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The Impact of External Debt on Economic Growth in Zambia (2000-2015)
Cointegration And Granger Non-Causality Approach
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Abstract:
The thrust of this study was to analyse the impact of external debt on Zambia's economic growth using a Vector Autoregressive approach (VAR). The study used annual time series data covering the period 2000 to 2015 on the following variables: Economic growth (proxied as Real Gross Domestic Product), capital (proxied as Gross Fixed Capital Formation), labour force and external debt. Results from the analysis confirm a long-run negative relationship between external debt and economic growth. The Toda-Yamamoto Granger causality tests revealed the existence of unidirectional causality running from external debt to economic growth. This result indicates that for Zambia, external borrowing has had an influence on the country's Gross Domestic Product (GDP). Thus, the results further confirm the presence of debt overhang in Zambia.

In this regard, effective debt management policies and strategies aimed at reducing the cost and risks associated with external debt are a must for ensuring a sustainable path of external debt to promote economic growth. There is need for government to put in place a public debt law to ratify any borrowings requirements. This will help in ensuring that all borrowings by government are targeted towards financing of projects that have a high return which would result in crowding in of private investments as well as ensuring fiscal sustainability.

Expansion of the tax revenue base will help ease the budget deficit which compels huge borrowing by governments both externally and internally.

On the other hand, the long run inverse relationship between real exchange rates with public debt and public debt service respectively, calls for Government to put in place a Medium-Term Debt Management Strategy to analyse the cost and risks inherent in the existing debt portfolio. This will help guide future borrowing strategies thus avoid exacerbating the existing debt burden to the detriment of economic growth.

***Key words**: Cointegration, Granger Causality, Public Debt, Economic Growth, Vector Error Correction Model*

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[1] INTRODUCTION

1.1 Background

Sustainable economic growth is a major concern for any sovereign nation most especially the Less Developed Countries (LDCs) which are characterized by low capital formation due to low levels of domestic savings and investment (Adepoju, Salau and Obayelu, 2007). It is expected that these LDC's when facing a scarcity of capital would resort to borrowing from external sources so as to supplement domestic saving (Aluko and Arowolo, 2010; Safdari and Mehrizi, 2011; Sulaiman and Azeez, 2011). Soludo (2003) asserted that countries borrow for two broad reasons; macroeconomic reason that is to finance higher level of consumption and investment or to finance transitory balance of payment deficit and avoid budget constraint so as to boost economic growth and reduce poverty. The constant need for governments to borrow in order to finance budget deficit has led to the creation of external debt (Osinubi and Olaleru, 2006).

Public debt is an important means of bridging Government financing gap especially for low-income Countries like Zambia. Notwithstanding this fact, public debt can however be viewed as a doubled-edged sword. For instance, effective and efficient utilization of public debt can increase economic growth and help a Government to achieve its social and economic objectives. Theoretically, financing developmental related projects through debt can help a country to build its production capacity and facilitate economic growth (Cohen, 1993). A further argument is that borrowing from external sources enables a Country to finance capital formation not only by mobilizing domestic savings but also by tapping into foreign capital surplus. Based on this argument, an analysis carried out by Siddiqui (2002) found that foreign borrowing increased resource availability and contributed to economic growth in South Asia. On the other hand, excessive reliance on public debt and inappropriate public debt management and strategies can increase macroeconomic risks and hamper economic growth. Even with concessional flows of loans, high public debt calls for increased revenues to service debt and this certainly has social, economic and political implication in the absence of a broad tax revenue base. As a result, the Government is left with no other alternative but to cut allocations for other public spending that can have positive externalities on economic growth (Isa A, 2004).

Links between economic performance and public debt can be observed through the effect that a fiscal deficit has on investments. And this can be explained through the 'debt overhang' and 'crowding out' effects. According to theoretical arguments, huge fiscal deficit results in increased borrowing by the Government which then constrains capital resources and pushes up the cost of capital through high interest rates. And if there is some likelihood that in future, the debt will be larger than the Country's repayment ability, expected debt-service costs will discourage further domestic and foreign investment (Krugman, 1988). A high debt burden also encourages capital flight, through creating risks of devaluation in order to protect the 'real' value of financial assets. The outturn of this capital flight is a reduction in domestic savings and investment which ultimately results in reduced tax base, thereby affecting the Government's capacity to service debt (Alberto & Tabellini, 1989).

In the light of the above, this dissertation employed Country specific time-series observations to investigate the impact of public debt (a composition of both external and internal borrowing by Central Government) on economic growth in Zambia from 2000 to 2015. Imperatively, a situation analysis of Zambia's public debt covering the above indicated period was undertaken to guide statement of the problem for this particular study.

