Foreign Borrowing and Economic Growth In Zambia: An Econometric Analysis

A Dissertation

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by

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ABSTRACT

In the recent past, Zambia has increased its external borrowings significantly after reaching the Heavily Indebted Poor Countries (HIPC) completion point. The Zambian government has been on an ambitious borrowing spree with the intent that most of these funds would be channelled towards building and maintenance of key national infrastructure including roads and construction of new airports. This study undertook to answer the question, does increasing external debt affect growth of a nation's economy? The thesis commenced an econometric study between the years 1980 to 2015 using publicly available data premised on the neo-classical economic growth model. The findings from this investigation show that shocks to external debt negatively impact the economic output of Zambia which is proxied by the Gross Domestic Product (GDP). Conversely, it was found that external debt stock could not reliably forecast future economic growth for the nation, a finding which in itself provides an area of further investigations. These research findings and recommendations make it clear that Zambia requires a comprehensive debt contraction and management framework to avoid the vagaries of short-term decisions which may not always be premised on sound economic thinking.

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ABBREVIATIONS

Term	Description
%	Percentage
BBC	British Broadcasting Corporation
BOZ	Bank of Zambia
CSO	Central Statistics Office
DBZ	Development Bank of Zambia
GDP	Gross Domestic Product
GNI	Gross National Income
GRZ	Government of the Republic of Zambia
HIPC	Heavily Indebted Poor Country
IMF	International Money Fund
LDC's	Less Developed Countries
MMD	Movement for Multiparty Democracy
MoF	Ministry of Finance
ODA	Official Development Assistance
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
PF	Patriotic Front
PWC	Price Waterhouse Coopers
UCT	University of Cape Town
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Program
UNIP	United National Independent Party
USD	United States Dollars
VAR	Vector Auto-Regressive
VARM	Vector Auto-Regressive Model
VEC	Vector Error Correction
VECM	Vector Error Correction Model
WBG	World Bank Group
ZMK	Zambian Kwacha Currency Before Rebasing
ZMW	Zambian Kwacha Currency After Rebasing
CRS	Constant Return to Scale

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CHAPTER 1: INTRODUCTION

1.1 Introduction

Almost all nations in the world use some level of borrowing to finance government processes, which include day to day operations, infrastructure spending, and dismantling of unsettled liabilities. Public debt serves as an important source of finance for the government, particularly for low income and poor countries and has of late captured the attention of several scholars due to potential sovereign debt issues in countries like Greece (Todaro & Smith, 2011). This interest has further grown due to several sub-Saharan countries contracting debt, mostly external, after struggling to reach their Heavily Indebted Poor Countries(HIPC) completion points (World Bank Group, 2014).

Borrowing by governments can be clustered in a binary way, that is, as internal debt (borrowing in-country) and external debt (borrowing from outside the nation). Internal debt includes, among other sources treasury bills, market stabilisation schemes and securities against savings (Alagidede, 2012). On the other hand, debt from foreign lenders emanates from foreign governments, international banks and regional and global financial institutions (Bank of Zambia, 2015). External debt can also be viewed differently and in three categories; firstly as foreign currency debt, that is, where the currency of the debt differs from the currency of the borrower nation or on the residence of the lender where the lender is outside the domicile of the debtor country and finally debt from outside can be based on the location of issuance and the associated legislative jurisdiction of issuance (Panizza, 2008).

Rao (2003) defines economic development as a comprehensive process that includes improvements in all sections of a society coupled with the well-being of the total population on a sustainable basis while minimising abject poverty and economic deprivation of that society. Economic growth is a subset of economic development and it focuses on growth in the Gross Domestic Product (GDP) from one period to another (OECD, 2016). In this vein, Rao further elucidates that economic growth is the rate of growth of total economic output inclusive of the contribution of capital accumulation in this output (Rao, 2003). The contemporary attention of development finance is on economic development as opposed to purely focussing on GDP evolution, that notwithstanding, a study where one variable is GDP is still relevant as economic output change is a critical subset of economic development (Soubbotina & Sheram, 2000). Hence, although a rudimentary measure to some extent by combining the economic output without regard to improvement in citizen welfare per se, GDP at least enables economic observers to ascertain whether the economy is stirring on the right trajectory or not by measuring the output of a nation over time.

Zambia is a land-locked country in sub-Saharan Africa, bordering seven nations and has a life expectancy of 53 years with a national population standing at 15 million in 2014 (CSO Zambia, 2014). The political economy of the country is fairly peaceful, though recent elections such as the 2015 and 2016 ones were marred by sporadic outbreaks of violence before and on election day as noted by the European Union Election Observation Mission (European Union, 2016). As of 2015, the World Bank World Development Indicators report show that the country's population has risen to 16.2 million, with a Gross National Income per capita of $1,500, down from $1,740 in 2014 and total economic output of $21 billion in 2015, down from $27 billion in 2014 (The World Bank, 2016).

The nation's output as represented by GDP, in 2013 was disaggregated as follows; the primary sector, including Agriculture and mining, made up 17.6 percent, the secondary sector which includes construction and manufacturing made up 23.6 percent while the tertiary sector made up 56.2 percent, the balance being government subsidies at 2.8 percent. Interestingly, between 1964 and 2014, CSO notes that the Country trade balance has mostly been positive with the exception, among others, between the years 2003 to 2005 when the country ran a trade deficit for the three consecutive years (CSO Zambia, 2014). The total external debt for the Country stood at $7.3 billion in 2014, up from $6 billion in 2013 (The World Bank, 2016). The nation's fertility rate dropped to 5.3 between the period 2013 to 2014, previously being at 5.9 in 2010 although Zambia recorded a success in reducing infant mortality which reduced to 45 in 2014 from a high of 70 in 2010, infant mortality being measured by the number of deaths per 1000 live births under the age of one. According to the amended Constitution of Zambia (2016), the nation is a democratic sovereign practising multiparty democracy and has a presidential governance structure with the president and vice president being elected together with 150 parliamentarians. Up to 8 additional members of parliament are nominated by the president. The head of state subsequently constitutes his cabinet to administer state affairs and appoints several other lower-ranked officials including Permanent Secretaries and Commissioners of numerous state enterprises (Zambia Development Agency, 2017). The uppermost courts of petition in the republic are the Supreme Court, led by the Chief Justice and the Constitution Court, led by the president of the Constitutional Court, these institutions hold equal ranking (GRZ, 2016).

1.2 Problem Statement

The milieu discussed above shows declining economic fortunes for Zambia, a rising population, and an unfavourable global economic outlook while at the same time the country is contracting more external debt (The World Bank, 2016). These challenges are emphasised by figure 1 and 2 below.

Figure 1: Zambia Selected Macro Economic Variables 2012-2015 in Percentage (%)

Year	2012	2013	2014	2015
Real Gross Domestic Product(GDP) growth	7.2	6.5	7.1	7.4
GDP per Capita growth	4	3.2	3.8	4.2
Inflation	6.6	7.1	6.8	6.3
Budget balance as a Percentage of GDP	-2.8	-7.3	-6.6	-5.7
Current Account Balance	2.1	0.2	-0.2	-0.4

Source: African Economic Outlook

Figure 2: Zambia Total External Debt as a Percentage of GDP

Year	2011	2012	2013	2014
Central Government	6,4	11,8	11,8	16,9
BoZ	1,9	1,6	1,5	1,3
Private and Parastatal	7,1	3,7	6,9	5,7
Total External Debt	15,4	17,1	20,2	23,9

Source: IMF Debt Sustainability Study Article IV Consultation, 2015

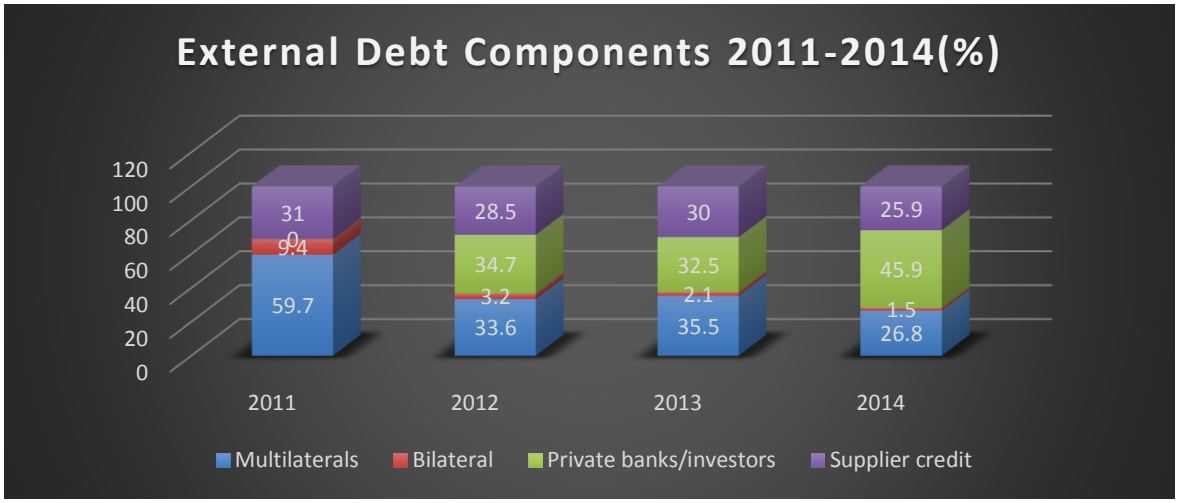
Figure 2 reveals that between the years 2011 to 2014, the central government's share of external debt has risen from being 6.4 percent of GDP in 2011 to 16.9 percent as of 2014. Though GDP

growth was strong during 2012 to 2015 period as shown in figure 1, the country recorded a budget deficit as a percentage of GDP of 5.7 percent in 2015.

Beginning with the end of the Movement for Multiparty Democracy(MMD)'s rule and coinciding with the ushering in of the Patriotic Front(PF) in the September 2011 general elections, Zambia has been on an ambitious infrastructure development plan to serve as a basis for economic development and increased private sector commercial participation in the country (The Economist, 2014). This demand to develop the country's infrastructure, in particular roads and airports, has placed a huge burden on the national budget (Zambia Development Agency, 2014). In addition, the declining prices of commodities (of which Copper remains the Country's main export) coupled with politically popular central government decisions to expand the civil services and its related bureaucracy have placed further pressure on the country's fiscus (PWC, 2015). Inevitably, the above factors have culminated into the necessity for the Government of the Republic of Zambia(GRZ) to borrow both domestically and externally (PWC, 2015). The country reached the HIPC completion point in 2005 and in the immediate years following this, there was a depressed appetite for borrowing, less for foreign debt with the national treasury opting to use domestic resources, mainly treasury bills and government bonds to finance its operations and investment needs. Fast forward a few years later, the country has steadily started borrowing from external lenders and cooperating partners, a key moment being the issuance of the first ever Eurobond worth $750 million in 2012 (Hambayi, 2015).

This is a critical feature of the borrowing in recent years as noted by Hambayi, the flavour of this debt is mostly of a foreign nature as opposed to funds which were borrowed from international development institutions such as the World Bank and the International Monetary Fund(IMF). As shown below in the next Chart, in 2011, Zambia almost had no debt with private investors and banks. However, by the end of 2012, private banks and investors accounted for 34.7 percent of the Country's external debt, and this has grown to 45.9 percent as of 2014. This increase in the borrowing in Eurobonds in recent years (2000 to 2014) by African Nations if thus new from earlier sovereign borrowing models (Dovis et al., 2016)

Figure 3: Zambia External Debt Components 2011-2014, in Percentage

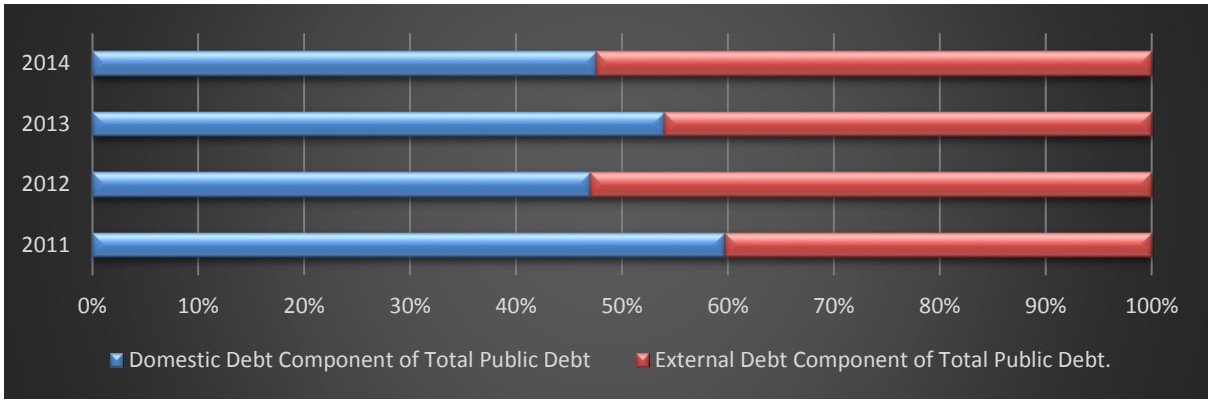


Source: IMF Debt Sustainability Study Article IV Consultation, 2015

Studies to examine the relationship of external borrowing to economic growth in Zambia have been done in the past, a notable example being the work of Koyi (Koyi, 2006). However, research in this area has not analysed Zambia's external debt quantum across time and the changes in the growth of the economy as measured by GDP for a thirty-five-year period.

Another key difference between this study and others is that most research was done when Zambia did not borrow from international debt markets but rather from mainly Cooperating partners and through the use of internal domestic debt as shown by figure 4 below.

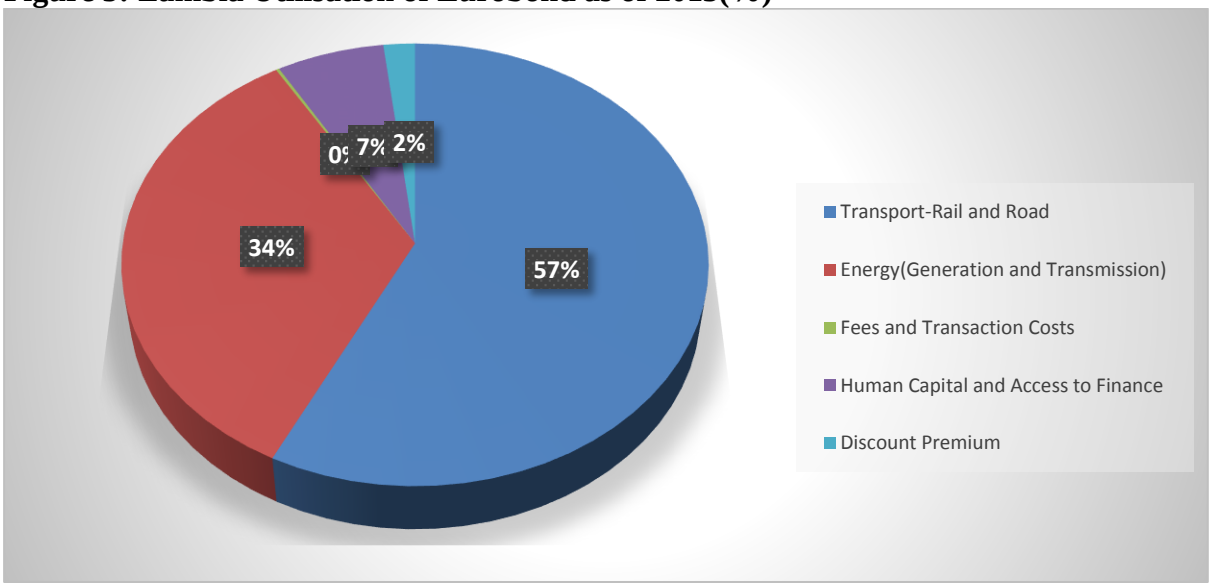
Figure 4: Zambia External and Internal Debt as a Percentage of Total Public Debt



Source: IMF Debt Sustainability Study Article IV Consultation, 2015

Debt from private banks and investors is often referred to as Eurobond debt and one definition of this debt by Stanford University's Yee-Tien Fu is that it is a liability which is denominated in a foreign currency to the party seeking it and this debt is accessed and traded on a market for long-term debt instruments (Fu, 2017). Borrowing from Eurobond markets presents an entirely new dynamic as the debt is traded and the issue price and interest payments are linked to the bond performance, hence making this study necessary to identify if the debt-GDP linkage holds. From an empirical perspective, this research used a different model from earlier studies as will be shown in the model specification. Further, this research looked at these dynamics in an environment where there is pressure to develop the infrastructure of the nation. Figure five below reveals that of the Eurobonds that Zambia has issued, as of 2013, over half of the funds were earmarked for infrastructure spending on roads and rail, accounting for fifty-seven percent while the energy sector, which is comprised of power generation and transmission had a thirty-four percent stake and human capital and access to finance amounted to a seven percent component.

Figure 5: Zambia Utilisation of Eurobond as of 2013(%)



Source: Ministry of Finance Zambia, Citizens Budget 2013

The current problem in the study of debt within the context of economic growth is that borrowing has not been disaggregated between external and internal borrowing in a period of political populism for a nation such as Zambia. Further, for Zambia, a problem exists in that most studies have not looked at the impact of altering the debt mix, a ratio which is currently left to the government to decide. This has had a material impact, namely that government has continued borrowing and altering the debt mix in preference for external market debt away from bilateral and multilateral lenders whose monies come with conditionalities aimed at strengthening the public financial management framework of nations. The end result of this has been a rising risk of debt default and potential government failure to provide public services due to constraints on funds available arising from money being directed to debt service. This study aims to contribute to the body of knowledge of research which has appraised the economic growth and external debts of nations. Addition to this knowledge within the finance and economics field is important because debt is an enabler of government functions and activities (Alagidede, 2012). Further, economic growth allows a nation to increase the output of its products and raise the living standards of its people, this makes it critical to understand what impact, if any debt has on the GDP advancement (Schiller, 2016).

While there are existing studies focusing on the relationship between debt and economic growth, none has done it for Zambia in the context of the current economic situation, debt stock and political economy. This study makes this addition to scholarship by examining the relationship between external borrowing and economic growth over a 40- year period. The scholarship which will be contributed to is the theory of debt overhang, which Krugman(1988) describes as an inability to acquire additional borrowing due to increasing debt service costs signalling potential increases in taxes and cuts to public spending programs, this formed the theoretical framework for the study(Krugman, 1988). Another academic school of thought, Ricardo's growth theory, will be enriched by the literature since it contends that external debt impacts on GDP growth by distorting productive resource allocation, influencing the choice of projects and activities to those with short-term horizons and through loss of incentives from investment (Rao, 2003). Zambia faces a challenge to sustain economic growth in the face of a debt overhang problem, which is signified by the accumulation of both the principle and interest arrears on these borrowings. The study sought to answer to the question, does a relationship exist between external debt and economic growth and if so what is the strength of this relationship and what lies behind the Zambian government appetite to opt for Eurobonds from several options that are available including multilateral sources? Hence, as discussed above, this study aims to fill relevant gaps in the body of knowledge and will add value to enhance policy making.

1.3 Purpose and Significance of the Research

This topic was selected due to the increasing debt to GDP ratio of Zambia, declining GDP of the nation and the County's increasing population (The World Bank, 2016). Further, the Nation has recently experienced a widening fiscal deficit while government expenditure has remained constant or increased (PWC, 2015). In the face of the increasing debt to GDP, Zambia's use of borrowed external foreign denominated monies exposes risks in the event of a shock to the Copper price, Copper exports account for about 70 percent of the country's exports(CSO, 2017). Similarly, there has been conflicting information from political parties on the true extent of Zambia's borrowing and the capacity to contract more debt, particularly from external sources (Reuters, 2015). The study included several stakeholders including the government, the central bank, academics and the general citizenry. This study will be useful to enable more informed decisions making, contribute to the democratic process and foster accountability by policymakers and government. This research is also critical in that it undertakes this analysis

in an environment where nations are now opting to buccaneer from the Eurobond market, borrowing Eurobonds whereas in the past countries have tended to borrow more from bilateral agencies and cooperating multilateral parties such as the International Monetary Fund and the World Bank. Apart from the misuse and misapplication of the Eurobond debt, another practical problem is the interest rates on these instruments are often on commercial terms which presents a challenge for Zambia to honour the repayments. The Eurobonds are also denominated in foreign currency, which presents a challenge in the event of the Zambian Kwacha depreciating. In terms of the Zambian treasury, this means the country has to pay out more in nominal kwacha terms simply due to the movement on the currency markets. The research outcome will be practical to stakeholders as it will show empirically whether there exists a link between the growth of the economy and the degree of external debt given the current borrowing trajectory that the country is on. From an academic perspective, it is hoped that this study will help researchers in the development of better Country debt sustainability analysis and allow an investigation into appropriate sources of debt and the optimal debt mix for nations. Further, this thesis will enable Zambian and other academics to critique government's debt proposals. Readers will also be able to offer theoretically robust explanations to help policymakers design policies that will not negatively impact the economic growth of their countries.

