LPDBT) has a unit root

Exogenous: Constant, Linear Trend
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-6.724772	0.0000
Test critical values:	1% level	-4.068290	
	5% level	-3.462912	
	10% level	-3.157836	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.006448
HAC corrected variance (Bartlett kernel)	0.006448

Phillips-Perron Test Equation
Dependent Variable: D(LPDBT,2)
Method: Least Squares
Date: 05/14/17 Time: 06:46
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LPDBT (-1))	-0.705402	0.104896	-6.724772	0.0000
C	0.011482	0.018167	0.632032	0.5291
@TREND("1995Q1")	0.000211	0.000356	0.592383	0.5552

R-squared	0.352689	Mean dependent var	0.000224
Adjusted R-squared	0.337091	S.D. dependent var	0.100393
S.E. of regression	0.081740	Akaike info criterion	-2.136297
Sum squared resid	0.554552	Schwarz criterion	-2.050681
Log likelihood	94.86079	Hannan-Quinn criter.	-2.101841
F-statistic	22.61134	Durbin-Watson stat	2.005210
Prob(F-statistic)	0.000000		

Investment (trend and intercept)

Null Hypothesis: D(LINVT) has a unit root

Exogenous: Constant, Linear Trend
Bandwidth: 4 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.787905	0.0000
Test critical values:	1% level	-4.068290	
	5% level	-3.462912	
	10% level	-3.157836	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000710
HAC corrected variance (Bartlett kernel)	0.000896

Phillips-Perron Test Equation
Dependent Variable: D(LINVT,2)
Method: Least Squares
Date: 05/14/17 Time: 06:58
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (LINVT (-1))	-0.941362	0.108568	-8.670737	0.0000
C	0.044319	0.007702	5.753963	0.0000
@TREND("1995Q1")	-0.000259	0.000120	-2.157561	0.0339

R-squared	0.476062	Mean dependent var	-5.47E-05
Adjusted R-squared	0.463437	S.D. dependent var	0.037029
S.E. of regression	0.027124	Akaike info criterion	-4.342546
Sum squared resid	0.061063	Schwarz criterion	-4.256930
Log likelihood	189.7295	Hannan-Quinn criter.	-4.308090
F-statistic	37.70785	Durbin-Watson stat	2.020522
Prob(F-statistic)	0.000000		

Government deficit (trend and intercept)

Null Hypothesis: D(GDFT) has a unit root

Exogenous: Constant, Linear Trend
Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-25.03272	0.0001
Test critical values:	1% level	-4.068290	
	5% level	-3.462912	
	10% level	-3.157836	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	11.51323
HAC corrected variance (Bartlett kernel)	1.916385

Phillips-Perron Test Equation
Dependent Variable: D(GDFT,2)
Method: Least Squares
Date: 05/14/17 Time: 07:00
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D (GDFT (-1))	-1.409595	0.102088	-13.80765	0.0000
C	0.341589	0.764992	0.446526	0.6564
@TREND("1995Q1")	-0.006503	0.015020	-0.432974	0.6662

R-squared	0.696745	Mean dependent var	0.104651
Adjusted R-squared	0.689438	S.D. dependent var	6.197759
S.E. of regression	3.453892	Akaike info criterion	5.351142
Sum squared resid	990.1380	Schwarz criterion	5.436758
Log likelihood	-227.0991	Hannan-Quinn criter.	5.385598
F-statistic	95.34869	Durbin-Watson stat	2.284858
Prob(F-statistic)	0.000000		

APPENDIX C: SELECTION OF LAG LENGTH CRITERIA

VAR Lag Order Selection Criteria

Endogenous variables: LGDP LPDBT LINVT
GDFT
Exogenous variables: C
Date: 09/15/17 Time: 10:29
Sample: 1995Q1 2016Q4
Included observations: 86

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-206.7632	NA	0.001580	4.901470	5.015626	4.947412
1	314.4744	981.8662	1.25e-08	-6.848242	-6.277464*	-6.618530
2	345.7678	56.03703*	8.77e-09*	-7.203903*	-6.176502	-6.790421*

* 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

APPENDIX D: JOHANSEN COINTEGRATION TEST

Date: 09/11/17 Time: 12:13
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments
Trend assumption: Linear deterministic trend
Series: LGDP LPDBT LINVT GDFT
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.397252	64.75296	47.85613	0.0006
At most 1	0.112987	21.21500	29.79707	0.3444
At most 2	0.082987	10.90398	15.49471	0.2175
At most 3	0.039361	3.453454	3.841466	0.0631