1.2 Statements of the problem

A number of empirical studies undertaken in this area show that in the long run and beyond a certain threshold, public debt would exert negatively on economic growth and such conclusion are consistent with the debt overhang theories advanced by the neoclassical economists. In the case of Zambia, public debt over the period of analysis depicts a rising trend and, in some periods, has been recorded to be above GDP. The rise has been attributed by continuous borrowing by Government, both external and internal to finance its budget deficit as it aspires to achieve its development agenda defined in the National Development Plans (NDP). Therefore, the Country is not precluded from the implication of a rising public debt stock and this has necessitated the need for an empirical analysis of the above phenomenon in Zambia.

1.3 Objectives of the project

The aim of this study is to investigate the impact of Zambia's increasing public debt stock on economic growth. For policy implication, the proposed study will also analyse the impact of public debt on the determinants of economic growth rate namely, public & private investments and domestic savings.

Specific Objectives

The specific objectives of this study are defined as follows;

[1] To determine the relationship between public debt and real economic growth.

[2] To determine the impact of public debt on:

- a) Private investments;
- b) Public investments;
- c) Domestic savings; and
- d) Public Debt Service.

1.4 Theoretical Framework / Model

Conventional view of public debt based on the neoclassical setting informed theoretical literature analysis in this study. According to the neoclassical theories, the growth models are augmented with variables depicting issuance of debt to finance government expenditure which include both consumption and capital goods (Adam & Bevan, 2005; Cohen, 1993; Elmendorf and Mankiw, 1999; Diamond, 1965; Solow, 1956). Analysis of such models tends to depict a negative relationship between public debt and economic growth. The argument for this conclusion is well explained using the crowding in/out and debt overhang hypotheses as some empirical studies have done (Fosu, 1996; Green, 1991; Savvides, 1992; Cordella et al, 2005). The theoretical arguments of crowding in/out and debt overhang effects of public debts are thus discussed as follows.

2.2 CROWDING IN OR OUT HYPOTHESIS

Mostly, Government mobilises debt resources to undertake huge capital investment projects. To the extent that debt is being used to finance these projects, the net effect of this budget deficit will depend on whether it's crowding in or crowding out private investment.

2.2.1 Crowding in Hypothesis

Crowding in effect can be viewed as an attempt by Government to increase private sector investment through undertaking of capital projects such as roads infrastructure, hydro-power, education or health care facilities which ultimately reduce the marginal cost of producing one unit of output for the private sector (Piana, 2001). This entails that huge Government spending directed towards production of capital goods can potentially increase the stock of public capital investment and thus crowd in private sector participation. Undertaking such projects

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would require Government to issue debt instrument (domestic or/and foreign) or raise taxes.

2.2.2 Crowding Out Hypothesis

According to Elmendorf and Mankiw (1999), public debt contracted to finance the budget deficit is a primary source of crowding out private investments. The implication of huge borrowings by the Government is an increase in interest rates. The increase in interest rates may reduce or crowd out private-sector investments in plants and equipment. This decline in investment means that the overall economy has a smaller capital stock with which to work, which then decreases future growth rates.

A further argument advanced by Elmendorf and Mankiw (1999) is the effect of a budget deficit on savings accumulation. An increased flow of Government borrowing can result in distortionary tax measures which can incite dissaving behaviour among consumers and consequently raise interest rates. By implication, this reduces investible funds and raises the cost of capital through high interest rates. The result is a decline in private sector investments. Aschauer (1989) provides empirical evidence pointing out to budget deficit as the primary source for crowding-out private investments as advanced above by the two scholars.

2.3 DEBT OVERHANG HYPOTHESIS

The adverse effect of public debt stock on economic growth has largely been explained by debt overhang hypothesis. Krugman (1988) thus defines debt overhang as a situation in which investments are reduced or postponed since the private sector anticipates that the returns from their investment will serve to pay back creditors. Implying that, the expected future public debt service of a country is likely to be an increasing function of the Country's output level. Therefore, huge accumulation of public debt stock creates uncertainty behaviour among investors on the actions and policies that the Government will adopt to meet its debt service obligations. In this regard, Krugman (1988) contends that most potential investors will assume that Government will finance its debt service obligations through distortionary tax measures, thus they will adopt a wait and see attitude which will affect private investments and therefore economic growth.