1.4 Research Questions and Scope

The objective of this exploration is to investigate the effect of external debt on economic growth in Zambia between 1980 and 2015. The findings are expected to reveal whether external borrowing increases or reduces economic growth as measured by the total economic output of the country and also ascertain if indeed a relationship between these two variables does exist. To achieve the above broad outcome, the study had several precise goals, the first was to empirically investigate the relationship between external borrowing and economic growth of Zambia between 1980 and 2015, the 35-year period being selected as it covers several political dispensations and allows for more robust econometric analysis. Secondly, the study discussed the rise and seemingly increasing appetite in the use of Eurobonds as a form of external debt financing as shown in figure three above. Also, the research analysed constituent components of Zambia's external debt stock including a classification of the type of creditors. Finally, the study aimed to contribute to policy synthesis and to add to current approaches on debt management and help the general populace in understanding Zambia's debt sustainability.

Building on empirical literature by authors like Iyoha (1999), it is hypothesised that external borrowings reduces the economic growth of a country by creating a debt outcropping consequence. More technically, the hypothesis is that external debt negatively affects GDP through a debt overhang effect. This type of research is relevant both practically and academically as it will help in explaining the external debt appetite of Zambia and can be generalised to sub-Saharan African countries. The study was be constrained by the fact that consideration is only given to external debt and its effect on GDP, GDP has other factors that may influence it and those factors could have a more pronounced effect than the debt level. Further, even though external debt is increasing as a component of total public debt as shown in figure 3, domestic debt is still a considerable portion of the overall liability pie.

1.5 Assumptions Made in the Research

The study conjectured that the effect of the Laffer curve holds for Zambia, the Laffer phenomenon referring to the suggestion that beyond a certain optimal point, the magnitude of outstanding debt stock becomes inversely related to the probability of debt repayment (Rao, 2003). Consequently, the research assumes that there exists an optimal debt level for the

country, a nexus where GDP grows, debt overhang is managed and debt repayments are consistent and timely by the borrower country. Another assumption made by this research was that the referenced data was of high quality and possessed data integrity given that all the data that was used was of a secondary nature. Finally, it was assumed that the economic theories on debt overhang, the Laffer curve, measurement of GDP using a neoclassical approach based on Solow's growth model as well as the determinates of GDP are theoretically sound.

The impact of the above assumptions on the study was mitigated by several actions, firstly, by ensuring that data was sourced from reliable sources such as World Bank among others. Secondly, the assumption on economic theories holding was reinforced by clearly showing in the literature review below that the theories have been tested empirically and have found to hold in several studies straddling numerous time periods.

1.6 Organisation of the Study

The research paper had five major components, chapter one was dedicated to introducing the topic while the second chapter focused on a review of relevant literature on the area of study. Chapter three explained the author's research methodology while chapter four detailed the research findings. Chapter five dwelled on the research conclusions after relevant analysis while subsequent parts of the paper were on references, figures and tables and appendices, respectively.

1.7 Summary of the Chapter

Chapter one started by introducing the research topic and discussing selected characteristics of Zambia, the country under investigation. The chapter also described the problem statement, showing clearly the challenges the nation has undergone. The problematization of debt and economic growth was stretched to show the evolving political landscape and debt composition between 1991 and 2015. The introductory chapter then explained the purpose and significance of the research as well as revealing the research questions. The chapter revealed underlying assumptions the author made during the course of the study and ended by explaining how the paper is organised. The subsequent chapter will analyse various literature across time and from various authors.

CHAPTER 2: LITERATURE REVIEW

2.1 Introduction

As this study is about examining external debt and economic growth, this phase of the research reviewed relevant literature in this regard. The review of literature covered the neoclassical framework of economic growth of nations, namely, what drives the increase in GDP of a country. The discussion was extended to the debt overhang effect and at what level debt becomes a curse. The literature review started by studying the economic growth model developed by Robert Solow, which posits that growth in GDP is affected by labour, capital and knowledge (Solow, 1956). In addition, the economic growth framework reviewed why nations need to borrow to grow their GDPs and discussed what source of borrowing has been exploited together with the impact of donor aid in this regard. Subsequently, a review of both theoretical and empirical literature on the economic growth and debt nexus was undertaken. The chapter is organised into five sections, namely, an introduction, theoretical literature review, empirical literature reviews and finally an amalgamation of the literature reviewed.

2.2 Theoretical Literature on Economic Growth and Debt

Public debt stock can be categorized as disbursed and undisbursed, with the former comprising of drawn down commitments which are attracting interest while the latter does not (Eaton, 1993). Public debt is thus comprised of disbursed and undisbursed amounts which a nation has borrowed internally and externally. For Zambia, the external debt sources are loans from bilateral institutions, loans from multilateral institutions, loans from private banks and financial obligations to international suppliers and Export Credit Agencies (Bank of Zambia, 2015). The Zambian central bank further observes that debt itself need not be bad as it can enhance economic development. According to Keynesians, growing budget deficits and public debt increase aggregate demand through the budgetary multiplier effect (William & Chandler, 1954). This Keynesian economic view posits that a central government taxing its citizens and incurring debt where necessary would inevitably spur economic growth. Further debt can lead to infrastructure growth and may expand aggregate supply as evidenced in Zambia in recent years by the expenditure on roads since 2011. On the other hand, Neo-classical economists argue that the savings rate may decline due to a loosened fiscal policy which would boost consumption (Jappelli, 2005). A third theoretical view suggests that debt has no impact on economic growth (Barro, 1991). According to the author, when a budget deficit is growing emanating from fiscal stimulus, market participants position themselves for an austere future, negative tax adjustments and thus reposition from consumption and investment to increase savings which neutralises the power of demand stimulating fiscal plan. Patitillo et al (2002) found that borrowing at a reasonable level can foster economic growth (Randveer, Lenno, & Kulu, 2011). Countries such as Zambia at the nascent stage of development have good investment opportunities but with little capital to finance these investments. Premised on borrowed funds being used productively, and minor macroeconomic instability, a nation's economy should grow and allow for repayment of debt. The writer Bird argues that debt contracting is an entirely rational and welfare enhancing activity representing a redistribution of living standards (Bird, 2004).The writer further contends that national debt contracting is similar to human life cycle stages, where at a certain age, individuals get into debt. The question of problems with debt, according to Bird, has to do more with the utilisation of the borrowed resources than the debt itself, the key being to invest appropriately to create additional capacity to repay the debt in future.

Bird further maintains that ability to repay debt is driven by three factors; the relationship between marginal productivity of the resources borrowed and the rate of interest on the loan, the domestic savings ratio and finally the state of a country's import payments and export earnings, in effect the trade deficit or surplus. It is also argued the debt is positive as over the long run, when an economy is expanding, that is, when GDP is increasing, the ratio of debt to GDP will eventually reduce (Krugman, 1988). Thus, debt offers an attractive option for nations provided that their GDP grows, eventually they would be able to manage their debt levels. The problems start when the underlying growth assumptions are not met or when an economy such as Zambia is disproportionately affected by high downside risk due to being over-reliant on one sector in the economy (Ostry, Ghosh, & Espinoza, 2015).

However, public debt has some negatives, chief of which is the debt overhang effect. The International Monetary Fund(IMF) defines debt overhang as the relationship between heavy debt and low growth (Koeda, 2008). The argument that in a period of economic growth, debt will be overtaken by GDP growth has also been questioned by authors such as Paul Krugman (1988) who noted debt that when problem debtor nations grow at a slower pace, and where their debt is market-based, it's possible for this debt to easily become unsustainable. Iyoha (1999) found that debt overhang has an effect of depressing investment through a disincentive effect and a crowding out effect. Consequently, beyond a certain point, external debt has a negative impact on economic growth, thereby making it highly probable the additional debt will reduce the probability of repayments (Diallo, 2009).

2.3 Empirical Literature on Economic Growth and Debt

Empirically, several authors have noted that excessive debt has a negative effect on growth (Diallo, 2009). Additionally, Clements et al found that reducing debt service led to an increase in the investment rate (Clements et al., 2015). Ndungu et al established the debt overhang effect through three identified channels, namely effects of debt on growth, liquidity due to debt drawdowns and indirectly on public sector expenditure and deficits (Ndungu, Odedokun, & Elbadawi, 1999). Koyi (2006), found that in the case of Zambia, the nation's external borrowing, through effects of debt-to-income ratios and high debt service rations reduce Gross Domestic Investment and thus depress Gross Domestic Product (Koyi, 2006). Koyi further observes that in the case of Zambia, growing the economy without an aggressive management of the nation's external debt position would prove to be challenging. In contrast in Uganda, Mbiri and Atingi(2000) found that the country could not attain a five percent growth by depending on domestic capital only (Mbire & Atingi, 1997). Dogruel found that economic growth had an impact on the external debt of sampled middle-income nations due to their integration into the world economy and their economies being liberalised (Dogruel & Dogruel, 2007). Iyoha(1999) deconstructs the question of debt and growth into two mathematical relationships (Koyi, 2006). The first equation involves production factors, that is capital and labour while the second calculation relates investment to rates of interest, external debt to income ratio, debt-service to export ration and growth of real output. Thus, the above equations are represented mathematically as:

Equation 1: $$LnGDP_t = \alpha_0 + \alpha_1 InL_t + \alpha_2 InPCGDI_{t-1} + \mu_t$$

Equation 2: $$PCGDI_t = \beta_0 + \beta_1 r_{t-1} + \beta_2 GDPGR_t + \beta_3 \left(\frac{D}{Y}\right)_{t-1} + \beta_4 \left(\frac{DS}{X}\right)_t + \mu_t$$

Where Ln is the Naperian Logarithm, GDP is the gross domestic product, L is the labour force, PCGDI is per capita gross domestic investment (capital stock proxy), t-1 is lag length, μ_{lt} is a

random error term, $\alpha_1>0$ is elasticity of output with respect to labour and $\alpha_2>0$ represents the elasticity of output with respect to investment per head. It is assumed that output positively depends on labour and investment per capita. GDPGR is the growth rate of real output, D/Y is the ratio of external debt stock to GNP(often used as a measure of debt overhang) (Koyi, 2006). DS/X is the ratio of total debt service payment to the export of goods and services which captures the effect of crowding out, Betas represent parameters of the modes and μ_{2t} is the Gaussian white noise.

2.4 Summary of the Chapter

This chapter discussed both empirical and theoretical scholarship on the debt GDP relationship. Chapter two started with an introduction then progressed to theoretical literature review on debt and GDP growth. The theoretical review covered definitions of debt and reviewed several authors' positions on this subject across time. The chapter then moved to an empirical review of writings on the subject. The empirical review was done for authors who has done econometric analysis of this topic in Zambia, the African continent and middle-income countries globally. Chapter three delves into the research methodology.

CHAPTER 3: RESEARCH METHODOLOGY

3.1 Introduction

This study was a quantitative research and used the deductive approach which depends on subordinated data. Research can be carried out in either an inductive or deductive style, where inductive reasoning ends up with the development of a theory while deductive reasoning results in confirming whether a hypothesis is supported or not (Bradford, 2015). Among other differences, deductive reasoning requires secondary data and starting out with a set of hypotheses in contrast to inductive analysis. The logical deduction has the advantage that it employs methods that can easily be replicated, follows sequential steps and is less costly as it relies on the use of data and information already sourced. However, while deductive reasoning has an advantage in employing logic, it has a weakness in that the major premise of the syllogism may be incorrect and as such wrong conclusions may be drawn. Further, use of secondary data means placing reliance on the validity and integrity of that data. This argument extends to the generalised formulae, in that the method relies on already developed models, which may have been using different data sets and timeframes for their analysis.

The secondary data used was for the period 1980 to 2015, for Zambia. This data was collected from local and international sources. The local statistics were sourced from reports from the Central Statistics Office of Zambia (CSO), Ministry of Finance Zambia (MoF), Bank of Zambia (BoZ), Economics Association of Zambia (EAZ) reports, Price Waterhouse Coopers (PWC) Reports, the National Demographic Health survey and the Zambia Development Agency (ZDA). Internationally, the following institution's reports served as data sources; The World Bank Group, The International Monetary Fund(IMF), World Debt statistics, the Organisation for Economic Cooperation and Development(OECD), Reuters website, the Financial Times website, the Economist website, Popustat.com website and Trending Economics website.

The date population comprised of variables that were used in the quantitative analysis test of the hypothesis including GDP of Zambia, the labour force, capital stock and external debt service. The sample data will cover a thirty-five-year period, 1980 to 2015, which allowed for any patterns to emerge and transcended various political parties and macroeconomic scenarios the country has experienced over the period. The choice of the date coverage period was also informed by the need to analyse economic growth and external debt over a period when there has been a tangible change in the population of the Country, from 5.9 million in 1980 to 16.1 million in 2015, representing a growth of over one hundred percent over this period (CSO Zambia, 2014). All the relevant data collected was used in the analysis.

3.2 Economic Growth Framework

Models of economic growth can be discussed under two main pillars, namely classical growth models and neoclassical growth models((Blanchard et al., 1992). Classical growth models built on the shoulders of famed economist Adam Smith, they were based on the premise that economic growth was driven and at the same time would be curtailed by increasing growth in populations, thus GDP growth would lead to growth in the population until the population reached a point where the GDP would not satisfy it (Solow et al., 2005). On the other hand, the neoclassical model of economic growth, espoused by Professor Robert Solow, is based on the premise that economic output is produced through Capital, Labour and Knowledge (Solow, 2007). More recently, there has been a new school of thought for what grows an economy, these new models are broadly called endogenous growth models (Barro, 1991). These stipulate that economic growth is based on productivity incentives native to a particular country, therefore a

population may be growing but if the labour force is sufficiently skilled in the right areas, that knowledge would contribute to eventual GDP growth. For this study, the Solow neoclassical model of GDP growth was used as it is one of the key anchors in macroeconomic theory, upon which even, endogenous growth models are based.

The Solow growth model stipulates that Output(Y) from an economy is a function of
Capital(K)
Labour(L) and
Knowledge(T)

Thus, Y = F (K, L, T) Where,
Y = National output
K = Capital stock
L = Labor supply
T = Scale of technological development
F = Function

The model makes certain assumptions, the first being of constant return to scale(CRS), which is that output increases by the same proportion as all inputs change (Solow et al., 2005). Another assumption, in a departure from earlier models like Harrod-Domar, is that planned investments and savings are assumed to be equal because of immediate price adjustments (Prescott, 2010). Implicit in the first assumption is that a country can benefit from further specialisation, that is to say, for a smaller increase in inputs, a greater output in Y can be achieved. The assumption of a constant return to scale implies that an increase in GDP(Y) is equal to the change in Capital stock(K) plus the change in Labour supply(L) where each portion of the equation is multiplied by the Marginal productivity. This can be expressed mathematically as

$\Delta Y = \Delta K.\ MPk + \Delta L.\ MPl$
Where,
MPk = marginal physical product of capital
MPl = marginal physical product of capital
When we apply mathematical operations by dividing and substitution, the above equation can be rewritten as

$\Delta Y/Y = b\ \Delta K/K + (1 - b)\ \Delta T/T$

Where b=elasticity of output with regard to K and T

The above equation shows that at a given level of technology, economic growth is equal to the elasticity of output with regards to increasing capital stock plus elasticity of output with regard to the increase in Technology output. The Solow model is applicable to our research as one of its components, Capital, which can be in the form of debt is what this study aims to investigate. This neoclassical model of growth also explains why nations need to borrow to finance growth in an economy. The borrowing helps in the Capital aspect of the Solow growth model.

These borrowed monies by nations are used to finance investments, keep taxes at a favourable level politically and fill in a shortfall when the government runs a budget deficit (Alagidede, 2012). The model makes a prediction of convergence based on its structure, the prophecy being that nation will converge in GDP per capita and in living standards over the long term (Solow et al., 2005).

The Capital in the growth equation can be sourced from savings in a nation, government borrowing or external aid (Alagidede, 2012). Several writers have evaluated whether aid contributes sufficiently to economic growth such that it would not be necessary for a country to borrow, the finding on these studies has been mixed. Rao (2003), notes that the theoretical underpinning of providing foreign aid to support economic development and growth is based on the two-gap model developed by Chenery and Strought, which in return is based on the economic growth model of Harrod and Domar (Rao, 2003). The two-gap model specifies that savings and foreign investment are two main influences on economic growth. This has then been used to justify external aid as a filler to the financing gap that is between the investment required and the available domestic resources (Easterly, 1999). One problem with this argument, noted by Easterly is that foreign aid is assumed to fill the gap required for investment undiminished in value, that is, all the aid investments results in an equal growth in an economy. Correspondingly there is an assumption of direct proportionality of aid to investment, which may not always be the case(Rao, 2003).Further, aid suffers from the problem of fungibility, where aid intended for one purpose is repurposed or misused for political expediency by recipient countries, these nations can negate the aid impact by reducing their proportional share of resources intended for that respective sector (Feyzioglu et al, 1998). As such, aid was not considered in this paper as an appropriate substitute for capital required to grow a nation's economy.

3.3 Data Collection, Frequency and Choice of Data

This study was quantitative and relied on publicly available data and information. Therefore, the maximum amount of time that was spent on data collection was about two weeks due to challenges in collecting data. Further, the data that the study used was secondary data from reputable sources including the Zambian Central Statistics office, the Bank of Zambia and International Organisations including the OECD, IMF and the World Bank.

3.4 Sampling

Sample data that was used in the study was the economic growth of Zambia from 1980 to 2015, as measured by the GDP, this was extracted from various sources. The research also sampled data on Zambia's external borrowings, labour force and capital. These data formed the sample set that was used to perform the quantitative analysis the eventually fed into the final comments, findings and recommendations. The period researched was a 35-year span, from 1980 to 2015. The choice of this period was driven by several factors, the first being the availability of data. Periods prior to 1980 proved a challenge to access data hence setting 1980 as the base year. Secondly, the end date of 2015 allowed for the appreciation of GDP evolution in varying political climates. Finally, the span of the study equates to 35 years, which in the time series econometric analysis is a recommended for relationships to be adequately investigated (Gujarati, 2009).

3.5 Data Analysis Method and Model Specification

The study relied on an empirical model using data between the years 1980 to 2015. The choice of the data set was driven by the need to appreciate the changes the country's economy has undergone during these periods including changes in the flavour of the external borrowings. The two areas of the relationship we seek to investigate are economic growth and external borrowing. This study used the methods employed by other authors like Cunningham (2003), Karagol (2002) and Mashingadze (2012). The techniques applied was a time series analysis on

the logarithms of the data set, the variables being economic growth, labour force, capital and external debt stock. Mathematically the model takes logarithms of the variables and is expressed as follows;

$$LNY_t = P_0 + P_1 LNK_t + P_2 LNLBF_t + P_3 LNEXT_t + E_t$$

Where

PO	=Y intercept
P1, P2 and P3	= Coefficients of LNK, LNLBF and LNEXT respectively
LNK	= Natural Logarithm of Capital
LNLBF	=Natural logarithm of Labour Force
LNEXT	=Natural logarithm of External Debt
E_t	=Error term

3.5.1 Explanation of the Model variables

3.5.1.1 Gross Domestic Product (LNY)

LNY represents the logarithm of Zambia's gross domestic product, this will be used to represent economic growth, that is, the dependent variable. Studies examining economic growth and debt by writers such as Fekadu(2014) and Koyi(2006) have used GDP as the proxy for a nation's economic output, this author adopts the same approach (Fekadu, 2014). An alternative measure that could have been used is the Gross National Product(GNP) since growth in an economy, according to the development finance scholar Rao, is the rate of growth of economic output(Rao, 2003). However, GNP was discounted as it measures the market value of goods and services produced by labour and citizens of a nation regardless of the location (Sardadvar, 2011).