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

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.397252	43.53796	27.58434	0.0002
At most 1	0.112987	10.31102	21.13162	0.7150
At most 2	0.082987	7.450528	14.26460	0.4373
At most 3	0.039361	3.453454	3.841466	0.0631

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):

LGDP	LPDBT	LINVT	GDFT
-0.994015	2.371485	-0.721402	0.581452
15.52778	0.752475	-10.37078	0.043810
-19.99217	1.436293	13.23925	-0.058467
-1.992473	-2.353803	3.601960	-0.038122

Unrestricted Adjustment Coefficients (alpha):

D(LGDP)	0.002324	-0.005150	0.000639	0.000458
D(LPDBT)	-0.005029	-0.002566	-0.009551	0.013508
D(LINVT)	-0.002675	-0.000840	-0.006902	-0.001741
D(GDFT)	-1.757048	0.104377	0.349715	-0.174857

1 Cointegrating Equation(s): Log likelihood 335.1603

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LPDBT	LINVT	GDFT

1.000000	-2.385763	0.725745	-0.584953
	(0.50828)	(0.36889)	(0.08103)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.002311
	(0.00177)
D(LPDBT)	0.004999
	(0.00849)
D(LINVT)	0.002659
	(0.00287)
D(GDFT)	1.746533
	(0.29469)

2 Cointegrating Equation(s): Log likelihood 340.3158

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LPDBT	LINVT	GDFT
1.000000	0.000000	-0.640141	-0.008880
		(0.02291)	(0.00862)
0.000000	1.000000	-0.572516	0.241463
		(0.06601)	(0.02482)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.082283	0.001637
	(0.02619)	(0.00419)
D(LPDBT)	-0.034850	-0.013857
	(0.13277)	(0.02123)
D(LINVT)	-0.010384	-0.006975
	(0.04494)	(0.00719)
D(GDFT)	3.367274	-4.088273
	(4.60924)	(0.73703)

3 Cointegrating Equation(s): Log likelihood 344.0411

Normalized cointegrating coefficients (standard error in parentheses)

LGDP	LPDBT	LINVT	GDFT
1.000000	0.000000	0.000000	-0.304098
			(0.12577)
0.000000	1.000000	0.000000	-0.022568
			(0.10609)
0.000000	0.000000	1.000000	-0.461177
			(0.18661)

Adjustment coefficients (standard error in parentheses)

D(LGDP)	-0.095057	0.002555	0.060195
	(0.04261)	(0.00483)	(0.02831)
D(LPDBT)	0.156093	-0.027575	-0.096204
	(0.21447)	(0.02432)	(0.14251)
D(LINVT)	0.127603	-0.016889	-0.080738
	(0.07052)	(0.00800)	(0.04686)
D(GDFT)	-3.624294	-3.585979	4.815038
	(7.43894)	(0.84358)	(4.94286)

APPENDIX E: VECTOR ERROR CORRECTION MODEL (VECM)

Vector Error Correction Estimates
Date: 09/11/17 Time: 12:02
Sample (adjusted): 1995Q3 2016Q4
Included observations: 86 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1
LGDP (-1)	1.000000
LPDBT (-1)	-2.385763 (0.50828) [-4.69380]
LINVT (-1)	0.725745 (0.36889) [1.96740]
GDFT (-1)	-0.584953 (0.08103) [-7.21885]
C	-2.473049

Error Correction:	D(LGDP)	D(LPDBT)	D(LINVT)	D(GDFT)
CointEq1	-0.002311 (0.00177) [-1.30658]	0.004999 (0.00849) [0.58901]	0.002659 (0.00287) [0.92549]	1.746533 (0.29469) [5.92673]
D (LGDP (-1))	0.018086 (0.09714) [0.18619]	-0.957539 (0.46616) [-2.05408]	0.203263 (0.15780) [1.28814]	16.95817 (16.1867) [1.04766]
D (LPDBT (-1))	-0.045609 (0.02278) [-2.00251]	0.355747 (0.10930) [3.25467]	-0.084544 (0.03700) [-2.28505]	-3.095953 (3.79535) [-0.81572]
D (LINVT (-1))	0.132296 (0.06641) [1.99217]	-0.469330 (0.31870) [-1.47264]	0.098729 (0.10788) [0.91518]	-2.637198 (11.0662) [-0.23831]
D (GDFT (-1))	-0.004104 (0.00071) [-5.74199]	0.005766 (0.00343) [1.68124]	0.000644 (0.00116) [0.55494]	0.064312 (0.11910) [0.54000]
C	0.020444 (0.00411) [4.97234]	0.059192 (0.01973) [2.99980]	0.028897 (0.00668) [4.32642]	-0.163934 (0.68515) [-0.23927]
R-squared	0.386017	0.180587	0.118521	0.488810
Adj. R-squared	0.347643	0.129374	0.063429	0.456861
Sum sq. resids	0.021776	0.501523	0.057465	604.6805
S.E. equation	0.016498	0.079177	0.026801	2.749274
F-statistic	10.05934	3.526182	2.151312	15.29954