Empirical evidence to support the above theoretical arguments advanced by Krugman (1988) can be found in studies undertaken by various scholar namely; Greene and Villanueva (1991); Levy and Chaudhary (1993); Elbadawi, Ndulu, and Ndungu (1997); Deshpande (1990); Fosu (1996); Chowdhury (2001); Syed et al (2010) and Isu (2010. Theoretically, it is also argued that a high level of public debt can have adverse consequences on the macroeconomic stability, discouraging capital inflows while favoring capital flight (Alberto & Tabellini, 1989; Cerra, Meenakshi, & Saxena, 2008).

Focusing on the interaction effects of deficits and debt stocks, Adam & Bevan (2005) argue that a high debt stock exacerbates the adverse consequences of high deficits. Using a simple theoretical model integrating the Government budget constraint and debt financing, the study found that an increase in productive Government expenditure, financed out of a rise in the tax rate, will be growth-enhancing only if the level of public debt is sufficiently low

1.5 Literature Review

Choice and application of methodology in econometric analysis relating to time series data and the objective of the study is of particular importance. Notable estimation techniques employed in the analysis of growth effects of debt include, the Ordinary Least Squares (OLS), Instrumental Variables & Generalised Methods of Moments and the Vector Auto-Regressive (VAR) framework. The

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methodologies cited here have their own weaknesses and strength when it comes to choosing the appropriate model especially for studies like this one. An in-depth understanding of the estimation technique to guide this research was therefore important. The discussion of the above cited estimation techniques is presented below.

2.4.1 Generalised Methods of Moments

The Generalised Method of Moment (GMM) estimation technique for public debt has increasingly gained leverage over other techniques especially in recent studies undertaken to model public debt and economic growth. As argued by Arellano and Bond (1991), the advantage of GMM lies in its robustness to standard errors. The use of instrumental variables also helps to reduce the endogeneity effects of regressors, particularly the debt and growth variables. GMM is also able to capture biases associated with observed Country specific effects in the case of panel or cross section data, hence the relaxation of the heteroskedasticity assumption (Pattillo, 2002). However, a limitation of GMM as advanced by Reinhart and Rogoff (2010) lies in the failure of the methodology to identify the direction of causality given the existence of feedback effects between the debt variable with other macroeconomic variables. This methodology is however more advantageous to studies relating to panel or cross section data.

2.4.2 Ordinary Least Squares Estimation Techniques

Macroeconomic data relate itself to time series which is either deterministic or stochastic leading to errors being correlated overtime and feedback effects or trending of data, all which can result in biased estimates of standard errors and coefficients, which Engle and Granger (1987) referred to as “spurious regression results”. Therefore, the dynamic structure of time series models makes the Ordinary Least Squares (OLS) estimator upwards biased and inconsistent. This is because the lagged level of depended variable is correlated with the error term. Nickel (1981) argues that the within transformation of the model under OLS does not solve the problem unless you include instrumental variables. A further limitation of traditional OLS according Sachs (1989), EL-Mahdy (2009) and Omotoye et al. (2006), lies in the failure of the technique to capture both short-run and long-run dynamics of the macroeconomic variables in a specified model.

2.4.3 Vector Autoregressive Regression (VAR) Framework

Time series properties are dynamic by their nature as alluded to by Enders (1995). In this respect, analysis of time series data requires application of the methodology that take into account the inherent setback (i.e. trending of data, the feedback effects between past and present values, and the stochastic behaviour of data). According to Johansen (1988), the VAR framework has an advantage over other alternative estimators when modelling time series data especially macroeconomic variables. In this respect, El-Mahdy (2009) advanced that the appropriate approach to explaining the growth effects of public debt is by employing a VAR framework. This is because the framework is able to capture both the short-run and long-run effects of public debt on economic growth. And on the basis of the short-run and long-run trajectory, informed policy decision can be inferred.

2.5 Analysis of Empirical Studies

There are a lot of empirical studies on growth effects of public debt. Though, most of the studies in this area generally deal exclusively with either public external debt or public domestic debt. Inferring to empirical literature, most of the studies on public external debt have been a reaction to the two waves of (external) debt crisis, the first affecting several Latin-American Countries in the 1980s (Green and Villanueva, 1991; Savvides, 1992), and the second concerning the debt relief policies which targeted a number of heavily indebted and poor Countries (HIPC) including Zambia. These studies include among others "Debt Relief Initiatives, Policy Design and Outcomes" by Arnone and Presbitero (2010) and "Debt Overhang or Debt Irrelevance" by Cordella, Ricci and Ruiz-Arranz (2005). Studies focusing on either domestic debt or total public debt investigating the effects of public debt on economic growth have also been undertaken.