3.5.1.2 Capital (LNK)

LNK proxies the capital employed at time t to generate the GDP, at time t of Zambia This is an independent variable which is also logarithmically is measured by the gross fixed capital formation. Gross fixed capital formation is defined by the United Nations System of National Accounts as a measure of acquisitions of new or existing fixed assets by sector, government or household (Chongo, 2013). It is a component of GDP and thus is expected to show how much new value was added to an economy (Mashingaidze, 2012). It should be noted that other researchers in similar studies have proxied capital with external reserves of a nation, this author applies GFCF due to the impact of capital on the wider economy (Boboye & Ojo, 2012).

3.5.1.3 Labour Force (LNLBF)

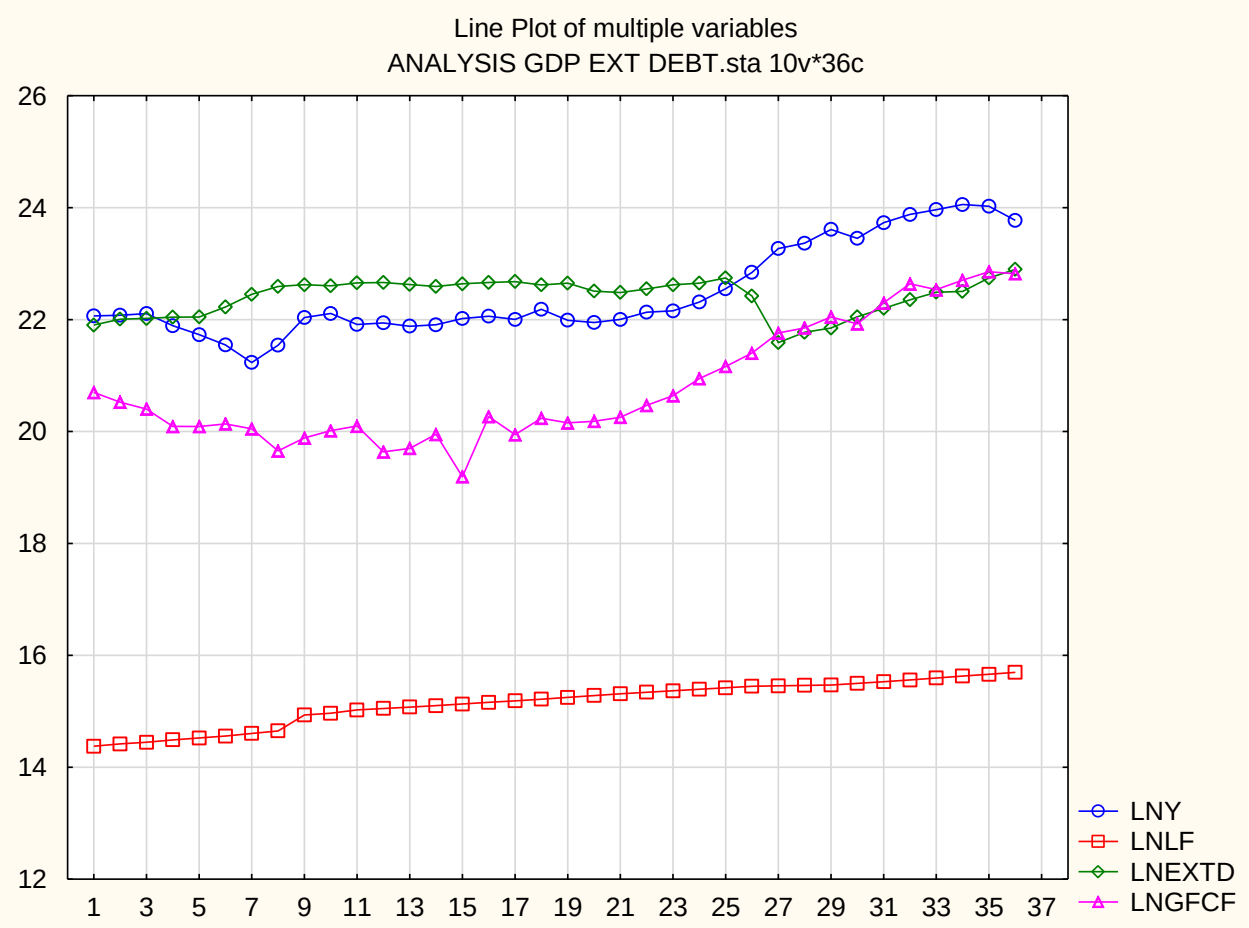
The labour force is represented by LNF, which the logarithm of the labour force in Zambia at time t. Labour Force as defined by the IMF and as used in this study, represents the number of citizens older than 15 years who are engaged to supply their labour in the production of goods and services in a particular period (Hood, 1995). The labour force as was used in this case represents both employed and unemployed people who are seeking employment as well as first-time job seekers in the labour market. Citizens not captured in this metric are family workers and those who are employed but are unpaid.

3.5.1.4 External Debt (LNEXT)

External debt is represented by LNEXT, which is the natural logarithm of the debt stock of Zambia at time t. This study measures external debt as Zambia's total liabilities to outside parties including multilateral institutions, bilateral partners and private banks and institutions including Eurobond debt providers. This debt is measured as total debt stock at time t, in contrast to other studies such as Koyi(2006) who used per capita gross domestic investment(PCGDI) to represent the nation's liabilities (Koyi, 2006).

These variables are plotted below and show that the variables contain some form of linear deterministic trend, generally moving upwards over the sample time period, as such appropriate tests were carried out as specified below in 3.5 including Stationarity and Cointegration among others.

Figure 6: GDP, External Debt, Labour Force and Gross Fixed Capital Formation Chart



Source: Authors estimation

3.6 Research Reliability and Estimation Technique

The research is meant to be an academic and scientific inquiry, at the same time, it must be recognised that this is bounded research which can be relied upon within the limits of known knowledge. It is possible for a black swan event to negate the findings, for instance, the discovery of a commodity such as oil can change the fortunes of the nation and enable it to

quickly unwind its debt. Therefore, the research is reliable and scientifically sound but the possibility of an outlier event remains possible. The validity of the results and finding can be authenticated by other researchers as the sourced data and methodology will be made available and discussed fully in the paper. In addition, the consistency of the findings will be reinforced by stationarity, unit root and cointegration tests among others.

3.6.1 Stationarity and Unit Root Tests

This model used time series data for a 35-year time span. Time series data has been found to be non-stationary, that is to say, the data exhibits movement that is due to statistical anomalies such as random walks (Nielsen, 2005). Further stationarity for data implies that it has a constant mean and variance over the data period and has a covariance between two time period dependent solely on the lag between the time periods and not the actual time of computation (Fekadu, 2014). Stationarity is critical in econometric analysis to avoid spurious regression which could prejudice the outcome of the findings and ultimately lead to wrong conclusions. Therefore, stationarity tests will be performed on the variables in line with the Augmented Dick Fuller(ADF) Test (Dickey & Fuller, 1981). ADF tests the tau statistic t, based on the following Hypothesis

Ho $\theta=0$
H1 $\theta<0$

Where $\theta=p-1$ and Ho and H1 are the null and alternate hypothesis respectively. Rejecting the null hypothesis means that the time series data is non-stationary. In addition, stationarity is confirmed when the expected values of the time series data are both finite and constant across time. Finally, the variance of the series must also be both finite and constant across time.

3.6.2 Cointegration Test

In an econometric model such as the one employed in this study, an implicit assumption exists that the variables may be moving in tandem with each other, thus a test to ascertain this Cointegration is necessary. Engle and Granger (1987), describe Cointegration as the presence of a relationship, of a long-run nature, between stochastic variables where even though the individual time series may be stationary, they may be related and move in step. Essentially, Cointegration means that two or more variables have between them a relationship that prohibits them from diverging from each other in the long term. The Cointegration test will reveal if there is a linkage between the variables in the model. As noted by Gujarati(1995), testing for Cointegration is the same as testing for the presence of a long run relationship between variables (Gujarati, 2008). This test can be performed by the Engle-Granger method or the Johannsen approach (Greene, 2003). The Engle-Granger approach requires that the variables are integrated to the same order for the Cointegration test to be performed while the Johansen method works on tests the maximum likelihood (ML) approach and overcomes the limitations of Engle-Granger by allowing for testing of variables with different orders of integrations. Due to this advantage over Engle-Granger, the Johansson technique will be applied in this study.

Johannsen (1998)'s model of testing Cointegration works on a maximum likely wood estimation technique by allowing for investigation using the Vector Autoregressive (VAR) error correction representation in a one-step process. The ML method, just like Engle-Granger involves first testing the order of integration of the variables, if the variables are I(1), the LM technique can be used to ascertain whether a stable long-run relationship exists. ML test will produce outcomes which will be used to determine the number of integrating

vectors. The results will be probable *g*-1 vectors, where *g* will show the number of variables involved in the model. Based on this product, coefficients, in the long run, can subsequently be determined and the secondary error correction model designed. This method produces a dual set of coefficients, the beta which indicates long-run coefficients and the alpha which represents the speeds of adjustment coefficients and coarsely equates to the error correction term. It must be noted that if the time series contains unit roots and is cointegrated, the ordinary least squares regression may lead to false outputs and accompanying conclusions.

3.6.3 Vector Auto-Regressive Model

There are several techniques for multivariate time series analysis based on linear autoregressive models, one such procedure is the Vector Auto-Regressive Models(VAR) (Greene, 2003). These models are based on an underlying assumption that past behaviour by variables can be used to forecast future outcomes. More technically, VAR models are used in forecasting systems where there are a number of time series values and an investigator is interested in analysing the dynamic influence of accidental disorders on the system of variables (Mashingaidze, 2012). This technique has been used by several authors, one of which is by Brenda Mumbi (2013) in her econometric study of public debt and economic growth in Zambia(Chongo, 2013). Using a Cointegration and Granger non-causality approach, the author analysed short and long-run impacts of gross public debt on economic growth using VAR. In that study, the author found Cointegration among the variables indicating a long run relationship between them and the results indicated that the explanatory variables had the prior expectations. As such, even in this study, the VAR model will be used to incorporate the feedback in the model and the interactions between them captured. Also, Mashigadzi (2012) found that VAR was appropriate to the study of external debt and GDP in the case of Zimbabwe. The multivariate VAR model is described as follows;

$Vt = E \quad AV + Et$

Where

$Vt = (LNY_t, LNK_t, LNLBF_t, LNEXT_t)$

Et is the vector error term and the A1-At represents four matrices of coefficients. LNY_t, LNK_t, $LNLBF_t$, and LNEXTt represent economic growth, capital, labour force and external debt, all in logarithmic form. Logarithms are used to make data stationary and conform to the normal probability distribution, in the absence of this, the data might be skewed.

3.6.4 Lag Length Test

In order for the VAR model to function as intended, the lag length must be optimal (Dickey & Fuller, 1981). The problem of using an improper standard for lag length is that the VAR model produces inconsistent results.

As a result of these deficient outcomes, the accompanying variance decomposition is misleading (Khim & Liew, 2004). In order to ascertain the correct lag length of the VAR model specified above, a lag length test will be performed to an appropriate maximum number of lags that leaves only a minor number of degrees of freedom. Selecting the wrong lag length will lead to an increase in the means square forecast error of the VAR model or autocorrelated errors when the lag length is either higher or lower respectively. In this study, the author will determine the appropriate lag length based on various criteria

including the Akaike's information criterion (AIC), final prediction error (FPE) and Schwarz information criterion among others.

3.6.5 Test for Autocorrelation and Residuals

In Ordinary least squares regression, it's possible for results from a regression to deviate from the sample statistics, for example, an actual value of a variable may defer from the sample mean, that value is called a residual autocorrelation (Greene, 2003).The test for autocorrelation in this study was performed using the Lagrange Multiplier(LM) Test. The LM test was used because it does not require an investigator to estimate the information under the alternate hypothesis. Another problem in OLS is that of Heteroscedasticity where the variations in a variable are not consistent across a range of values used to predict it. Heteroscedasticity can be tested using white's test which measures Heteroscedasticity residual by changing variances (Alhassan & Biekpe, 2016).

3.6.6 Granger Causality Test

Granger causality tests are performed in statistical analysis to show if one variable can be useful in predicting another inconstant. This analysis thus shows bi or unidirectional connectedness between variables in a model (Greene, 2003). Granger analysis however only reveals the ability of variables to predict the other, those variables may have other underlying factors that drive them.

3.6.7 Impulse Response

Impulse response analysis is a process of assessing the exchanges between components in a VAR model. As noted by Ndungu et al.,(2012), impulse response can be used to assess the dynamic behaviour of the VAR model or to investigate any impacts on a policy that the variables making up the VAR model may have (Ndungu et al., 1999). In this study, the impulse response will show how Capital, External debt and Labour Force respond over time to a shock. As noted by Nguyen, impulse response will show, in a dynamic model, the time effect of shocks at a given point in time on expected future variables (Nguyen, 2011).

3.6.8 Variance Decomposition

Variance decomposition is a technique used to ascertain the relative importance of each variable in a VAR model such as the one used in this study (Cerutti et al, 2015). Variance decomposition thus helps to recognise the variables impact on each other, in this research this means, variance decomposition will help clarify how the dependent variable, economic growth, and the three other independent variables of capital, labour force and external debt influence each other.

3.7 Limitations of the Research Methodology

The restriction that was encountered in the research was the limit to the variables that were used in the empirical models as well as the implicit reliance on the credibility of the dataset.
The existence of the relationship between two variables itself is not indicative of causality between them and it must be noted that other factors may play a role in the economic growth of a nation. This study acknowledged the limitations of the research in that it does not pretend to fully explain a complex measure such as GDP, which may be driven and affected by several others factors necessary to maximise output on the production possibility curve. Influences on Gross Domestic Product include selling price(s) of a country's main exports, political

instability, portfolio flows, overseas development assistance and the lack of proper infrastructure including roads, telecommunications, an adequately educated workforce and the proper market mechanism to ensure adequate competition and efficiency in production and consumption of goods and services. Additionally, the study straddles several political periods, each with its own characteristics both for the Zambian economy and the global economy of which the Country is a subset of. The study respects the limitations of undertaking a study across such a time period and is cognizant that actions of external players in the global economy could have an effect on Zambia's GDP and the availability and type of debt available at the sovereign level. Finally, a limitation is recognised in the use of secondary data as reliance will be placed on it, however, this is somewhat negated by ensuring that only data from reputable sources are used in this research.

3.8 Summary of the Chapter

The research methodology chapter started by an introduction which described the different types of research that can be undertaken and explained the nature of this thesis and its selected research model. The chapter then explicated the economic growth framework applied in this examination and explained the related equation and its components. Chapter three clarified why the author selected the data set used and the validity and limitations of the numbers. The chapter then went on to designate the Vector Autoregressive model in detail and its components. The research methodology chapter also included an in-depth discussion of the various tests to be performed on the VAR model including stationarity and unit root, cointegration, lag-length estimation, granger analysis, impulse responses and variance decompositions tests. The chapter concluded with an acknowledgement of the limitations of the research methodology applied. The next chapter looks at the research findings and discussion thereof.

CHAPTER 4: RESEARCH FINDINGS AND DISCUSSION

4.1 Introduction

This chapter discusses the empirical analysis of the economic growth model specified as per below;

$$LNY_t = P_0 + P_1 LNK_t + P_2 LNLBF_t + P_3 LNEXT_t + E_t$$

The chapter begins with an introduction moves to stationarity and root unit tests then proceeds to lag length estimation and cointegration analysis. From there, a Vector Auto-Regressive Model is specified which is then tested for autocorrelation, normality and heteroskedasticity. Finally, impulse responses from the VAR model and variance decomposition are performed culminating in the conclusion of the chapter.

4.2 Stationarity and Unit Root test

Due to the non-stationarity of time series data, it is necessary to perform a root unit test, this test will check if the variables have a deterministic trend. Data which is non-stationary may result in false regression due to cyclical movements, random walks and means and variances which fluctuate across time. This unstable behaviour means the model and subsequent analysis may produce faulty results driven by the failure of the Law of Large numbers(LLN) and the Central Limit Theorem(CLM) to hold. This paper uses the Augmented Dick-Fuller(ADF) test to check for non-stationarity in the variables at level and first differencing. The ADF test is also run with constant and trend with the null hypothesis being that the time series has a unit root and the alternative hypothesis being that the variables under investigation maintain stationarity. The results of this analysis are below in table 1,2 and 3, at level and first and second differencing respectively.

Table 1: ADF Test at Level

Augmented Dick Fuller(ADF) Test Results at Level				
Variable and Period Covered	**T Statistic**	**Critical Values at 5%**	**Probability**	**Test Inference**
LNY, 1980 to 2015	-2.615	-3.553	0.276	Unit Root
LNLF, 1980 to 2015	-1.936	-3.558	0.612	Unit Root
LNEXTD, 1980 to 2015	-2.267	-3.548	0.440	Unit Root
LNGFCF, 1980 to 2015	-2.246	-3.548	0.451	Unit Root

Source: Author's assessment

Table 2: ADF Test at First Differencing

Augmented Dick Fuller(ADF) Test Results at First Differencing				
Variable and Period Covered	**T Statistic**	**Critical Values at 5%**	**Probability**	**Test Inference**
LNY, 1980 to 2015	-3.353	-3.553	0.075	Unit Root
LNLF, 1980 to 2015	-5.710	-3.548	0.000	No Unit Root
LNEXTD, 1980 to 2015	-4.270	-3.548	0.010	No Unit Root
LNGFCF, 1980 to 2015	-10.173	-3.548	0.000	No Unit Root

Source: Author's assessment

Table 3: ADF Test at Second Differencing

Augmented Dick Fuller(ADF) Test Results at Second Differencing				
Variable and Period Covered	**T Statistic**	**Critical Values at 5%**	**Probability**	**Test Inference**
LNY, 1980 to 2015	-7.543	-3.553	0.000	No Unit Root
LNLF, 1980 to 2015	-10.328	-3.553	0.000	No Unit Root
LNEXTD, 1980 to 2015	-7.591	-3.553	0.000	No Unit Root
LNGFCF, 1980 to 2015	-3.789	-3.588	0.033	No Unit Root

Source: Author's assessment

The ADF test above was performed using the Akeike Information Criterion with a lag length of 10, the decisions criteria being that the null hypothesis holds if the test statistic is greater than the critical value results. At level, the ADF results reveal that the author cannot reject the null hypothesis, which is that the time series variables have a unit root. Table 1 shows that, in all cases, the test statistic is greater than the critical value at the 5 percent level. However, at first differencing, the LNY, LNEXTD and LNGFCF have a p-value less than 0.05, therefore they do not contain unit roots, LNY still contains a unit root as revealed by p-value greater than 5 percent. Therefore, differencing at the first level, though eliminating most unit roots still leaves us with one variable containing a unit root. A third test was performed, differencing at second level, and in this case, all variables do not contain unit roots and have p values under 5 percent, as such subsequent analysis will not be performed using second differencing. Therefore, the ADF results, show that variables are integrated to the same order and a there may exist a long run relationship between them, this will be verified by the cointegration assessment.

4.2.1 Lag Length Estimation

Lag length estimation is an essential step in VAR econometric analysis as it is important to determine how far back in an autoregressive model one intends to test for autocorrelation. Choosing an incorrect lag length will lead to incorrect analysis and inferences. Precisely, if the lag length is too small the serial correlation of the errors will negatively affect the test and similarly, a large P will lead to the power of the test suffering. Lag length can be tested using the Akaike's information criterion (AIC), final prediction error (FPE), Schwarz information criterion (SIC) and Hannan-Quinn criterion (HQC) among other techniques. Khim and Sen Lew appraised lag estimation models and found that, with smaller data sets, comprising of less than 60 years of data points, AIC and FPE provided superior estimation compared to the other methods. Thus, this study performed a lag analysis and the results are as per below

Figure 7: VAR Lag Length Test Results

VAR Lag Order Selection Criteria
Endogenous variables: Y_LN_DATA LF_LN_DATA GFCF_LN_DATA EXTE_DEBT_LN_DATA
Exogenous variables: C
Date: 08/21/17 Time: 20:35
Sample: 1980 2015
Included observations: 33

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-44.748925...	NA	0.000226	2.954480	3.135875	3.015514
1	89.0018091...	226.9709	1.81e-07	-4.181928	-3.274954*	-3.876759
2	110.309591...	30.99314*	1.38e-07*	-4.503612*	-2.871058	-3.954307*
3	119.116126...	10.67459	2.41e-07	-4.067644	-1.709511	-3.274204

* 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

Source: Author's assessment

In the table above, the * indicates the lag to choose for each criterion. Based on the above, it can be seen that LR, FPR an AIC all point to a lag length of two, therefore that is the length to be used in the Johansen cointegration test and the Vector Error Correction Model.