Log likelihood	234.0679	99.18274	192.3415	-205.8939
Akaike AIC	-5.303904	-2.167041	-4.333523	4.927765
Schwarz SC	-5.132671	-1.995807	-4.162289	5.098998
Mean dependent	0.024321	0.029507	0.034833	0.067442
S.D. dependent	0.020427	0.084856	0.027694	3.730461

Determinant resid covariance (dof adj.)	6.47E-09
Determinant resid covariance	4.84E-09
Log likelihood	335.1603
Akaike information criterion	-7.143263
Schwarz criterion	-6.344173

APPENDIX F: THE DIAGNOSTIC TESTS

VEC Residual Serial Correlation LM test

VEC Residual Serial Correlation
LM Tests
Null Hypothesis: no serial
correlation at lag order h
Date: 09/19/17 Time: 13:05
Sample: 1995Q1 2016Q4
Included observations: 86

Lags	LM-Stat	Prob
1	44.70089	0.0002
2	24.13630	0.0866
3	13.83108	0.6113
4	93.37341	0.0000

Probs from chi-square with 16 df.

Testing of Heteroskedasticity: Breusch-Pagan-Godfrey

Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.905349	Prob. F (3,84)	0.1349
Obs*R-squared	5.606714	Prob. Chi-Square (3)	0.1324
Scaled explained SS	3.475256	Prob. Chi-Square (3)	0.3240

Testing of Heteroskedasticity: White test

Heteroskedasticity Test: White

F-statistic	0.842541	Prob. F (9,78)	0.5795
Obs*R-squared	7.797030	Prob. Chi-Square (9)	0.5547
Scaled explained SS	4.832898	Prob. Chi-Square (9)	0.8486

Test of Heteroskedasticity: Harvey

Heteroskedasticity Test: Harvey

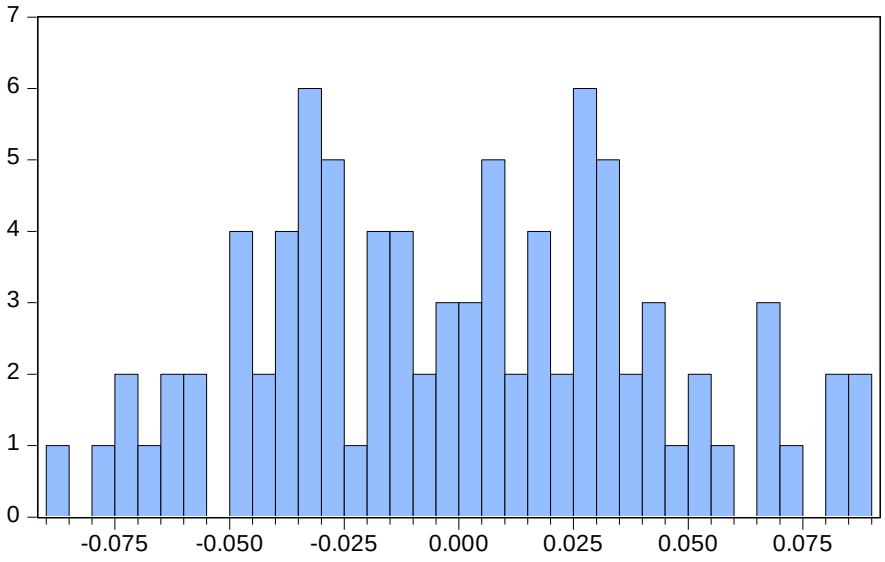
F-statistic	0.653178	Prob. F (3,84)	0.5832
Obs*R-squared	2.006049	Prob. Chi-Square (3)	0.5712
Scaled explained SS	1.551541	Prob. Chi-Square (3)	0.6704