Studies investigating growth effects of debt would focus either on cross section analysis or Country specific. In this study, empirical review is done to help in the selection of an appropriate methodology to be employed and also appreciate how variables of interest have been measured. A further reason justifying empirical review is to see how estimated results support theoretical arguments about debt and growth. Empirical literature was therefore analysed according to specific grouping.

2.5.1 Cross Section or Panel Studies

Most studies undertaken at cross Country level have mainly applied the GMM technique utilizing panel data. As discussed earlier, most argument for using this methodology lies in its robustness to standard errors and ability to capture Country specific effects. Most results under GMM techniques analysing the impact of public debt (domestic or external debt) on economic growth have been consistent with theory.

For instance, Pottillo et al (2002) analyzed the consequences of debt on economic growth. The analysis covers 93 Countries covering the time period 1968 to 1998. Armone and Presbitero (2007) using a data set covering 121 countries over a period 1980-2004 also investigated the relationship between external indebtedness and economic growth, with particular attention to LICs, for which the theoretical arguments of debt overhang and liquidity constraint were considered.

In the two studies analysed above, it was noted that in the short-run, external debt has a positive impact on economic growth while in the long-run and above a certain threshold, debt exerts negatively on economic growth. Particularly, Pattillo et al (2002) concludes that lofty burden of debt hampers economic growth, mainly due to decline in the efficiency of investment and not because of the volume of debt. The negative and linear relationship between past values of the NPV of public external debt and current economic growth was supported by a study done by Armone and Presbitero (2007). He argued that the outcome of the study was due to the "extended debt overhang", where it was argued that a large indebtedness leads to misallocation of capital and discourage long-term investment and structural reforms.

Abbas and Christensen (2010) also complement the vast literature in this area but focusing on public domestic debt growth effects using a panel of low-income Countries and emerging markets. Applying GMM technique, the study shows that moderate levels of domestic debt have a positive contribution to GDP growth. He argued that the presence of developed financial markets, increased private savings, better institutions & political accountability and improved monetary policy mainly accounted for this outturn. He however concluded that in the long-run and when the stock of domestic debt becomes too large (above the 35 percent of bank deposits), its contribution to economic growth would be negative, because of inflationary pressures and crowding out of the private sector.

The application of Instrumental Variables (IV) in this methodology was able to minimise the endogeneity effect between public debt and

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economic growth. Engle and Granger (1987) asserts that most endogenous variables have feedback effects implying causality. However, the above studies and many that have applied GMM like Chrietensen, 2005; Schclarek, 2004; Maana et al, 2008; Checherita & Rother, 2010 did not detect the direction of causality which according to EL-Mahdy (2009) is important for policy guidance.

A cross Country study was also undertaken by Fosu (1996) to investigate the effects of public external debt on Sub-Saharan Africa using OLS estimation method. The study covered a time period 1970 to 1986. His findings were consistent with theory as the study reviewed that 33% reduction in growth was due to the debt burden effects.

Applying OLS estimation technique, a study was also done by Deshpande (1990) on 13 severely indebted Countries including Zambia, Venezuela, Sierra Leone, Philippines, Peru, Morocco, Mexico, Kenya, Honduras, Egypt, Ivory Coast, Argentina and Algeria. Data used covered a period 1971 to 1991. He concluded that in the short-run, investment showed a rising trend in all Countries but as debt accumulates a declining trend sets in.

Notwithstanding the above, the application of OLS to analyse time series data and in particular public debt and economic growth variables which are highly endogenous could render the result bias even though consistent to theory. (Engle and Granger,1987).

2.5.2 Country Specific Studies

At Country level, some of the studies reviewed in this area also showed consistent results to theory despite applying different methodology techniques. For instance, Syed et al (2010) employed OLS to analyse public debt and economic growth in Pakistan for a period 1972 to 2010. The study did allude to poor social economic conditions arising mainly due to huge public debt which stands to be over the GDP figure in Pakistan. The results in this study were in support of the neoclassical theoretical arguments on debt accumulation. Isa (2004) also applied the OLS technique using time series data to examine the impact of external debt on economic growth and public investment in Nigeria from 1970-2002. The debt service burden was said to impede the Country's rapid economic development and worsened the social problems. Service delivery by key institutions designed to mitigate the living condition of vulnerable groups were hampered by decaying infrastructure due to inadequate funding. By cutting down expenditure on social and economic infrastructure, the Government appears to have also constrained private sector investment and growth. He concluded that debt overhang was the major factor that contributed largely to the poor performance of Nigeria's economy during the period under review.

Cholifihani (2008) applied a production function model using a VEC to analyze the relationship between public debt and economic growth in Indonesia for the time period of 1980 to 2005. The study concluded that in the short run, the change in capital stock boost up economic growth but in the long run the debt service slowed down economic growth.