4.2.2 Cointegration test using Johansen Maximum Likelihood Technique

Cointegration among variables in a VAR models is when the variables have a long run relationship with each other and are stationary. The technique used is the Johannsen Maximum Likelihood approach, which is performed as the variables in the model are stationary after second differencing to the same order. The results are reported in table 4 and table 5 below for the Johanssen Cointegration test at level showing the Trace Test and the Maximum Eigenvalue respectively. In this test, the presence of cointegration vectors implies that the standard asymptotic statistical distributions do not hold.

Table 4: Cointegration Trace Test

Trace Test			
Hypothesized Number of Cointegration Equations	**Trace Statistic**	**0.05 Critical Value**	**Probability**
None	39.760	47.856	0.231
At Most 1	19.952	29.797	0.426
At Most 2	4.341	15.495	0.874
At Most 3	0.081	3.841	0.776

Source: Author's assessment

Table 5: Cointegration Maximum Eigenvalue Test

Maximum Eigenvalue Test			
Hypothesized Number of Cointegration Equations	**Maximum Eigenvalue Statistic**	**0.05 Critical Value**	**Probability**
None	19.808	27.584	0.355
At Most 1	15.611	21.132	0.248
At Most 2	4.260	14.265	0.831
At Most 3	0.081	3.841	0.776

Source: Author's assessment

Above test results shows the trace and eigenvalue results at the 0.05 critical value and associated probabilities. The null hypothesis is that the variables are cointegrated at the given p-value of 5 percent. The results for both the trace analysis and the Eigen evaluation have shown that the variables are not integrated at the 0.05 level, therefore a Vector Error Correction technique cannot be used in this study, instead, a Vector Auto Correction Model will be applied.

4.2.3 VAR Model Specification

As noted above in the cointegration test, a VAR model is specified and is as below in figure 8. This model is run on second differencing based on the findings of the ADF test above with a lag length of 2 as determined based on the lag length estimation. The VAR model is used as opposed to VEC model as the ML tests revealed no cointegration of the variables, in such cases, econometric authors have found that VAR provides the best linear unbiased estimator(BLUE). The variables, all for Zambia, for the years 1980 to 2015 are represented by

DYLN: Second differenced Logarithm of Gross Domestic Product(GDP)
DLFLN: Second differenced Logarithm of Labour Force
DFGFCFLN: Second differenced Logarithm of Gross Fixed Capital Formation
DEXTDLN: Second differenced Logarithm of External Debt Stock

Figure 8: VAR Model

	DYLN	DLFLN	DGFCFLN	DEXTDLN
DYLN(-1)	-0.2559234...	0.17242700...	0.28488071...	0.00011299...
	0.25103407...	0.05263310...	0.33654005...	0.26749318...
	[-1.01948]	[3.27602]	[0.84650]	[0.00042]
DYLN(-2)	-0.1755810...	0.04923090...	0.43793253...	-0.2978224...
	0.28489302...	0.05973214...	0.38193186...	0.30357209...
	[-0.61631]	[0.82419]	[1.14662]	[-0.98106]
DLFLN(-1)	0.16040380...	-0.9651679...	0.66412450...	-0.0376445...
	1.08412097...	0.22730241...	1.45338885...	1.15520161...
	[0.14796]	[-4.24618]	[0.45695]	[-0.03259]
DLFLN(-2)	-0.8352466...	-0.4054234...	1.66137263...	0.31791140...
	1.01916304...	0.21368300...	1.36630528...	1.08598470...
	[-0.81954]	[-1.89731]	[1.21596]	[0.29274]
DGFCFLN(-1)	-0.0912233...	-0.0225368...	-1.2407834...	0.10471088...
	0.11814735...	0.02477138...	0.15839011...	0.12589370...
	[-0.77211]	[-0.90980]	[-7.83372]	[0.83174]
DGFCFLN(-2)	0.04951661...	-0.0048585...	-0.6317061...	0.03534236...
	0.12443706...	0.02609011...	0.16682219...	0.13259580...
	[0.39792]	[-0.18622]	[-3.78670]	[0.26654]
DEXTDLN(-1)	0.05832197...	0.05876775...	0.00934704...	-0.3552714...
	0.19584255...	0.04106136...	0.26254947...	0.20868302...
	[0.29780]	[1.43122]	[0.03560]	[-1.70245]
DEXTDLN(-2)	-0.0755200...	0.03013750...	-0.1006714...	-0.3909806...
	0.20405163...	0.04278252...	0.27355468...	0.21743032...
	[-0.37010]	[0.70444]	[-0.36801]	[-1.79819]
C	-0.0016599...	-0.0001354...	0.02535829...	0.00505937...
	0.03941546...	0.00826405...	0.05284096...	0.04199975...
	[-0.04211]	[-0.01639]	[0.47990]	[0.12046]
R-squared	0.30466073...	0.60885532...	0.77003087...	0.24720509...
Adj. R-squared	0.06280360...	0.47280500...	0.69004160...	-0.0146366...
Sum sq. resids	1.13877176...	0.05005982...	2.04665601...	1.29299478...
S.E. equation	0.22251250...	0.04665312...	0.29830361...	0.23710159...
F-statistic	1.25967230...	4.47522149...	9.62667796...	0.94410129...
Log likelihood	7.96653683...	57.9583260...	-1.4135745...	5.93436435...
Akaike AIC	0.06459144...	-3.0598953...	0.65084841...	0.19160222...
Schwarz SC	0.47682967...	-2.6476571...	1.06308663...	0.60384045...
Mean dependent	-0.0010249...	-0.0002757...	0.00860302...	0.00407824...
S.D. dependent	0.22984714...	0.06425324...	0.53580505...	0.23538522...

Determinant resid covariance (dof adj.)	3.098217472104364e-07
Determinant resid covariance	8.26843524562032e-08
Log likelihood	79.30763513106899
Akaike information criterion	-2.706727195691812
Schwarz criterion	-1.05777430504212

Source: Author's assessment

4.2.4 Autocorrelation, Normality, Heteroscedasticity and Lag Stability, The Residuals Tests

The Vector Autoregressive model used in the GDP external debt study is tested for autocorrelation using the Lagrange Multiplier test(LM), also known as Rao's score. The LM examination shows in multivariate model the score vector evaluated at the null hypothesis being true, the null hypothesis is that theta is zero. This serial correlation is the variance between the variable and its lag value, which can lead to a smaller estimated standard error, this smaller standard error can lead to an incorrect t value thereby skewing the significance of the variables. The LM results are shown in table 6 below:

Table 6: Lagrange Multiplier Test

Lags	Lagrange Diagnostics Results	Probability
1	15.842	0.464
2	17.482	0.355
3	21.143	0.173
4	14.837	0.537

Source: Author's assessment

In the above LM test results, the p values are all over the 0.05 for all lags 1 to 4, therefore the author cannot reject the null hypothesis that there is no serial autocorrelation and accepts the null, meaning that this model is free from serial autocorrelation.

To ascertain whether residuals from the model are normally distributed, tests for skewness and kurtosis are performed and the resulted are documented in Table 7 below. Skewness and Kurtosis show asymmetry of the probability distribution while kurtosis reveals the thickness of the tails in the distribution, respectively.

Table 7: Skewness and Kurtosis Test

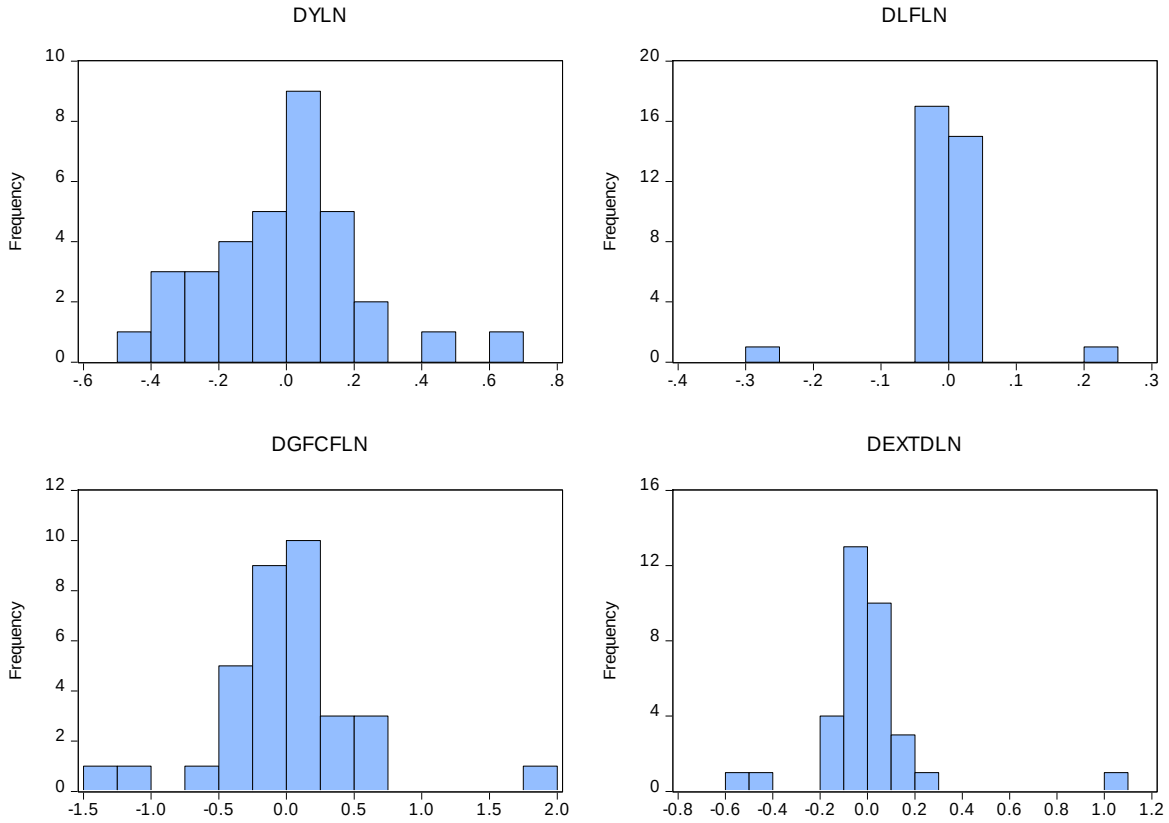
Component	Skewness	Chi-sq	df	Prob.
1	0.80158857...	3.42690262...	1	0.06414229...
2	0.84520513...	3.80998249...	1	0.05094798...
3	0.00656453...	0.00022982...	1	0.98790442...
4	0.03431284...	0.00627931...	1	0.93684004...
Joint		7.24339426...	4	0.12357152...

Component	Kurtosis	Chi-sq	df	Prob.
1	4.10546229...	1.62939586...	1	0.20178662...
2	3.78158259...	0.81449514...	1	0.36679458...
3	3.24361622...	0.07913182...	1	0.77847740...
4	4.62451361...	3.51872597...	1	0.06067907...
Joint		6.04174880...	4	0.19605206...

Component	Jarque-Bera	df	Prob.
1	5.05629848...	2	0.07980658613040781
2	4.62447763...	2	0.09903927206547348
3	0.07936165...	2	0.9610961480363319
4	3.52500528...	2	0.171614835063042
Joint	13.2851430...	8	0.1024080777263046

Source: Author's assessment

Figure 9: Skewness and Kurtosis Graphs



Source: Author's assessment

The null hypothesis is that the variables are normality distributed, the results above indicate that the p-value is greater than 0.05, therefore, we cannot reject the null; hypothesis and we conclude that the data is normally distributed. A further interpretation for Skewness is that if the results of the test indicate a value smaller than negative one or greater than a positive one, the data is skewed, the results are all between -1 and +1, therefore we conclude that the data is not skewed. The Kurtosis findings are all above 3, indicating that the data is approximately normally distributed and its kurtosis is Leptokurtic. The above graphs show additional support for this approximately normal distribution.

Heteroscedasticity exhibits itself when variables in a sample or population have variances that differ from each other. Ideally, variables must be homoscedastic, meaning their variance must be the same, the absence of it implies heteroscedasticity. To test for this, the white test is performed and the results are in table 8, below. Whites test works by revealing if the variance in the variables consistent, thus, the null test is that the variables are homoscedastic. The results of the white test reveal that the p-value is statistically significant at the 0.05 level, therefore we cannot reject the null hypothesis and we accept the at data are homoscedastic and are therefore their variances are constant.

Table 8: Whites Test

Joint test:

Chi-sq	df	Prob.
180.496763...	160	0.1277415101828137

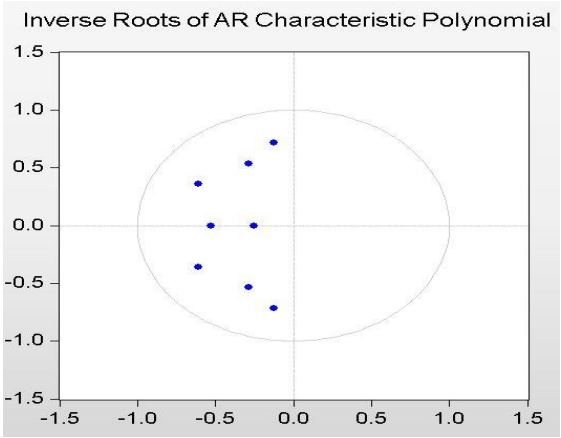
Individual components:

Dependent	R-squared	F(16,15)	Prob.	Chi-sq(16)	Prob.
res1*res1	0.29579892...	0.39379588...	0.96307753...	9.46556544...	0.89301003...
res2*res2	0.90989172...	9.46665044...	3.84649972...	29.1165353...	0.02316207...
res3*res3	0.34164559...	0.48650504...	0.91791649...	10.9326589...	0.81362267...
res4*res4	0.90149806...	8.58007947...	7.09283713...	28.8479380...	0.02498184...
res2*res1	0.79971601...	3.74335359...	0.00712232...	25.5909125...	0.06006304...
res3*res1	0.51501577...	0.99555254...	0.50564224...	16.4805046...	0.41995734...
res3*res2	0.46620822...	0.81880282...	0.65270763...	14.9186632...	0.53060366...
res4*res1	0.95000261...	17.8134790...	6.03157020...	30.4000835...	0.01603492...
res4*res2	0.60299507...	1.42393167...	0.24961542...	19.2958424...	0.25362062...
res4*res3	0.84918040...	5.27853574...	0.00120962...	27.1737729...	0.03959164...

Source: Author's assessment

An additional test to determine the stability of the VAC model was carried out, this test is the lag stability test of the variables. In order for the VAC model used to be deemed appropriate, the unit roots must all lie within the circle of the inverse roots as shown in figure 10. The results of the analysis clearly demonstrate that the unit roots of the variables all lie within the circle, thus it is inferred that the Autoregressive Model stability holds and the technique is appropriately specified.

Figure 10: Lag Stability Test



Source: Author's assessment

4.2.5 Block Exogeneity Analysis

Block exogeneity tests are used to reveal if one-time series can be suitable in forecasting another by checking if a causal relationship exists between the lags of the variables, this analysis is carried out with the Granger causality investigation. Granger tests are performed in linear regression models and have a null hypothesis that no Granger causality exists at the 0.05 probability level with the alternate being that there is a causal relationship between variables, this relationship being one way or bi-directional. The results of the Granger analysis performed by the author are listed below in table XXX below. The findings indicate that the null hypothesis is not rejected in all cases where the dependent variables are Gross Domestic Product, Labour Force and Gross Fixed Capital formation except for where GDP is the independent variable and Labour Force is the dependent variable. This means that when LNY is the dependent variable, and LNLF is the dependant, we reject the null hypothesis, which tells us that economic growth can be used to forecast labour force in Zambia and vice versa. All other scenarios' where the independent and dependant are varied as revealed in the table below shows that the relationships would not be ideal in the Vector Autoregressive model to predict the other variables.

Table 9: Granger Causality Test

Granger Causality Test				
Independent Variable	**Dependent Variable**	**Chi-Square**	**Probability**	**Decision**
LNLF	LNY	2.052	0.358	Do not reject null hypothesis
LNGFCF	LNY	2.805	0.246	Do not reject null hypothesis
LNEXTD	LNY	0.290	0.865	Do not reject null hypothesis
ALL above	LNY	5.274	0.509	Do not reject null hypothesis
LNY	LNLF	11.547	0.0031	Reject null
LNGFCF	LNLF	1.400	0.497	Do not reject null hypothesis
LNEXTD	LNLF	2.201	0.3327	Do not reject null hypothesis
LNY	LNGFCF	1.420	0.492	Do not reject null hypothesis
LNLF	LNGFCF	1.981	0.371	Do not reject null hypothesis
LNEXTD	LNGFCF	0.150	0.928	Do not reject null hypothesis
LNY	LNEXTD	1.269	0.530	Do not reject null hypothesis
LNLF	LNEXTD	0.237	0.888	Do not reject null hypothesis
LNGFCF	LNEXTD	0.989	0.609	Do not reject null hypothesis
Null Hypothesis: Independent variable does not Granger Cause Dependent Variable				

Source: Author's assessment

4.2.6 Impulse Response

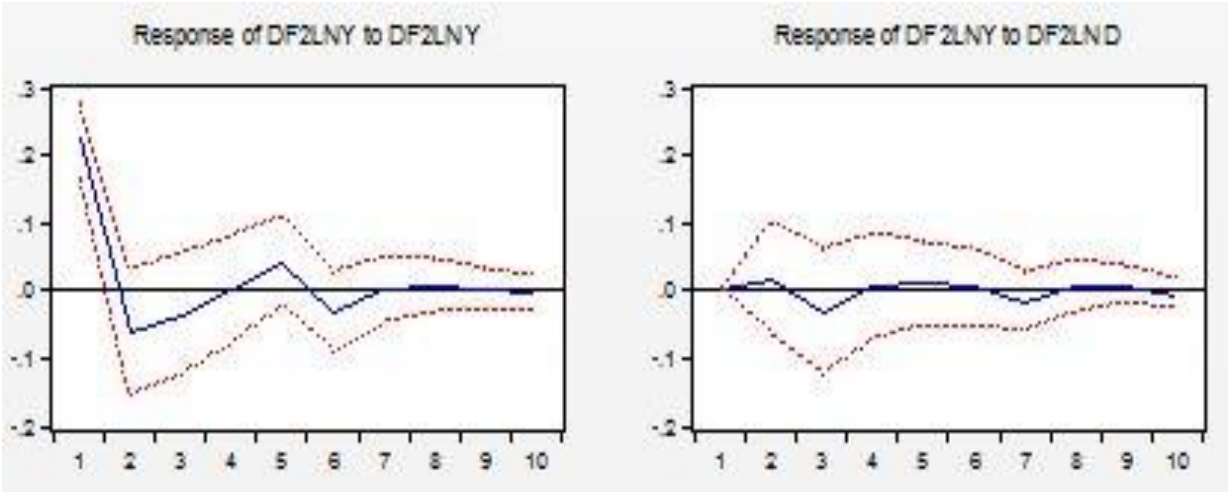
An impulse response function is developed under a Vector Autoregressive environment to show the impact to a dependent variable when a shock is applied to an independent inconstant, thus impulse response is when a unit shock is applied to each variable and we wish to see the impact to the VAR system. This will reveal how the variables react to one another within one standard deviation. Impulse response, therefore, is, therefore, the reaction of the variables to external impulses in the time-invariant model used, VAR, in this case, the analysis was performed in a dynamic environment. The graphs are arranged in order from figure 11 to 26 the impulse response is approximated for a 10-year period following application of the one standard deviation shock to the residual. The first one is the response of GDP to GDP itself, the impulse response becomes negative after one year, then gradually slopes up into positive territory before normalising at the 7-year period, beyond that, the economic growth response is not affected by itself, it remains zero for the estimated period. Figure 13 shows the impact on GDP of a shock to the labour force in Zambia, it can be seen that the results fluctuate between years two to four between negative one and positive one, after that the impulse response remains zero for GDP to a shock to the labour force. positive throughout the period estimated. In figure 14, it is noted that GDP of the country when a shock to GFCF is applied is mainly positive at year three and then negative in the following year and thereafter remaining zero, hence a shock to the net increase in physical assets negatively results in both a negative impact and subsequently a positive one then remaining constant at zero. Interestingly, in the second figure, 12, the GDP impulse response related to external debt stock standard deviation shock is negative over the 10-year period, thus a one standard deviation shock produces a mostly negative impact on the economic growth statistic, the negative impacts being recorded in year 3 and year and generally remaining constant over the other periods.