Test of Heteroskedasticity: Glejser

Heteroskedasticity Test: Glejser

F-statistic	1.409969	Prob. F (3,84)	0.2456
Obs*R-squared	4.218885	Prob. Chi-Square (3)	0.2388
Scaled explained SS	3.403115	Prob. Chi-Square (3)	0.3335

Test of normality: Jarque-Bera Residuals test



Series: Residuals
Sample 1995Q1 2016Q4
Observations 88

Mean	-4.04e-15
Median	0.000126
Maximum	0.089816
Minimum	-0.087218
Std. Dev.	0.042157
Skewness	0.141113
Kurtosis	2.360552
Jarque-Bera	1.791332
Probability	0.408336

APPENDIX G: VARIANCE DECOMPOSITION

Variance Decomposition of LGDP: Period	S.E.	LGDP	LPDBT	LINVT	GDFT
1	0.013815	100.0000	0.000000	0.000000	0.000000
2	0.016541	94.57103	1.509115	3.301186	0.618668
3	0.019081	79.74685	10.64767	7.283508	2.321978
4	0.021430	66.55502	16.39628	12.79736	4.251339
5	0.024291	61.49824	18.45160	16.44340	3.606768
6	0.027158	57.41915	18.76896	20.92403	2.887853
7	0.030148	51.66243	20.33257	23.55253	4.452468
8	0.032632	46.57087	21.59686	25.53382	6.298448
9	0.034945	44.25536	22.32475	27.30799	6.111889
10	0.037290	43.20978	22.01839	29.25494	5.516896

Variance Decomposition of LPDBT: Period	S.E.	LGDP	LPDBT	LINVT	GDFT
1	0.076412	0.594020	99.40598	0.000000	0.000000
2	0.120193	0.350452	98.21352	1.433351	0.002681
3	0.155532	0.366235	93.68378	5.580734	0.369256
4	0.187014	0.292663	88.44604	10.22135	1.039949
5	0.216618	0.261825	84.11316	13.24360	2.381407
6	0.239194	0.237153	80.78213	16.00759	2.973127
7	0.257984	0.215579	77.96394	18.20887	3.611616
8	0.273288	0.192122	75.37059	19.99753	4.439766
9	0.286941	0.175909	72.97881	21.10546	5.739826
10	0.296994	0.169742	71.14051	22.19832	6.491434