A vector error correction model was also employed by Isu et al (2010) to analyse the impact of public external debt on economic growth in Nigeria. Using the national identity framework, a negative long run relationship between external debt and growth was observed. The results were both significant and consistent with theory. The VEC based granger causality was also applied to detect the direction of causality. Uni-directional causality was found to run from external debt to public debt service while a bi-directional causality was found to be present between external debt and economic growth.

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In the case of Zambia, the study undertaken by Chikuba (2003) focused only on public external debt effects on growth from 1970 to 1999. The study concluded that there was crowding out of investment in Zambia due to the presence of debt overhang. The study applied the two-stage-least squares regression approach and OLS to estimate the growth and investment model respectively. The two-stage-least squares technique was applied to cater for endogeneity problem between the debt and growth variables. Like other studies so far analysed in this section, his results were valid and consistent with theoretical arguments, however the methodology did not state the direction of causation effect.

Not too many studies focusing on either public external or domestic debt have been undertaken in Zambia thus creating a gap in information especially for policy guidance.

Further, the study undertaken by Chikuba (2003) did not take into account the effects of public domestic debt on growth, despite being on the increase. This study has filled in this information gap by analyzing the short and long run economic growth effects of a rising public debt stock (both domestic and external public debt) in Zambia covering both the pre and post HIPC periods from 1980 to 2008. A further contribution by this study is the analysis of the short and long run impact of public debt on the empirical determinants of economic growth which is important for policy guidance.

2.5.3 Choosing Appropriate Methodology

To investigate the relationship between the debt variables and economic variables, various methods such as Ordinary Least Square (OLS); Engle-Granger Co-integration test and Johansen Maximum Likelihood Co-integration test specified under a VEC and GMM technique have been applied in econometric analysis.

As shown in the empirical literature discussed under Section 2.4.1 and 2.4.2, the OLS and GMM requires inclusion of Instrumental Variables to address the problem of endogeneity in time series data. Additionally, the GMM technique works very well with panel data. The Engel-granger co-integration test specified under a VECM only identifies a single co-integrating relation, among what might be many such relations, therefore cannot be used to estimate a model with multiple co-integrating relations. Since we are not using panel data and the variables being estimated in the two models are more than two, the application of GMM technique and Engle-Granger Co-integration test will not apply in this case. Equally, OLS estimation techniques, would not be appropriate given the challenges already discussed under Section 2.4.2 of this study.

Empirical studies that have applied GMM or OLS to analyse the growth effects of public debt as shown above have not indicated the direction of causality between the debt variable and economic growth which according to Erdal Karagol (2002) would be necessary to come up with targeted policy variables. In order to capture the feedback effects and come up with targeted policies to guide debt management in Zambia, this study applied the Johansen Maximum Likelihood Co-integration test specified under the Vector Error Correction Model to analyse the effects of public debt on economic growth. Further, the Johansen Maximum Likelihood is able to detect more than one Co-intergrating vectors as well as determine the short-run and long-run relationships between variables.

2.5.4 Underlying Weakness of the VEC Model

Notwithstanding the above, one of the weakness of the application of a VECM to estimate multivariable (i.e. “n” variables) parameters requires that all the

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"n" variables are jointly stationary. If after transformation, some variables are still non-stationary, and the model contains a mix of I (0) and I (1), then the application of the VECM for analysis will not be easy.

Additionary, application of a VECM based on a VAR Framework in econometric analysis relate to defining the appropriate number of lags of each variable in the model in relation to the sample size. According to Lütkepohl (1993), if many lagged parameters are included in the analysis when the sample size is small, it results in loss of data points and reduces Degrees of Freedom. By implication the power of the test statistics will be downward. If on the other hand, you don't include enough lag length, there will be serial correlation in the errors and the test results will be unbiased and inconsistent. Johansen (1991) and Gonzalo (1994) advanced that VAR order selection can affect proper inference about co-integrating vectors and rank.

In order to address the weakness alluded to above, selection of an appropriate lag order becomes paramount before carrying out the analysis and subjecting the model to diagnostic test to see if the model is well specified. On the basis of the Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hanna and Quinn Information Criteria (HQIC) and Schwartz Bayesian Information Criterion (SBIC), the study chose the lag length for the two models specified under the VAR in levels that minimizes the information criteria. The study also carried out diagnostic test to ascertain if the two models are well specified and has desired fit implying that they satisfy the BLUE assumptions (Gujarati, 1995). Chapter four (4) of this study explains in detail the econometric procedure that were followed to estimate the results.