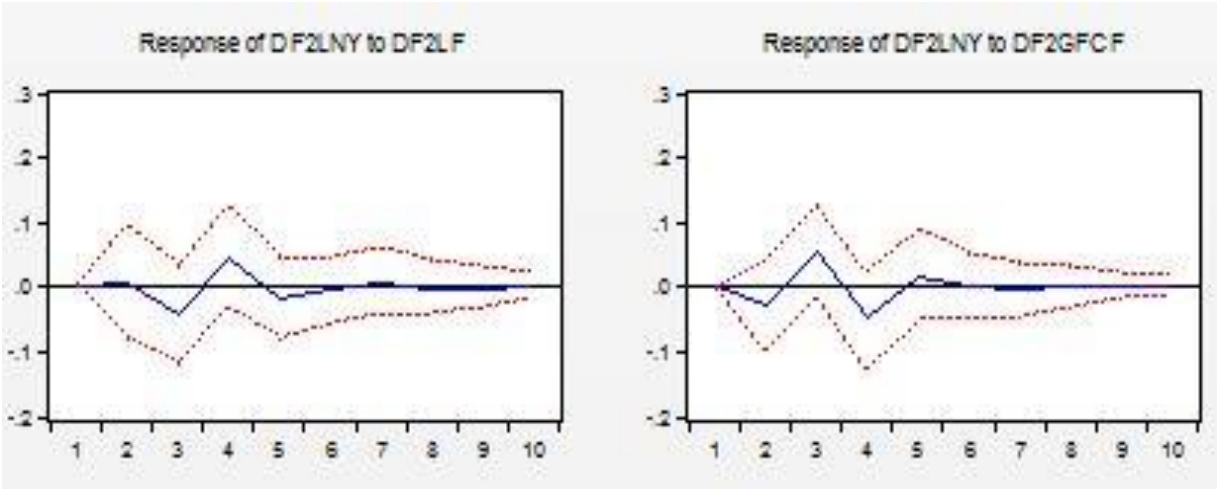
In Figure 15, the impact on external debt from shocks to the other variables reveals that, when a there is shock to economic growth, the impact on external debt stock will initially be negative in the first two years, this then normalises and remains constant over the forecast period of 10 years, A shock to external debt has a negative impulse impact on external debt while changes to the Labour force remain muted and constant at approximately zero throughout the entire period, this is shown in figure 17. A shock to GFCF yields a positive impact in year 2 which then becomes negative in the third year before formalised to zero over the rest of the period.

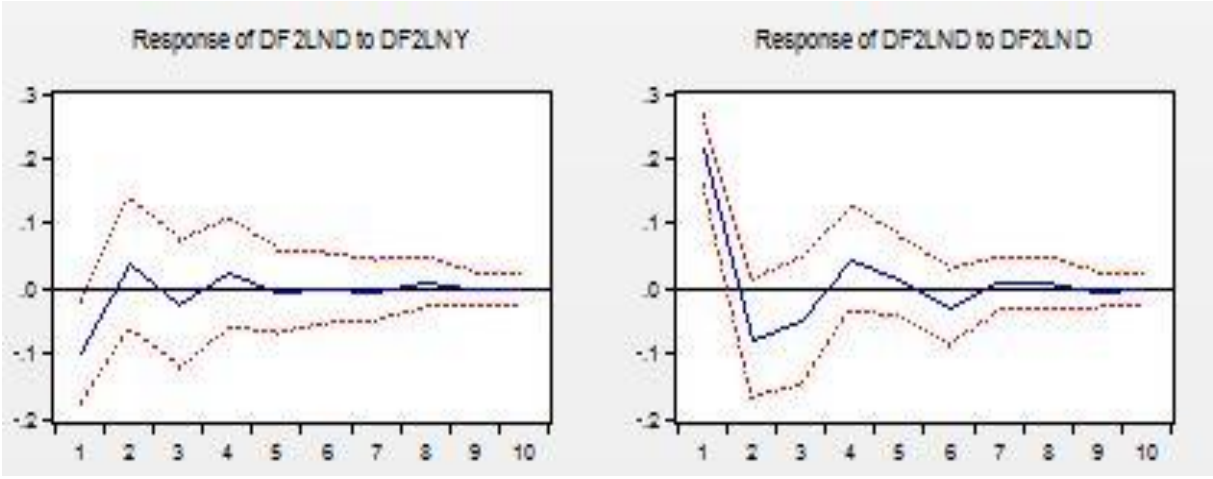
A shock to Labour force by altering the GDP as shown in figure 19 reveals an initial positive impact to LNLF though it becomes negative subsequently. Figure 20 reveals that the impact on a shock to external debt results in LNLF remaining largely close to zero positives over the entire period of review. A shock to LNLF itself shows a step negative impact from a positive position and fluctuates between to positive and negative then normalising to zero at the 8^{th} year. A shock to Gross fixed capital formation shows a largely unaffected result in Labour force with positive and negative impacts hovering between one.

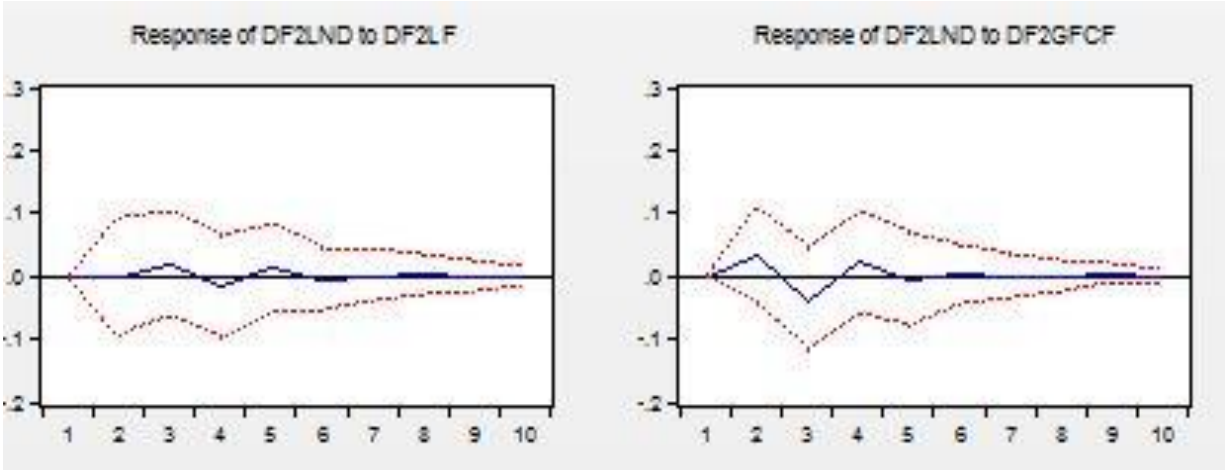
Finally, a shock to LNY initially shows no impact on GFCF though this becomes negative in the fourth year then positive the next and subsequently remains at about zero to year ten. A shock to LND has a muted response over the period which labour force is also largely constant with spikes which are within one occurring between year 4 to 6. The biggest impact is s shock to GFCF itself, which spikes wildly between the first 4 years then normalises at about the 5^{th} year to within range of zero.

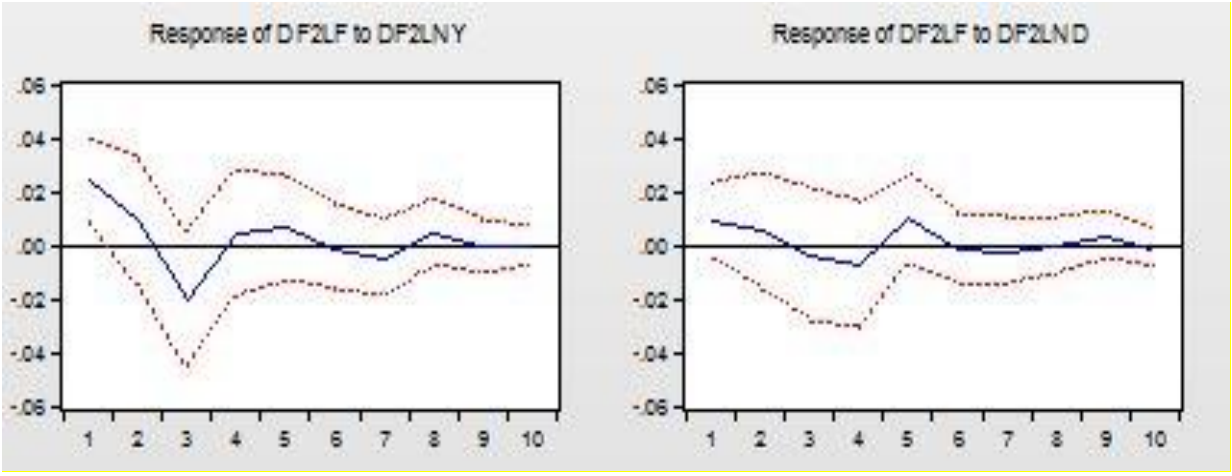
Figures 11 to 26, lest to right respectively: Impulse Responses

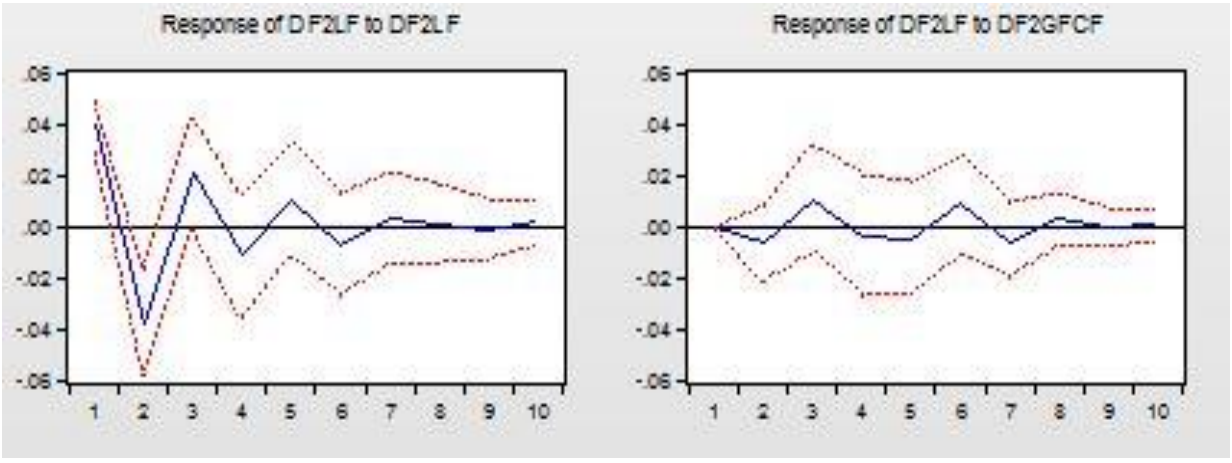


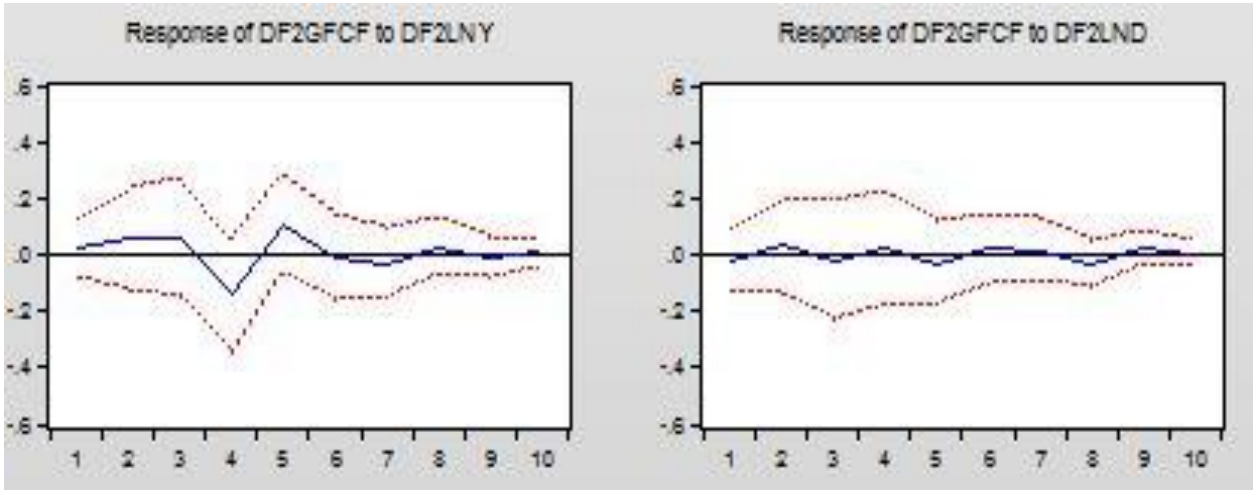


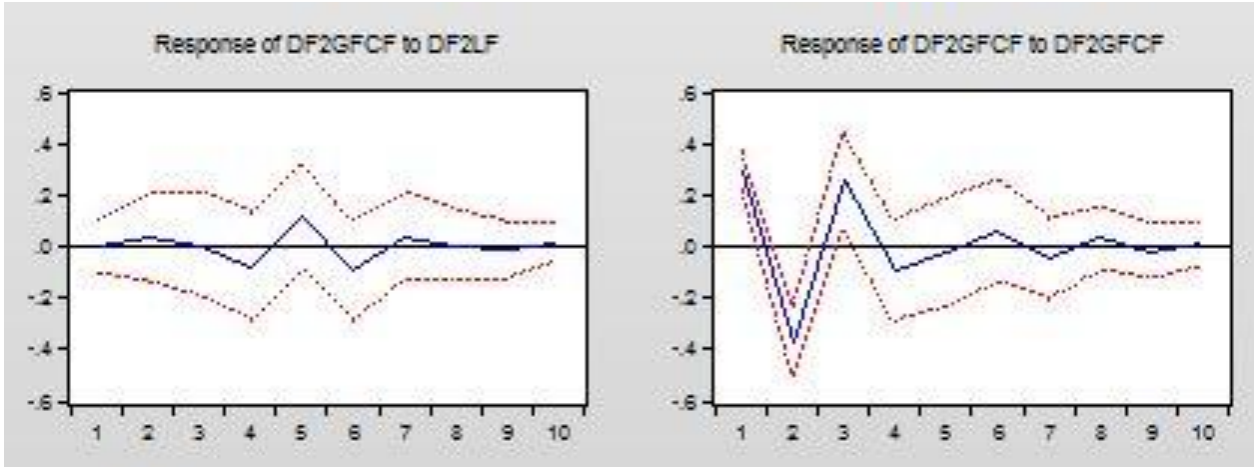



Response of DF2LND to DF2LF
Response of DF2LND to DF2GFCF


Response of DF2LF to DF2LNY
Response of DF2LF to DF2LND


Response of DF2LF to DF2LF
Response of DF2LF to DF2GFCF





Source: Author's assessment

4.2.7 Variance Decomposition Analysis

While impulse response tracks the dynamic impact of structural shock to endogenous variables in a model, the variance decomposition helps show what proportion of those fluctuations are due to shocks to the variable itself and what share can be attributed to shock to other variables (Kilian & Lütkepohl, 2014). For this study of economic growth and the impact of external debt, graphs below represented in figures 27 to 30 and show the variance decomposition of the variables in the model.

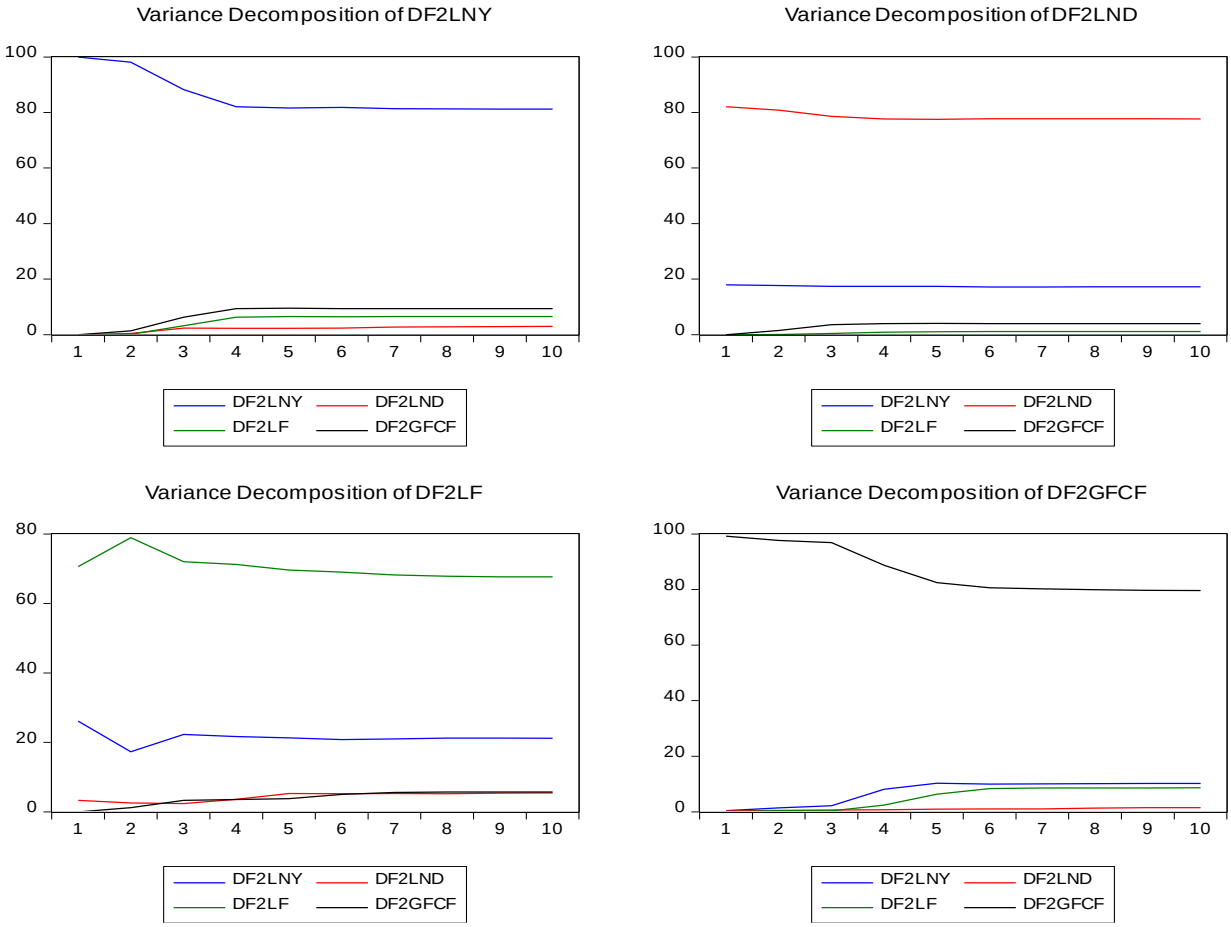
For the gross domestic product, the decomposition of the variance reveals that most the of the variation in GDP is caused by GDP itself, over the 10-year period for the analysis, GDP account for 100 percent in the first year. Subsequently, this effect starts decreasing and the gross fixed capital formation starts having a larger stake in the variance of the GDP, labour force and the external debt stock has a lower effect than GFCF. Figures 27 to 30 in graph form and table 10, in tabular from revealing these relationships. Starting with figure 27, it can be seen that the blue line representing GDP however with the 80 to 100 percent range and the next line, in black represents an increase in productive capacity, GFCF.

Variance decomposition of the external debt stock for Zambia reveals that external debt explains about 80 percent of the variation in external debt over the 10-year period. The Second highest influence on external debt at 20 percent is the economic growth rate GDP. Gross fixed capital formation and labour source have minimal impact on LND.