Variance Decomposition of LINVT: Period	S.E.	LGDP	LPDBT	LINVT	GDFT

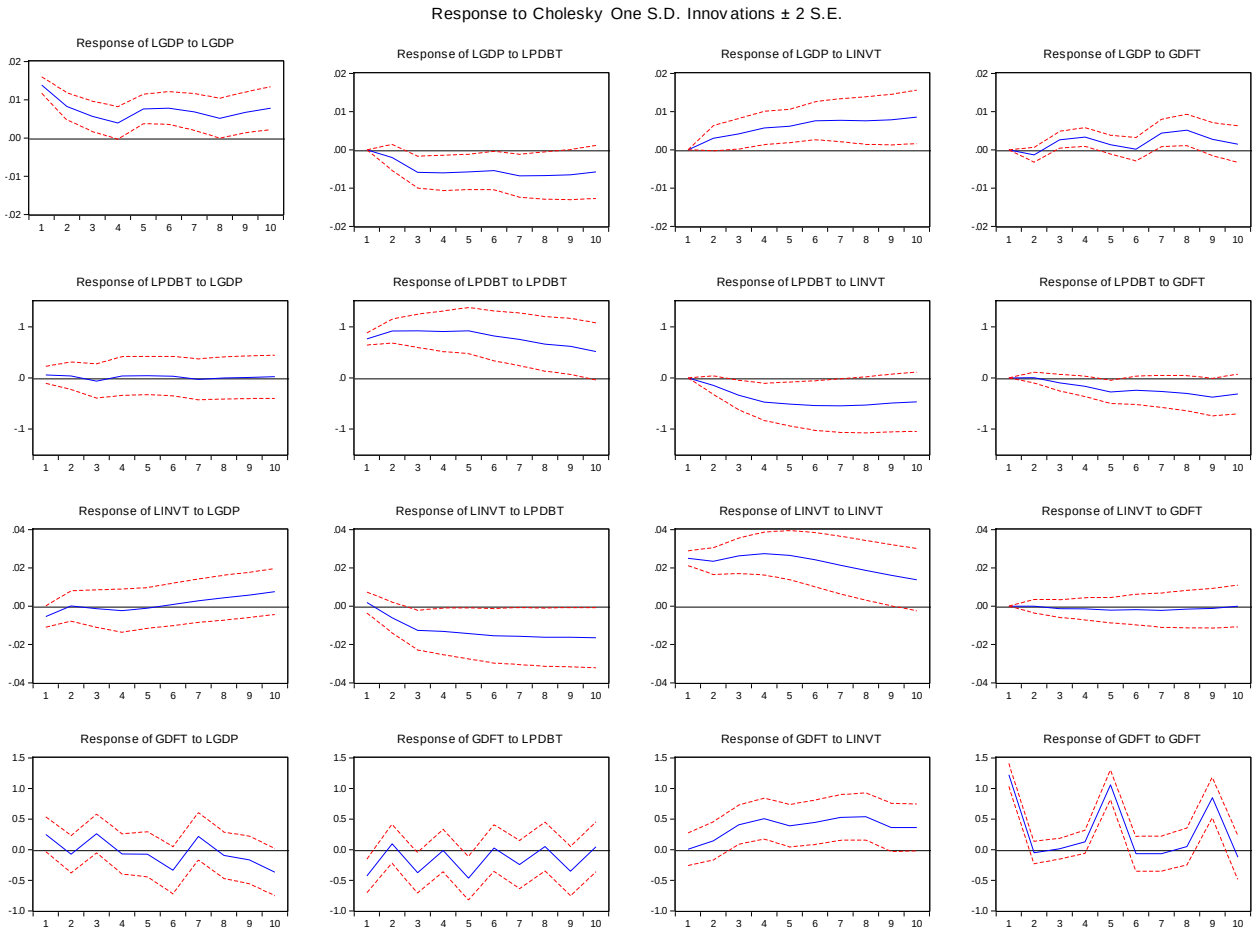
1	0.025615	4.427726	0.557610	95.01466	0.000000
2	0.035267	2.336526	3.181676	94.48150	0.000297
3	0.045752	1.471737	9.429715	89.01218	0.086367
4	0.055038	1.203662	12.26775	86.40284	0.125751
5	0.062820	0.949274	14.58544	84.25585	0.209436
6	0.069104	0.803714	17.08770	81.86828	0.240303
7	0.074093	0.850778	19.35220	79.50455	0.292476
8	0.078266	1.074961	21.67170	76.95196	0.301373
9	0.081751	1.496117	23.82227	74.38739	0.294225
10	0.084866	2.181611	25.89192	71.65339	0.273080

Variance Decomposition of GDFT:

Period	S.E.	LGDP	LPDBT	LINVT	GDFT
1	1.319200	3.569050	10.56745	0.001430	85.86207
2	1.333259	3.813634	10.85780	1.133508	84.19505
3	1.467517	6.320845	15.55969	8.616362	69.50311
4	1.559394	5.813073	13.78838	18.18032	62.21823
5	1.981876	3.744873	14.06425	15.08471	67.10617
6	2.060202	6.155682	13.03009	18.60386	62.21036
7	2.152233	6.641375	13.24197	23.01566	57.10100
8	2.222135	6.414791	12.47359	27.49247	53.61915
9	2.437345	5.809646	12.45747	25.05225	56.68064
10	2.494931	7.747254	11.92355	25.99365	54.33554

Cholesky Ordering: LGDP LPDBT LINVT GDFT

APPENDIX H: IMPULSE RESPONSE FUNCTION



APPENDIX I: GRANGER CAUSALITY TEST

Pairwise Granger Causality Tests
Date: 06/19/17 Time: 13:42
Sample: 1995Q1 2016Q4
Lags: 4

Null Hypothesis:	Obs	F-Statistic	Prob.
LPDBT does not Granger Cause LGDP	84	6.63207	0.0001
LGDP does not Granger Cause LPDBT		3.59543	0.0098
LINVT does not Granger Cause LGDP	84	2.85010	0.0295
LGDP does not Granger Cause LINVT		1.80440	0.1369
GDFT does not Granger Cause LGDP	84	9.16750	4.E-06
LGDP does not Granger Cause GDFT		3.41396	0.0128
LINVT does not Granger Cause LPDBT	84	1.40824	0.2395
LPDBT does not Granger Cause LINVT		1.21410	0.3120
GDFT does not Granger Cause LPDBT	84	2.16089	0.0816
LPDBT does not Granger Cause GDFT		2.84961	0.0295
GDFT does not Granger Cause LINVT	84	0.17097	0.9526
LINVT does not Granger Cause GDFT		2.16582	0.0810