2.5.5 Measurement of the Public Debt and Growth Variables

Most of the empirical studies reviewed under Section 2.5 have either employed real Gross Domestic Product (GDP) or per capita GDP to measure the growth variable while the public debt variable that is the stock of public debt or public debt service have been measured as ratios of GDP (Deshpande, 1990; Jayaraman et al, 2006; Syed, 2010; etc.). In this study, the growth variable is measured as real GDP while the stock of public debt and public debt service are used to measure the debt burden. Except for real GDP, all the variables employed are measured as ratios of real growth.

All the variables were deflated at 2005 constant local prices to remove the effects of inflation. The variables were specified in their natural logs to eliminate the effects of multicollinearity among explanatory variables according to Syed (2010).

[3] METHODOLOGY/RESEARCH DESIGN

Our interest is to analyse the relationship between public debt and economic growth in their short and long-run trajectory in Zambia. Therefore, application of traditional OLS on time series data that is either stochastic or deterministic (non-stationery data) to analyse our model would yield results that are spurious (Eagles & Granger, 1987). In this case, the regression analysis will apply the Vector Error Cointegration Model (VECM) specified under the VAR Framework.

3.2 MODEL SPECIFICATION

In terms of our model specification, the said research will specify two equations. The first equation will be used to explain the relationship between public debt and economic growth while the second equation will be used to explain the impact of a growing public debt on the determinants of economic growth.

ISSN: 3471-7102, ISBN: 978-9982-70-318-5

3.2.1 Analysis of the Relationship of Public Debt and Economic Growth

The first model will be specified according to the model employed by Isu (2010) who investigated the impact of external debt on Nigeria"s economic growth using an error correction approach. The study argued that a framework linking the various sectors of the economy was required to analyse effects of external debt on growth. As such the national income identity model augmented with a debt variable was employed in this study.

This study however, focuses on total public debt (both domestic and external public debt) as opposed to analysis of public external debt alone. The model is simplified further by excluding consumption and includes Foreign Direct Investment (FDI) to capture the effects of the external sector given a positive outlook in this sector. The model is therefore specified as follows:

$$Y_t = \beta_0 + \beta_1 L_t + \beta_2 Z_t + \mu_t \ldots\ldots\ldots\ldots (Eqn\ 1)$$

Where it is the time, *Y* is GDP in real terms, *L* is a vector of explanatory variables that have been empirically shown to be robust determinants of real growth, Z represents the stock of public debt-to-GDP ratio and μ is the error term which is assumed to have a zero mean and constant variance.

The mathematical model for the growth equation has been specified below and the expected direction of the relationship of each explanatory variable with Real GDP in the model is positive except for the public debt to GDP.

$$RGDP = f\left\{\overset{+}{GFCFGDP}, \overset{+}{FDIGDP}, \overset{+}{TGEGDP}, \overset{-}{PDGDP}\right\} \ldots\ldots\ldots\ldots (Eqn\ 2)$$

Where:

RGDP: Real GDP Growth

GFCFGDP: the ratio of Stock of Gross Fixed Capital Formation to Gross Domestic Product

FDIGDP: the ratio of Foreign Direct Investments to Gross Domestic Product

TGEGDP: the ratio of total Government Expenditure to Gross Domestic Product

PDGDP: the ratio of total Public Debt to Gross Domestic Product

3.2.2 Analysis of the Impact of Public Debt on the Determinants of Growth Rate of Real Gross Domestic Product

Theoretically, public debt does not affect growth directly but does so through variables that empirically determine growth namely public investment domestic savings, total factor productivity and human capital (Krugman, 1989; Elmendorf & Mankiw, 1999; Cohen, 1993). In analysing the public debt model, the study however focused on investment (disaggregated into private & public) and domestic savings. Specification of the public debt model below was informed by Syed (2010).

Save for the public debt service, all the explanatory variables in the equation shows a negative relationship with public debt as their excepted outcome. The mathematical equation with expected outcome relationship is specified as;

$$PDGDP = f\left\{\overset{-}{PGDFIGDP}, \overset{-}{GGDFIGDP}, \overset{-}{DSGDP}, \overset{-}{REER}, \overset{+}{PDSGDP}\right\} \ldots\ldots\ldots\ldots (Eqn\ 3)$$

Where:

PDGDP: the ratio of Public Debt Stock to Gross Domestic Product

PGDFIGDP: the ratio of Gross Domestic Fixed Investments (GDFI)-Private to Gross Domestic Product

GGDFIGDP: the ratio of Gross Domestic Fixed Investments (GDFI)-Public to Gross Domestic Product