In figure 29, the labour force is shown by the green line and explains between 60 to 80 percent of the variance in labour force itself. The second biggest influence is the economic growth rate which affects about 20 percent while GFCF and GDP have a minimal influence on the Labour force.

Gross fixed capital formation, is mainly affecting itself, hovering between 80 to 100 percent over the 10-year period. GFCF is represented by the black line and between year 1 and 3, the variance moves from 100 percent to about 80 percent and levels off at this point to year ten. GFCF is jointly affected to equal measure after year 3 by both GDP and labour force, debt stock has a minimal influence throughout the forecast period.

Figures 27 to 30, left to right respectively: Variance Decomposition



Source: Author's assessment

Gross fixed capital formation, is mainly affecting itself, hovering between 80 to 100 per cent over the 10-year period, the second contributing variable to the variance is GDP, which peaks at under 20 percent in year 2-3 and gradually declines to under 5 percent by year ten.

Table 10: Variance Decomposition Analysis Table

Variance Decomposition of DF2LNY:

Period	S.E.	DF2LNY	DF2LND	DF2LF	DF2GFCF
1	0.2225125...	100	0	0	0
2	0.2328666...	98.120350...	0.4429835...	0.0822456...	1.3544204...
3	0.2485543...	88.239952...	2.3312746...	3.1614314...	6.2673418...
4	0.2577594...	82.057866...	2.2697067...	6.2759926...	9.3964340...
5	0.2626853...	81.642898...	2.3069230...	6.5140273...	9.5361508...
6	0.2648462...	81.831292...	2.3237253...	6.4562127...	9.3887689...
7	0.2656289...	81.355472...	2.7686661...	6.5194000...	9.3564610...
8	0.2658237...	81.317494...	2.8260813...	6.5134006...	9.3430234...
9	0.2659416...	81.245455...	2.9062077...	6.5126394...	9.3356974...
10	0.2660592...	81.191664...	2.9695512...	6.5087500...	9.3300342...

Variance Decomposition of DF2LND:

Period	S.E.	DF2LNY	DF2LND	DF2LF	DF2GFCF
1	0.2371015...	17.919907...	82.080092...	0	0
2	0.2543772...	17.669520...	80.829268...	0.0057210...	1.4954900...
3	0.2642989...	17.379279...	78.615351...	0.4536667...	3.5517028...
4	0.2705752...	17.410527...	77.682292...	0.9054863...	4.0016942...
5	0.2713817...	17.377324...	77.530916...	1.0668652...	4.0248934...
6	0.2731520...	17.154677...	77.782485...	1.0862796...	3.9765571...
7	0.2732767...	17.174102...	77.766119...	1.0863722...	3.9734055...
8	0.2735797...	17.225351...	77.721178...	1.0866618...	3.9668079...
9	0.2736302...	17.223070...	77.720082...	1.0874723...	3.9693738...
10	0.2736805...	17.236704...	77.706766...	1.0885535...	3.9679755...

Variance Decomposition of DF2LF:

Period	S.E.	DF2LNY	DF2LND	DF2LF	DF2GFCF
1	0.0466531...	26.101714...	3.3025341...	70.595750...	0
2	0.0612379...	17.316415...	2.5411524...	78.947059...	1.1953725...
3	0.0686693...	22.300222...	2.3868171...	72.032552...	3.2804084...
4	0.0703544...	21.649863...	3.5949013...	71.230692...	3.5245431...
5	0.0721228...	21.301544...	5.2900115...	69.623686...	3.7847570...
6	0.0730571...	20.797429...	5.1936327...	69.013240...	4.9956966...
7	0.0736097...	20.972533...	5.2549299...	68.175891...	5.5966450...
8	0.0738123...	21.257392...	5.2316570...	67.811804...	5.6991463...
9	0.0739309...	21.211873...	5.4220366...	67.665135...	5.7009542...
10	0.0739675...	21.191289...	5.4684531...	67.641428...	5.6988292...

Variance Decomposition of DF2GFCF:

Period	S.E.	DF2LNY	DF2LND	DF2LF	DF2GFCF
1	0.2983036...	0.4455189...	0.3504181...	0.0206106...	99.183452...
2	0.4791542...	1.4228882...	0.5161162...	0.4359709...	97.625024...
3	0.5477608...	2.1757380...	0.6228857...	0.3446472...	96.856728...
4	0.5802839...	8.0902661...	0.7177245...	2.4493389...	88.742670...
5	0.6023943...	10.256835...	0.9492392...	6.3222937...	82.471631...
6	0.6122084...	9.9627550...	1.0258698...	8.3633122...	80.648062...
7	0.6161190...	10.078505...	1.0707720...	8.6278947...	80.222828...
8	0.6185297...	10.165312...	1.3736740...	8.5609576...	79.900056...
9	0.6196716...	10.177860...	1.4943824...	8.5935099...	79.734247...
10	0.6200920...	10.194103...	1.4923599...	8.6609985...	79.652538...

Cholesky Ordering: DF2LNY DF2LND DF2LF DF2GFCF

Source: Author's assessment

4.3 Summary of the Chapter

Chapter four started by revealing the economic growth model and discussed the findings from various tests and analysis. The Vector Auto-Regressive model used was tested for stationarity using a root unit test, cointegration validity was also reviewed. Autocorrelation, normality and heteroscedasticity checks were also carried out on the sample data to affirm the appropriateness

of the empirical technique. After initial tests for stationarity, the variables were second-order differenced and the subsequent VAR formulated based on these new stationary variables. Finally, Granger causality analysis was undertaken culminating into a discussion on the impulse responses and variance decompositions. The results from these tests were discussed in the context of the model. The next chapter, chapter five, will apply the empirical findings to the research questions proposed at the outset.

CHAPTER 5: RESEARCH CONCLUSIONS

5.1 Introduction

This chapter deliberates the research finding of the study as applied to the Zambian context and presents an overview of the study as well as serving as the last part of the research. The chapter is starts off with a discussion on the research journey, from inception to conclusion. Then there will be a discussion of the empirical findings and applications to Zambian including policy recommendations. Finally, the chapter will conclude with recommendations for areas of future study to enlighten this debate further.

The study was arranged in five chapters, starting with the introductions, then literature review before proceeding to a discussion of the research findings, the undertaking of the data analysis and the subsequent conclusions in chapter 5. As Zambia has recently been contracting more debt, particularly private sources, this study aimed to investigate the relationship between external debt stock and economic growth and also to discuss the rising appetite for Eurobond debts as opposed to borrowing from sovereigns and international development institutions. Further, the research has an objective of disaggregating Zambia's debt stock and finally contributing to the debt management discussion through the suggestion of appropriate debt mitigation strategies. The research reviewed various literature broadly under the themes of the Solow economic growth model, theoretical and empirical literature on the debt growth nexus, focussing on the debt overhang hypothesis. The research methodology was specified in chapter three and the Autoregressive model generalised. In chapter four based on Stationarity and Unit root tests as well as cointegration results, a Vector Autoregressive Model was preferred and stated using transformed variables which are logarithms of the various inputs differenced to the second order. Chapter four analysed the results based on calculations by the author.

Zambia debt stock and appetite for Eurobonds were discussed in Chapter one under the problem definition. Essentially, the Country is now increasingly seeking debt from private sources primarily because these sources don't have conditionalities attached to their debt. As long as a Nation honours its dues through interest payments, the lenders are unconcerned about utilisation of the monies they lend.

5.2 Summary of Findings and Policy Recommendations

The question of debt accumulation for African countries is very topical as more nations have been opting to acquire external borrowing to finance their developments and for political expediency. In the study, the first step that was taken was a review of the data, natural logarithms were taken as a means of data transformation. Subsequently, a root unit test was carried out. The finding of the root unit test indicated that the transformed variables were stationary once second differenced and hence lending credence to their suitability for use in a VAR time series model. The findings from the cointegration tests revealed that the variables were not cointegrated, therefore, a Vector Error correction technique could not be used, instead, a Vector Autoregressive model had to be applied, this empirical analysis was thus based on a VAR technique. A lag length of two was specified based on findings from lag length analysis. Subsequent tests of the residuals showed that the variables were free from autocorrelation and were homoscedastic, thus they passed the normality and residuals inspection. Applied to this study of economic growth and external debt, this pointed to appropriateness of the data used in determining whether there is a link between external borrowings' and economic growth in a VAR model.

When the data were analysed for Granger causality, that is to determine whether the time series variables can be used to predict the future, an interesting observation was found. Labour force was found to be able to predict the GDP of Zambia while the Granger causality test for external debt found that this variable could not be used to predict the future economic output. This finding does not imply that there is no relationship between GDP and external debt, rather, it only shows that future GDP growth of Zambia is influenced by other factors, the quantum of the external debt stock held in the past by Zambia cannot be used in a time series Autoregressive Model(AR) to estimate future GDP. The policy implication for this is that GRZ should not rely on the current external debt stock to predict future changes or positions to GDP, rather a totality and variation of other factors linked to economic growth need to be considered. More importantly, this shows that policies to further deepen the nation's debt based on predicted effects to GDP should be carefully weighted, this finding shows that the Zambian government cannot use an increased in debt stock as a precursor to improved economic output of the nation and the two variables, GDP and external debt does not Granger cause one another.

The impulse response is used to show the dynamic impact to either a linear or non-linear model of applying shocks to selected input variables. In this case, I evaluated three independent variables and one dependent outcome, economic growth. Analysis of the time series impulse responses reveals that reveals that both Labour Force and Gross fixed capital formation has impacts that fluctuate between positive and negative. The findings also reveal that for Zambia, growth in the economic output is most negatively affected by a shock to the external debt stock. The policy implication for this is that Zambia is negatively exposed to shock to the external debt stock, which is cause for concern. Therefore, a variation in the debt stock can lead to a negative consequence on the economic growth of the country. For the Zambian government, this is supportive evidence of the need to effectively monitor and ensure rationality in the accumulation of debt, especially given the recent trajectory of rapid debt infusion into the nation's coffers. In addition to prudent debt management, the debt must only be contracted for rational, well planned and required projects with a clear return on capital employed as the risk of a negative shock to the GDP due to a variation in the debt stock is clear and present. For labour force, since it has a muted impact overall, the nation's government must ensure that this grows through the provision of adequate education and health for the citizens.

The variance breakdown is used to analyse the shocks between those attributable to the variable itself and those attributable to other variables in the VAR model. When GDP is broken down it is seen that the variance is mostly explained by itself in the first two years of the forecast, then gross fixed capital formation, labour force and external debt stock increase in impact, though this is mainly subdued as it still only accounts for a combined 20 percent. The policy impaction here is linked to the impulse response, which is to say, the variables though insignificant in the variance decomposition must still be tracked as for when they are combined, their influence on the variance of GDP adds up to 20 percent of the 10-year forecast period.

Other policy implications of the study are, firstly, the Zambian government must be aware of the negative impact of external debt on GDP as revealed by the impulse response, therefore, GRZ must take measures to manage the debt stock of the country to a level where it does not negatively impact on economic growth. Secondly, time series analysis has revealed that Labour Force seems to be a strong predictor of future GDP for Zambia, as such the country must ensure that appropriate data for this metric is kept for the country and secondly that Zambia deliberately increased its Labour Force. Thirdly, GRZ must ensure an appropriate growth in Gross Fixed Capital Formation to provide the basis for further GDP growth.

5.3 Summary of the Paper

The main finding in the Vector Autoregressive model and related analysis expose interesting results with regard to external debt stock and Gross Domestic Product. On one hand external debt stock cannot be used to forecast the GDP position of the country and on the other, and more significantly, a shock to the external debt stock causes a mostly negative effect on the economic growth output. The findings also reveal the importance of Zambia having a proper debt contraction and management strategy to ensure that debts are monitored. Finally, the political economics of debt demand that the nation must not make politically expedient results to contract debt which is not appropriately utilised as this burden falls on the nation to pay back, long after the short tenures of political office holders.

5.4 Recommendations for Future Study

The empirical findings in this paper demand that further studies are carried out to inform the external debt to GDP discussion. One such area would be a study of both external and internal dues and economic growth. Further, an investigation on the debt source and growth in an economy can be studied. Finally, a research into the impact of external borrowing on disaggregated components of GDP can also be useful for the intellectual capital in this regard.

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FIGURES AND TABLES

Figure 1: Zambia Selected Macro Economic Variables 2012-2015 in Percentage (%)

Year	2012	2013	2014	2015
Real Gross Domestic Product(GDP) growth	7.2	6.5	7.1	7.4
GDP per Capita growth	4	3.2	3.8	4.2
Inflation	6.6	7.1	6.8	6.3
Budget balance as a Percentage of GDP	-2.8	-7.3	-6.6	-5.7
Current Account Balance	2.1	0.2	-0.2	-0.4

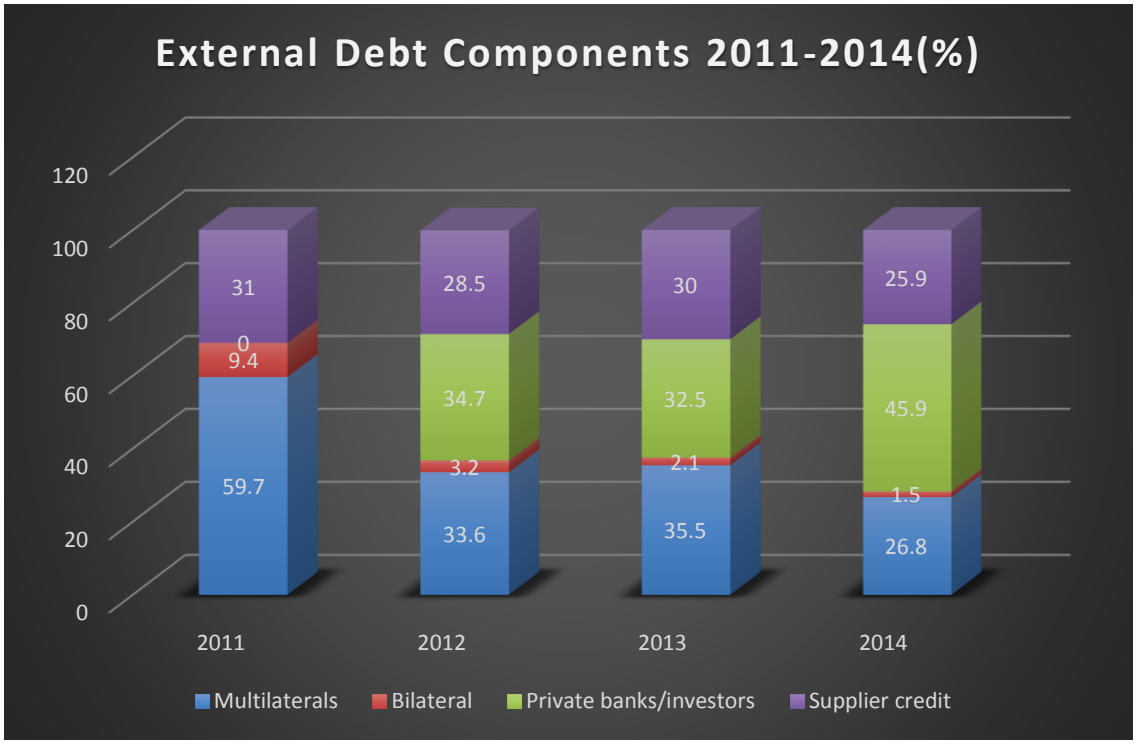
Source: African Economic Outlook

Figure 2: Zambia Total External Debt as a Percentage (%) of GDP

Year	2011	2012	2013	2014
Central Government	6,4	11,8	11,8	16,9
BoZ	1,9	1,6	1,5	1,3
Private and Parastatal	7,1	3,7	6,9	5,7
Total External Debt	15,4	17,1	20,2	23,9

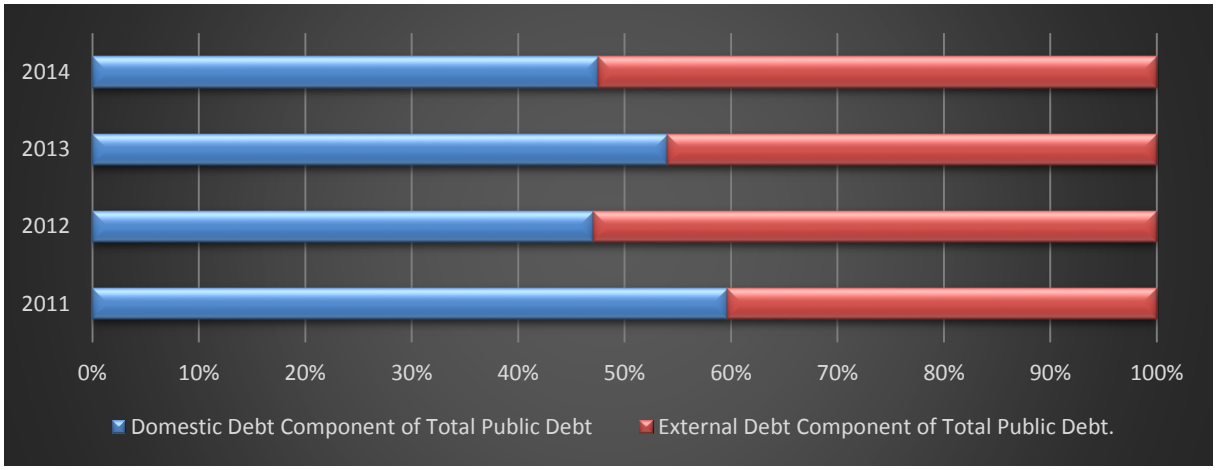
Source: IMF Debt Sustainability Study Article IV Consultation, 2015

Figure 3: Zambia External Debt Components 2011-2014



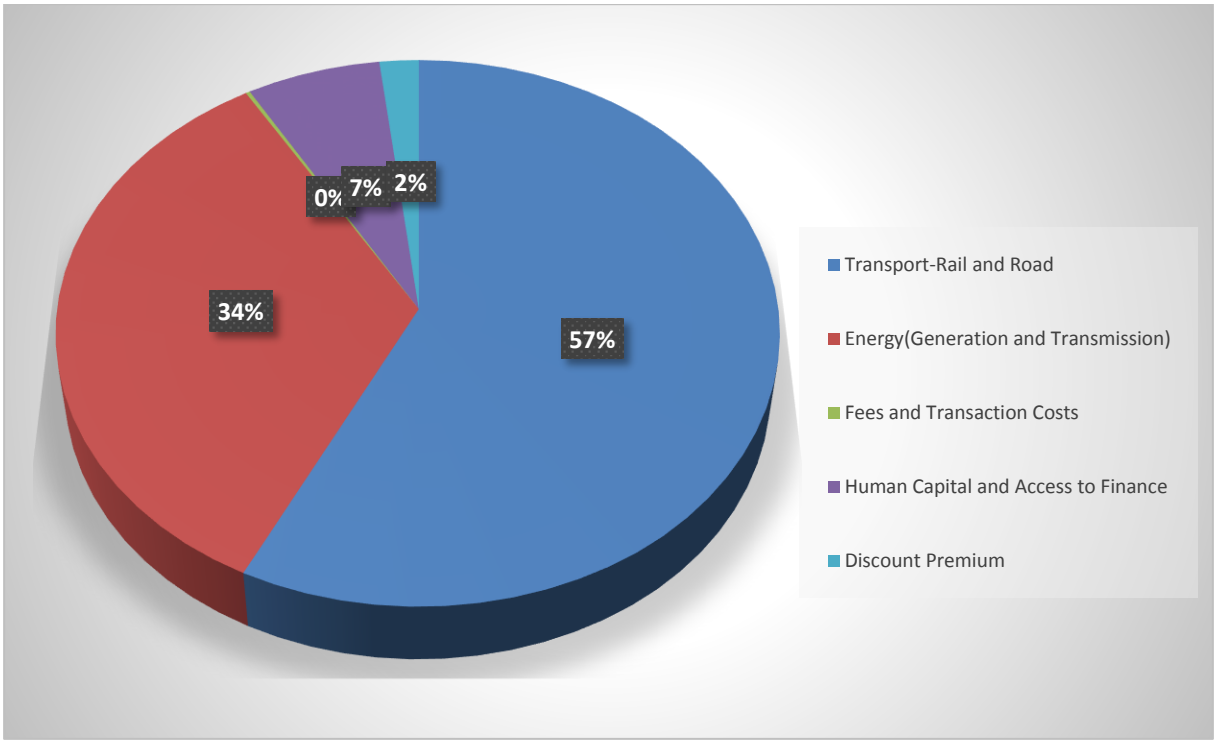
Source: IMF Debt Sustainability Study Article IV Consultation, 2015