DSGDP: the ratio of Domestic Savings to Gross Domestic Product

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REER: The Real Effective Exchange Rate
PDSGDP: the ratio of Public Debt Service to real GDP Growth
Using the VAR Framework, the two stochastic models of regression (the growth and the public debt models) cardinal in our regression analysis will therefore be specified as follows:

3.2.3 The Growth Equation

$$\ln RGDP = \delta_0 + \delta_1 \ln GFCFGDP + \delta_2 \ln FDIGDP + \delta_3 \ln TGEGDP + \delta_4 \ln PDGDP + \mu_t \ldots\ldots (Eqn\,4)$$

Where:

lnRGDP: the log of Real GDP Growth
lnGFCFGDP: the log of Stock of Gross Fixed Capital Formation to Gross Domestic Product
lnFDIGDP: the log of Foreign Direct Investments to Gross Domestic Product
lnTGEGDP: the log of total Government Expenditure to Gross Domestic Product
lnPDGDP: the log of total Public Debt to Gross Domestic Product
Following Johansen & Juselius (1992), the Vector Autoregressive (VAR) model for the multivariate cointegrating test for the growth model would be expressed by:

$$\ln RGDP_t = \delta_0 + \delta_1 \ln GFCFGDP_t + \delta_2 \ln FDIGDP_t + \delta_3 \ln TGEGDP_t + \delta_4 \ln PDGDP_t + \mu_t \ldots\ldots (Eqn$$

By taking the first-differencing the growth model can be written in its Vector Error Correction (VEC) form as:

$$\Delta \ln RGDP_t = \delta_1 \Delta \ln RGDP_{t-1} + \delta_2 \Delta \ln GFCFGDP_{t-1} + \delta_3 \Delta \ln FDIGDP_{t-1} + \delta_4 \Delta \ln TGEGDP_{t-1} + \delta_5 \Delta \ln PDGDP_{t-1} + \xi_{t-1} + \mu_t \ldots\ldots (Eqn\,6)$$

Where Δ is the difference operator and ξt-1 is the lagged value of the error correction term derived from the long-run cointegration relationship and is used to capture the short-run dynamics.

3.2.4 The Public Debt Equation

From the mathematical equation for the public debt model in equation (3), we specify our regression stochastic model in its log form as:

$$\ln PDGDP = \beta_0 + \beta_1 \ln PGDFIGDP + \beta_2 \ln GGDFIGDP + \beta_3 \ln DSGDP + \beta_4 \ln REER + \beta_5 \ln PDSGDP + \mu_t \ldots\ldots Eqn\,(7)$$

Where:
lnPDGDP: the log of Public Debt Stock to Gross Domestic Product
lnPGDFIGDP: the log of Gross Domestic Fixed Investments (GDFI)-Private to Gross Domestic Product
lnGGDFIGDP: the log of Gross Domestic Fixed Investments (GDFI)-Public to Gross Domestic Product
lnDSGDP: the log of Domestic Savings to Gross Domestic Product
lnREER: The Real Effective Exchange Rate
lnPDSGDP: the log of Public Debt Service to real GDP Growth
The multivariate co-integration approach advanced by Johansen will be based on the following VAR process:

$$\ln PDGDP_t = \beta_0 + \beta_1 \ln PGDFIGDP_t + \beta_2 \ln GGDFIGDP_t + \beta_3 \ln DSGDP_t + \beta_4 \ln REER_t + \beta_5 \ln PDSGDP_t + \mu_t \ldots\ldots (Eqn\,8)$$

In a Vector Error Correction form, equation (8) will now be rewritten as:

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$$\Delta InPDGDP_t = \beta_1 \Delta InPDGDP_{t-1} + \beta_2 \Delta InPGDFIGDP_{t-1} + \beta_3 \Delta InGGDFIGDP_{t-1} + \beta_4 \Delta InDSGDP_{t-1} + \beta_5 \Delta InREER_{t-1} + \beta_6 \Delta InPDSGDP_{t-1} + \xi_{t-1} + \mu_t \cdots\cdots\cdots (Eqn\ 9)$$

Where Δ is the difference operator and ξt-1 is the lagged value of the error correction term derived from the long-run co-integrating vector and is used to capture the short-run dynamics.