Figure 4: Zambia External and Internal Debt as a % of Total Public Debt



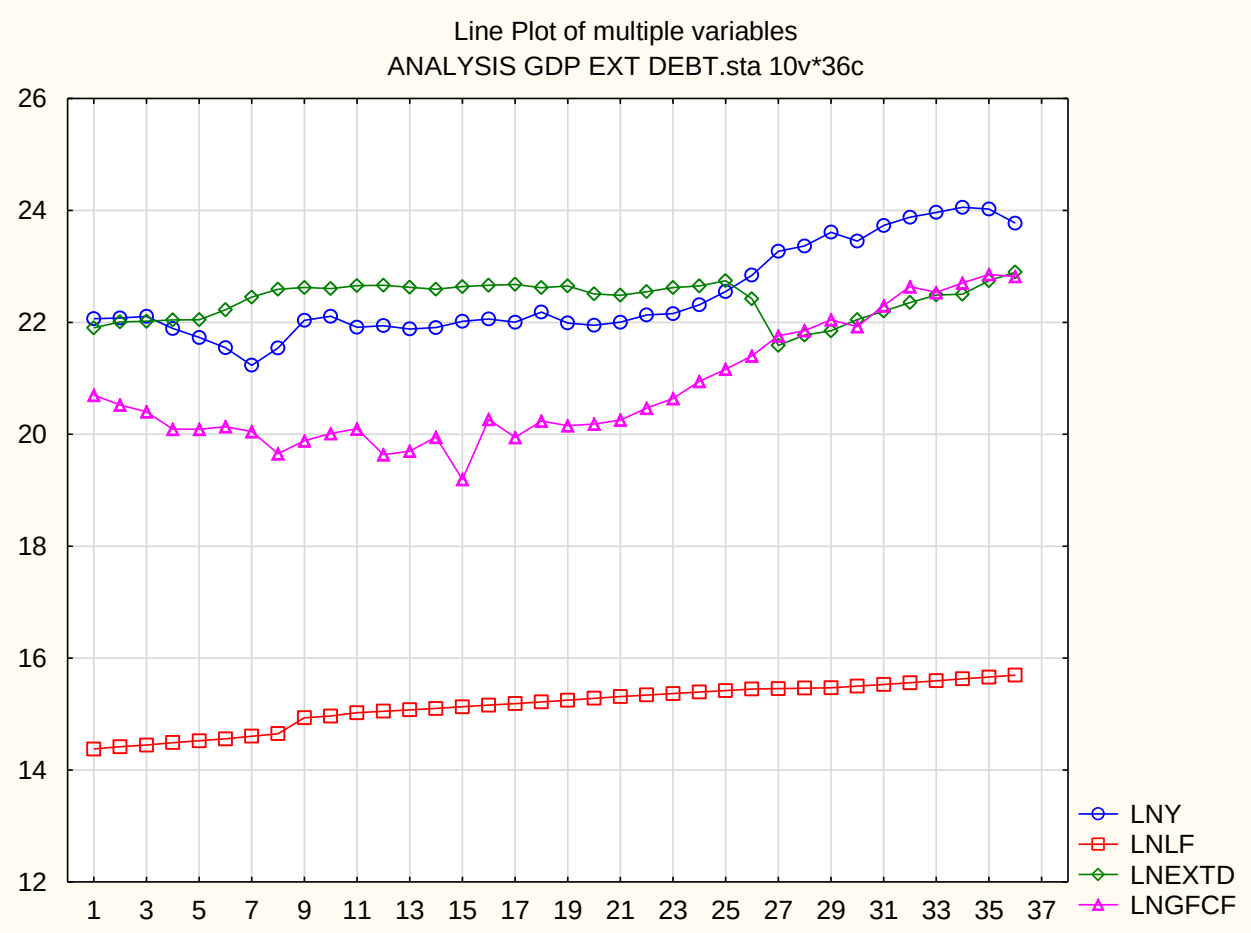
Source: IMF Debt Sustainability Study Article IV Consultation, 2015

Figure 5: Zambia Utilisation of Eurobond as of 2013(%)



Source: Ministry of Finance Zambia, Citizens Budget 2013

Figure 6: GDP, External Debt, Labour Force and Gross Fixed Capital Formation Chart



Source: Authors estimation

Figure 7: VAR Lag Length Test Results

VAR Lag Order Selection Criteria
Endogenous variables: Y_LN_DATA LF_LN_DATA GFCF_LN_DATA EXTE_DEBT_LN_DATA
Exogenous variables: C
Date: 08/21/17 Time: 20:35
Sample: 1980 2015
Included observations: 33

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-44.748925...	NA	0.000226	2.954480	3.135875	3.015514
1	89.0018091...	226.9709	1.81e-07	-4.181928	-3.274954*	-3.876759
2	110.309591...	30.99314*	1.38e-07*	-4.503612*	-2.871058	-3.954307*
3	119.116126...	10.67459	2.41e-07	-4.067644	-1.709511	-3.274204

* 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

Source: Authors estimation

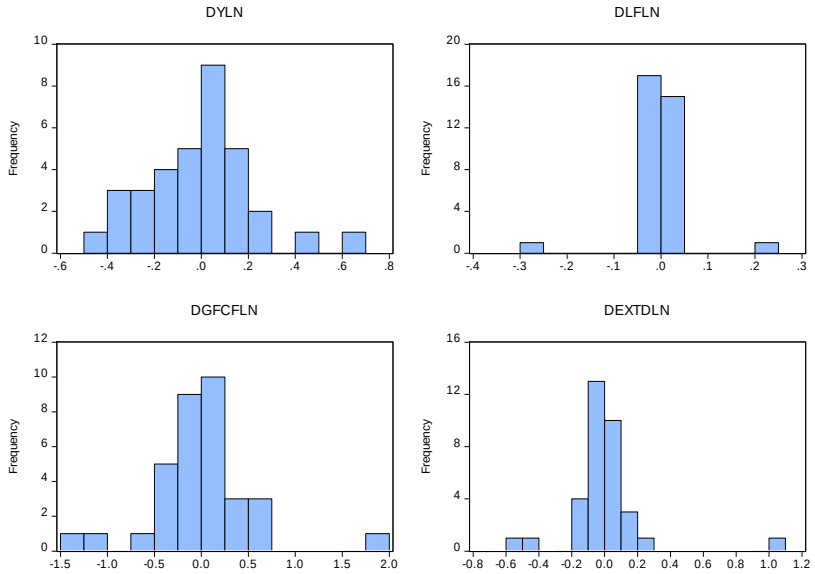
Figure 8: VAR Model

	DYLN	DLFLN	DGFCFLN	DEXTDLN
DYLN(-1)	-0.2559234...	0.17242700...	0.28488071...	0.00011299...
	0.25103407...	0.05263310...	0.33654005...	0.26749318...
	[-1.01948]	[3.27602]	[0.84650]	[0.00042]
DYLN(-2)	-0.1755810...	0.04923090...	0.43793253...	-0.2978224...
	0.28489302...	0.05973214...	0.38193186...	0.30357209...
	[-0.61631]	[0.82419]	[1.14662]	[-0.98106]
DLFLN(-1)	0.16040380...	-0.9651679...	0.66412450...	-0.0376445...
	1.08412097...	0.22730241...	1.45338885...	1.15520161...
	[0.14796]	[-4.24618]	[0.45695]	[-0.03259]
DLFLN(-2)	-0.8352466...	-0.4054234...	1.66137263...	0.31791140...
	1.01916304...	0.21368300...	1.36630528...	1.08598470...
	[-0.81954]	[-1.89731]	[1.21596]	[0.29274]
DGFCFLN(-1)	-0.0912233...	-0.0225368...	-1.2407834...	0.10471088...
	0.11814735...	0.02477138...	0.15839011...	0.12589370...
	[-0.77211]	[-0.90980]	[-7.83372]	[0.83174]
DGFCFLN(-2)	0.04951661...	-0.0048585...	-0.6317061...	0.03534236...
	0.12443706...	0.02609011...	0.16682219...	0.13259580...
	[0.39792]	[-0.18622]	[-3.78670]	[0.26654]
DEXTDLN(-1)	0.05832197...	0.05876775...	0.00934704...	-0.3552714...
	0.19584255...	0.04106136...	0.26254947...	0.20868302...
	[0.29780]	[1.43122]	[0.03560]	[-1.70245]
DEXTDLN(-2)	-0.0755200...	0.03013750...	-0.1006714...	-0.3909806...
	0.20405163...	0.04278252...	0.27355468...	0.21743032...
	[-0.37010]	[0.70444]	[-0.36801]	[-1.79819]
C	-0.0016599...	-0.0001354...	0.02535829...	0.00505937...
	0.03941546...	0.00826405...	0.05284096...	0.04199975...
	[-0.04211]	[-0.01639]	[0.47990]	[0.12046]
R-squared	0.30466073...	0.60885532...	0.77003087...	0.24720509...
Adj. R-squared	0.06280360...	0.47280500...	0.69004160...	-0.0146366...
Sum sq. resids	1.13877176...	0.05005982...	2.04665601...	1.29299478...
S.E. equation	0.22251250...	0.04665312...	0.29830361...	0.23710159...
F-statistic	1.25967230...	4.47522149...	9.62667796...	0.94410129...
Log likelihood	7.96653683...	57.9583260...	-1.4135745...	5.93436435...
Akaike AIC	0.06459144...	-3.0598953...	0.65084841...	0.19160222...
Schwarz SC	0.47682967...	-2.6476571...	1.06308663...	0.60384045...
Mean dependent	-0.0010249...	-0.0002757...	0.00860302...	0.00407824...
S.D. dependent	0.22984714...	0.06425324...	0.53580505...	0.23538522...

Determinant resid covariance (dof adj.)	3.098217472104364e-07
Determinant resid covariance	8.26843524562032e-08
Log likelihood	79.30763513106899
Akaike information criterion	-2.706727195691812
Schwarz criterion	-1.05777430504212

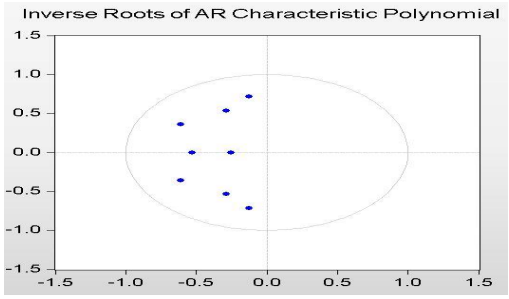
Source: Author's assessment

Figure 9: Skewness and Kurtosis Graphs



Source: Author's assessment

Figure 10: Lag Stability Test



Source: Author's assessment

Table 1: ADF Test at Level

Augmented Dick Fuller(ADF) Test Results at Level				
Variable and Period Covered	**T Statistic**	**Critical Values at 5%**	**Probability**	**Test Inference**
LNY, 1980 to 2015	-2.615	-3.553	0.276	Unit Root
LNLF, 1980 to 2015	-1.936	-3.558	0.612	Unit Root
LNEXTD, 1980 to 2015	-2.267	-3.548	0.440	Unit Root
LNGFCF, 1980 to 2015	-2.246	-3.548	0.451	Unit Root

Source: Author's assessment

Table 2: ADF Test at First Differencing

Augmented Dick Fuller(ADF) Test Results at First Differencing				
Variable and Period Covered	**T Statistic**	**Critical Values at 5%**	**Probability**	**Test Inference**
LNY, 1980 to 2015	-3.353	-3.553	0.075	Unit Root
LNLF, 1980 to 2015	-5.710	-3.548	0.000	No Unit Root
LNEXTD, 1980 to 2015	-4.270	-3.548	0.010	No Unit Root
LNGFCF, 1980 to 2015	-10.173	-3.548	0.000	No Unit Root

Source: Author's assessment

Table 3: ADF Test at Second Differencing

Augmented Dick Fuller(ADF) Test Results at Second Differencing				
Variable and Period Covered	**T Statistic**	**Critical Values at 5%**	**Probability**	**Test Inference**
LNY, 1980 to 2015	-7.543	-3.553	0.000	No Unit Root
LNLF, 1980 to 2015	-10.328	-3.553	0.000	No Unit Root
LNEXTD, 1980 to 2015	-7.591	-3.553	0.000	No Unit Root
LNGFCF, 1980 to 2015	-3.789	-3.588	0.033	No Unit Root

Source: Author's assessment

Table 4: Cointegration Trace Test

Trace Test			
Hypothesized Number of Cointegration Equations	**Trace Statistic**	**0.05 Critical Value**	**Probability**
None	39.760	47.856	0.231
At Most 1	19.952	29.797	0.426
At Most 2	4.341	15.495	0.874
At Most 3	0.081	3.841	0.776

Source: Author's assessment

Table 5: Cointegration Maximum Eigenvalue Test

Maximum Eigenvalue Test			
Hypothesized Number of Cointegration Equations	**Maximum Eigenvalue Statistic**	**0.05 Critical Value**	**Probability**
None	19.808	27.584	0.355
At Most 1	15.611	21.132	0.248
At Most 2	4.260	14.265	0.831
At Most 3	0.081	3.841	0.776

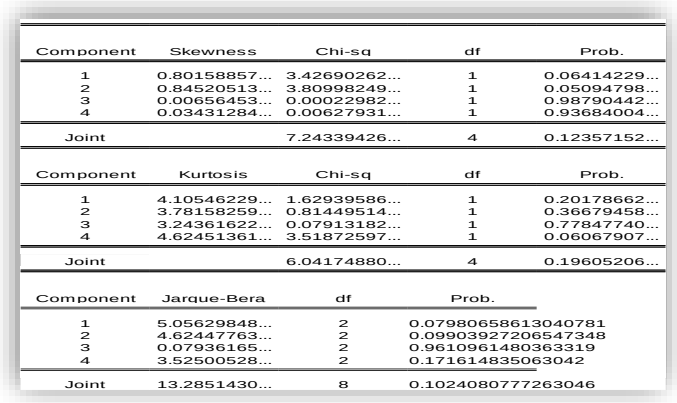
Source: Author's assessment

Table 6: Lagrange Multiplier Test

Lags	Lagrange Diagnostics Results	Probability
1	15.842	0.464
2	17.482	0.355
3	21.143	0.173
4	14.837	0.537

Source: Author's assessment

Table 7: Skewness and Kurtosis Test



Component	Skewness	Chi-sq	df	Prob.
1	0.80158857...	3.42690262...	1	0.06414229...
2	0.84520513...	3.80998249...	1	0.05094798...
3	0.00656453...	0.00022982...	1	0.98790442...
4	0.03431284...	0.00627931...	1	0.93684004...
Joint		7.24339426...	4	0.12357152...

Component	Kurtosis	Chi-sq	df	Prob.
1	4.10546229...	1.62939586...	1	0.20178662...
2	3.78158259...	0.81449514...	1	0.36679458...
3	3.24361622...	0.07913182...	1	0.77847740...
4	4.62451361...	3.51872597...	1	0.06067907...
Joint		6.04174880...	4	0.19605206...

Component	Jarque-Bera	df	Prob.
1	5.05629848...	2	0.07980658613040781
2	4.62447763...	2	0.09903927206547348
3	0.07936165...	2	0.9610961480363319
4	3.52500528...	2	0.171614835063042
Joint	13.2851430...	8	0.1024080777263046

Source: Author's assessment

Table 8: Whites Test

Joint test:

Chi-sq	df	Prob.
180.496763...	160	0.1277415101828137

Individual components:

Dependent	R-squared	F(16,15)	Prob.	Chi-sq(16)	Prob.
res1*res1	0.29579892...	0.39379588...	0.96307753...	9.46556544...	0.89301003...
res2*res2	0.90989172...	9.46665044...	3.84649972...	29.1165353...	0.02316207...
res3*res3	0.34164559...	0.48650504...	0.91791649...	10.9326589...	0.81362267...
res4*res4	0.90149806...	8.58007947...	7.09283713...	28.8479380...	0.02498184...
res2*res1	0.79971601...	3.74335359...	0.00712232...	25.5909125...	0.06006304...
res3*res1	0.51501577...	0.99555254...	0.50564224...	16.4805046...	0.41995734...
res3*res2	0.46620822...	0.81880282...	0.65270763...	14.9186632...	0.53060366...
res4*res1	0.95000261...	17.8134790...	6.03157020...	30.4000835...	0.01603492...
res4*res2	0.60299507...	1.42393167...	0.24961542...	19.2958424...	0.25362062...
res4*res3	0.84918040...	5.27853574...	0.00120962...	27.1737729...	0.03959164...

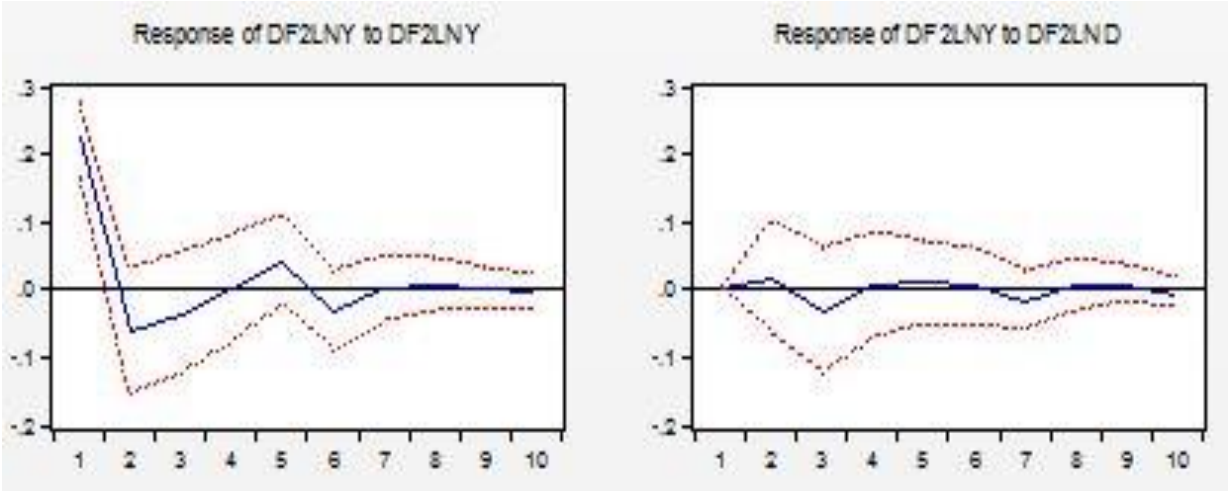
Source: Author's assessment

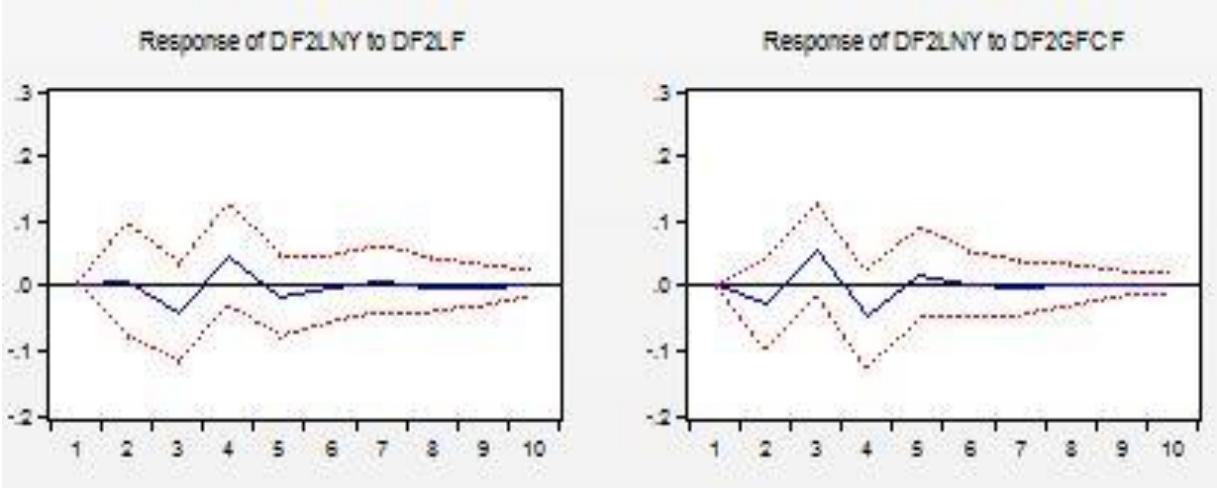
Table 9: Granger Causality Test

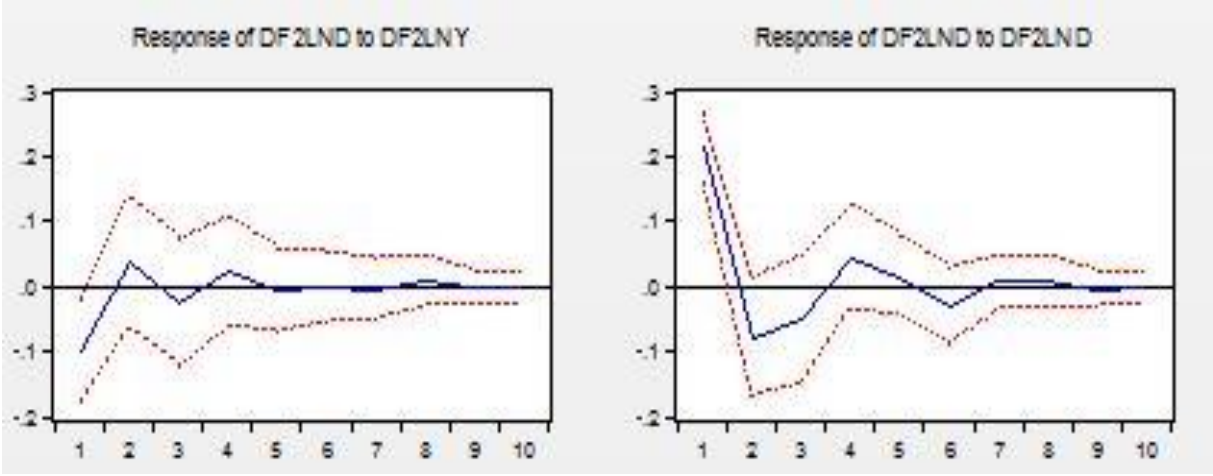
Granger Causality Test				
Independent Variable	**Dependent Variable**	**Chi-Square**	**Probability**	**Decision**
LNLF	LNY	2.052	0.358	Do not reject null hypothesis
LNGFCF	LNY	2.805	0.246	Do not reject null hypothesis
LNEXTD	LNY	0.290	0.865	Do not reject null hypothesis
ALL above	LNY	5.274	0.509	Do not reject null hypothesis
LNY	LNLF	11.547	0.0031	Reject null
LNGFCF	LNLF	1.400	0.497	Do not reject null hypothesis
LNEXTD	LNLF	2.201	0.3327	Do not reject null hypothesis
LNY	LNGFCF	1.420	0.492	Do not reject null hypothesis
LNLF	LNGFCF	1.981	0.371	Do not reject null hypothesis
LNEXTD	LNGFCF	0.150	0.928	Do not reject null hypothesis
LNY	LNEXTD	1.269	0.530	Do not reject null hypothesis
LNLF	LNEXTD	0.237	0.888	Do not reject null hypothesis
LNGFCF	LNEXTD	0.989	0.609	Do not reject null hypothesis
Null Hypothesis: Independent variable does not Granger Cause Dependent Variable				

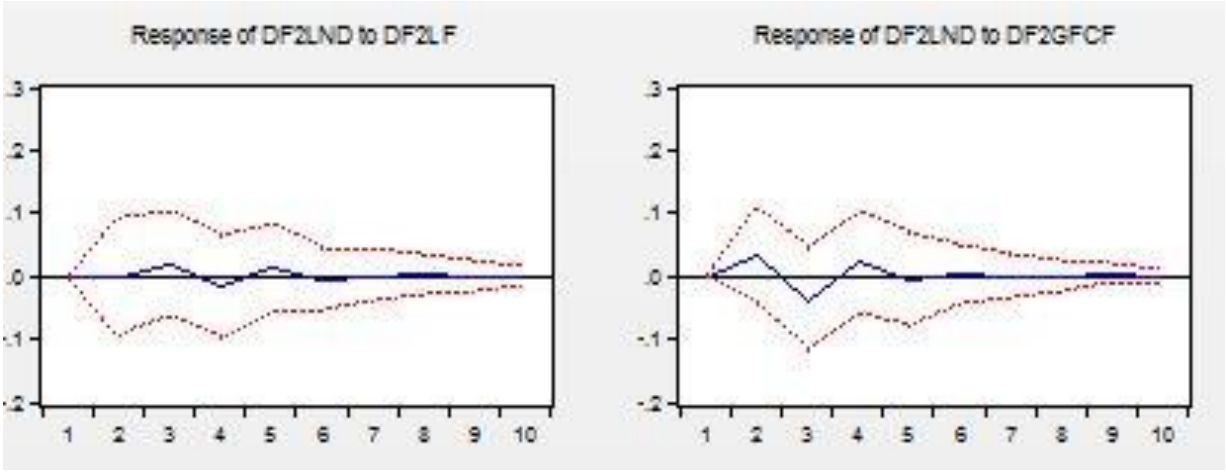
Source: Author's assessment

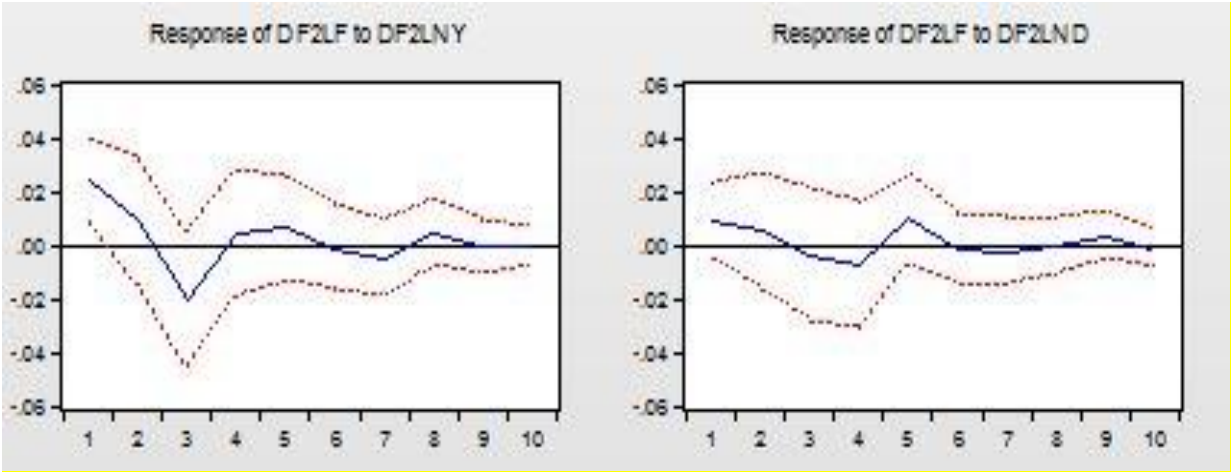
Figures 11 to 26, lest to right respectively: Impulse Responses

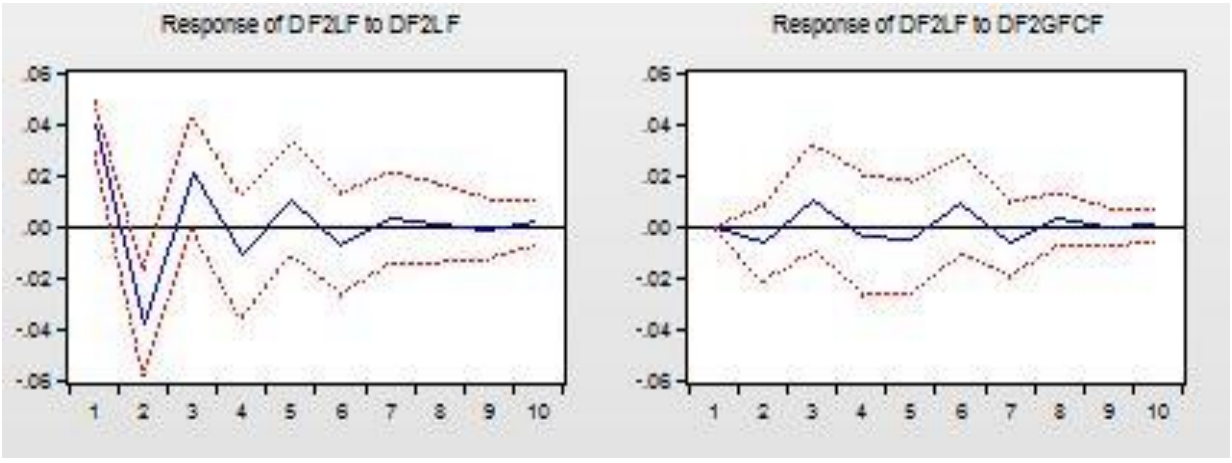

Response of DF2LNY to DF2LNY
Response of DF2LNY to DF2LND

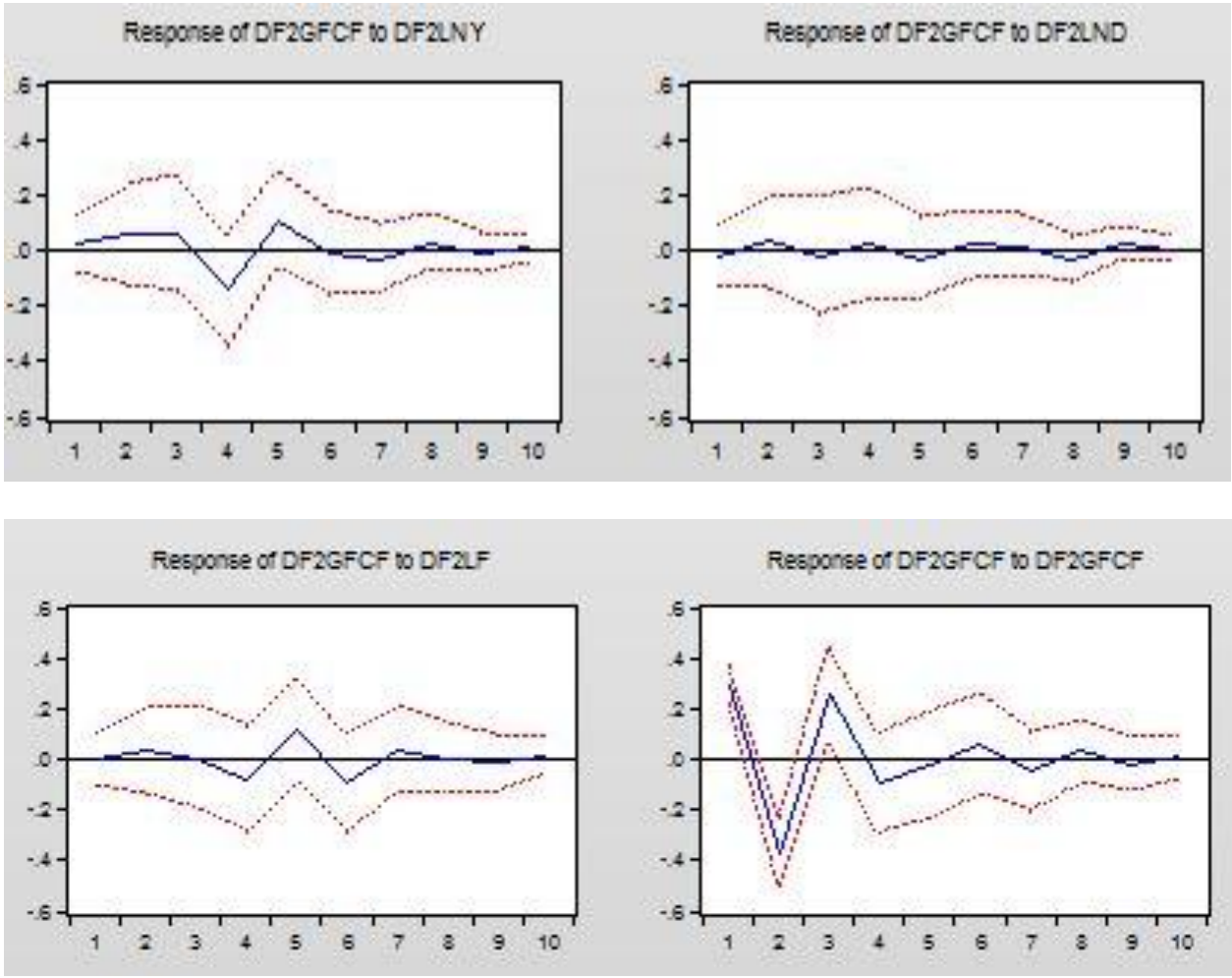

Response of DF2LNY to DF2LF
Response of DF2LNY to DF2GFCF


Response of DF2LND to DF2LNY
Response of DF2LND to DF2LND


Response of DF2LND to DF2LF
Response of DF2LND to DF2GFCF

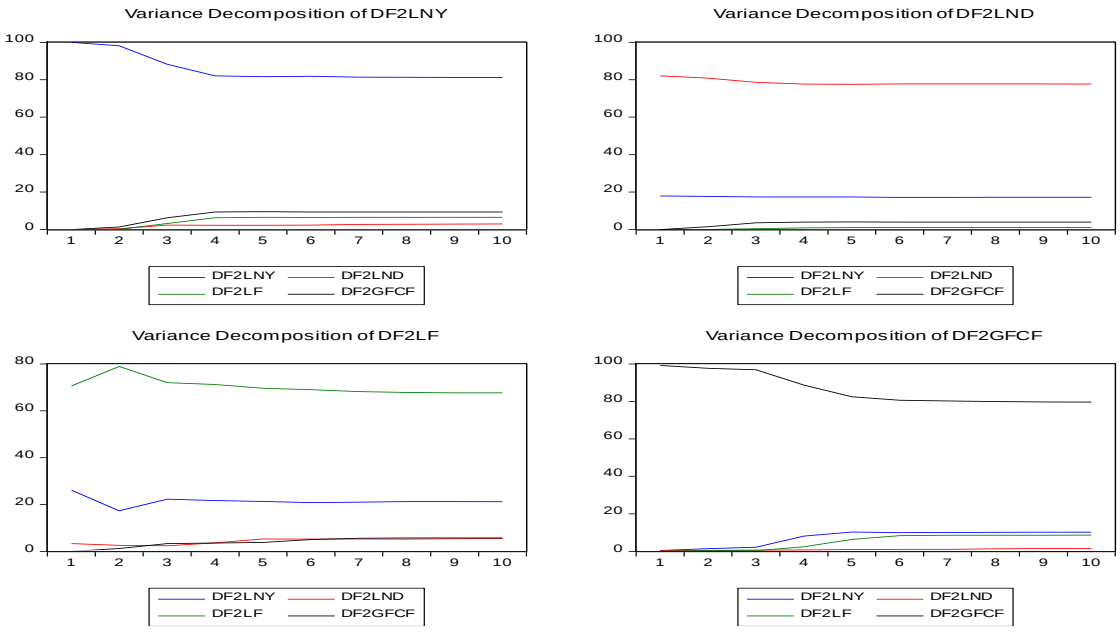

Response of DF2LF to DF2LNY
Response of DF2LF to DF2LND


Response of DF2LF to DF2LF
Response of DF2LF to DF2GFCF



Source: Author's assessment

Figures 27 to 30, left to right respectively: Variance Decomposition



Source: Author's assessment

APPENDICES

Appendix A: Gross Domestic Product, Labour Force and Population of Zambia 1980 to 2015

Year	GDP (USD)	LN GDP	Labour Force(LF)	LN LF	Population
1980	3 829 500 000	22	1 751 400	14	5 889 230
1981	3 872 666 667	22	1 824 200	14	6 094 206
1982	3 994 777 778	22	1 880 400	14	6 305 709
1983	3 216 307 692	22	1 962 300	14	6 521 542
1984	2 739 444 444	22	2 032 000	15	6 738 765
1985	2 281 258 065	22	2 100 000	15	6 955 212
1986	1 661 948 718	21	2 201 000	15	7 170 656
1987	2 269 894 737	22	2 300 000	15	7 385 686
1988	3 713 614 458	22	3 063 696	15	7 600 072
1989	3 998 637 681	22	3 158 804	15	7 813 808
1990	3 285 217 391	22	3 354 107	15	8 027 253
1991	3 378 882 353	22	3 433 027	15	8 239 732
1992	3 181 921 788	22	3 522 034	15	8 452 275
1993	3 273 237 853	22	3 615 655	15	8 669 168
1994	3 656 647 744	22	3 723 892	15	8 896 109
1995	3 807 067 122	22	3 832 922	15	9 137 077
1996	3 597 220 962	22	3 944 544	15	9 394 304
1997	4 303 281 932	22	4 064 820	15	9 666 578
1998	3 537 683 046	22	4 194 111	15	9 950 224
1999	3 404 311 977	22	4 327 317	15	10 239 714
2000	3 600 683 040	22	4 466 392	15	10 531 221
2001	4 094 480 988	22	4 588 209	15	10 824 125
2002	4 193 845 678	22	4 715 299	15	11 120 409
2003	4 901 839 731	22	4 844 811	15	11 421 984
2004	6 221 077 675	23	4 977 369	15	11 731 746
2005	8 331 870 169	23	5 112 555	15	12 052 156
2006	12 756 858 899	23	5 154 643	15	12 383 446
2007	14 056 957 976	23	5 191 115	15	12 725 974
2008	17 910 858 638	24	5 223 557	15	13 082 517
2009	15 328 342 304	23	5 384 042	15	13 456 417
2010	20 265 556 274	24	5 547 185	16	13 850 033
2011	23 460 098 340	24	5 734 776	16	14 264 756
2012	25 503 370 699	24	5 926 812	16	14 699 937
2013	28 045 460 442	24	6 129 078	16	15 153 210
2014	27 150 630 607	24	6 339 583	16	15 620 974
2015	21 154 394 546	24	6 557 573	16	16 100 587

Appendix B: External Debt, GDP and Gross Fixed Capital Formation of Zambia 1980 to 2015

Year	External Debt Stock (EXT Debt) (USD)	LN EXT Debt	GDP Per Capita (USD)	GFCF (USD)	Log of GFCF
1980	3 252 572 000	22	650	976 369 320	21
1981	3 609 975 000	22	635	819 494 993	21
1982	3 662 595 000	22	634	723 893 681	20
1983	3 745 392 000	22	493	531 076 726	20
1984	3 751 427 000	22	407	530 575 600	20
1985	4 487 166 000	22	328	556 307 592	20
1986	5 633 311 000	22	232	509 354 043	20
1987	6 480 351 000	23	307	343 026 493	20
1988	6 694 153 000	23	489	432 301 859	20
1989	6 553 432 000	23	512	492 392 244	20
1990	6 904 821 000	23	409	535 621 843	20
1991	6 958 490 000	23	410	337 381 403	20
1992	6 700 066 000	23	376	358 984 416	20
1993	6 477 912 000	23	378	462 181 185	20
1994	6 808 523 000	23	411	216 290 714	19
1995	6 957 805 000	23	417	633 305 616	20
1996	7 060 060 000	23	383	458 825 534	20
1997	6 659 844 000	23	445	615 240 218	20
1998	6 870 439 000	23	356	566 736 824	20
1999	5 953 053 000	23	332	581 967 132	20
2000	5 811 476 000	22	342	624 970 555	20
2001	6 189 777 000	23	378	774 430 134	20
2002	6 674 671 000	23	377	919 626 480	21
2003	6 874 318 000	23	429	1 249 429 929	21
2004	7 540 235 000	23	530	1 549 546 027	21
2005	5 460 805 000	22	691	1 972 403 625	21
2006	2 375 621 000	22	1 030	2 820 541 503	22
2007	2 857 153 000	22	1 105	3 089 157 085	22
2008	3 079 658 000	22	1 369	3 748 742 713	22
2009	3 774 356 000	22	1 139	3 315 213 873	22
2010	4 384 218 000	22	1 463	4 833 132 516	22
2011	5 099 158 000	22	1 645	6 803 428 519	23
2012	5 849 018 000	22	1 735	6 120 808 968	23
2013	5 926 616 000	23	1 851	7 252 556 070	23
2014	7 539 909 000	23	1 738	8 416 695 488	23
2015	8 785 199 000	23	1 314	8 131 749 263	23