3.3 ECONOMETRIC PROCEDURES

3.3.1 Augmented Dick Fuller (ADF) Test of Unit Root

It is important to determine the characteristics of the individual series before conducting the co-integration analysis. This is important because in the absence of non-stationery of time series variables, the normal properties of t-statistics and measures such as R-squared break results, hence a problem. The econometric methodology applied will therefore begin by examining the rank of integration for the series of the dependent and explanatory variable in their natural log format using the Augmented Dickey-Fuller. Transforming of data in the natural logs allows for interpretation of results in their percentage term and possibly eliminates serial correlation and the problem of multicollinearity (Muoghalu & Ezirim, 2007; Syed, 2010). The regression equation for the ADF test of unit root can be written as follows:

$$\Delta Y_t = \alpha + \beta_t + \delta Y_{t-1} + \sum \delta_i \Delta Y_{t-1} + \mu_t \cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots (Eqn\ 10)$$

Where, the t symbol denotes time trend, Y is the variable in estimation procedure, μ represent the distributed random error tem with zero value of mean and constant variance. Assuming that μt is serially uncorrelated and using the AR(ρ) process, the hypothesis for the ADF test will be specified as follows;

H0: δ = 1 is the Null Hypothesis implying unit root, and

H1: δ < 1 is the Alternative Hypothesis implying stationery

The outcome of the above hypothesis test highlights the trend of the variables and therefore the modus operandi of estimation that will be applied in our model.

3.3.2 Cointegration Test

Long-run equilibrium analysis underlines the concept of cointegration of variables in a model which the study is trying to investigate between the debt variables and economic growth. To determine the long run relationship among the unit root variables, it is important to test empirically that the series are cointegrated. So far there are two major procedures to test for the existence of cointegration, namely, the Engle-Granger (1987) two step procedures and the Johansen Maximum Likelihood Estimation procedure. The Johansen MLE (1990) procedure is however preferred to the Engle-Granger methodology because it can estimate and test for the presence of multiple co-integrating vectors. Johansen procedure also allows for testing both restricted and unrestricted versions of co-integrating vector(s) and speed of adjustment parameters. On the basis of the existence of cointegration relationship between variables, a Vector Error Correction Mechanism (VECM) which according to Johansen (1990) avoids the arbitrary selection of endogenous and exogenous will be employed.

The Johansen approach involves two tests namely; the trace test (Trace) which is the likelihood ratio test for the hypothesis that there are at most “r” co-integrating vectors and the Maximum Eigen Value (Max-Eigen). The Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hanna and Quinn Information Criteria (HQIC) and Schwartz Bayesian Information Criterion (SBIC) will also be

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extended to determine the maximum lag order for the cointegration test. Equations 5 and 8 using the Johansen-Juselius approach for testing co-integration is specified as follows:

$$\Delta Y_t = \prod Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + \beta x_t + \mu_t \cdots\cdots\cdots\cdots\cdots\cdots (Eqn\ 11)$$

Where:

$$\prod = \sum_{i-1}^{p} A_j - 1 \quad \& \quad \Gamma_i = - \sum_{j-t+1}^{p} A_j$$

And:

Y_t is a K vector of non-stationery variables is a vector of deterministic variables

is a vector of white noises with zero mean and finite variance

The Π matrix represents the coefficient matrix Π to be estimated by the Johansen" method in unrestricted form and denotes the number of the cointegrating vectors. If Π has reduced rank $r < k$ where r and k denote the rank of Π and the number of variables constituting the long-run relationship, respectively, and two $\boldsymbol{k\ x\ r}$ matrices $(\boldsymbol{\alpha})$ $\boldsymbol{and}$ $(\boldsymbol{\beta})$ exists, each with rank r, such that $\boldsymbol{\Pi} = \boldsymbol{\alpha\beta'}$ $\boldsymbol{and}$ $\boldsymbol{\beta' y}$ is stationary. Thus "r" is called the cointegration rank and each column of $(\boldsymbol{\beta})$ is a cointegrating vector (representing a long-run relationship). The elements of the $(\boldsymbol{\alpha})$ matrix represent the adjustment or loading co-efficients, and indicate the speed of adjustment of the endogenous variables in response to any dis-equilibrating shocks, while the elements of the Γ matrices captures the short-run dynamic adjustments. Using the VECM approach we express equation 6 and 9 above as follows:

$$\Delta Y_t = \mu + \Gamma \Delta Y_{t-1} + \cdots\cdots + \Gamma_{k-1} \Delta Y_{t-k+1} - \prod \Delta\, Y_{t-1} + \mu_t \cdots\cdots\cdots\cdots (Eqn\ 12)$$

Where Γ is estimable parameters, Δ is a difference operator, and μt is a vector of impulses which represent the unanticipated movements in .

3.3.3 Reverse Causality and Endogeneity

Engel and Granger (1987) identify that if cointegration exists between two variables in the long-run then there must be either unidirectional or bi-directional granger causality between these two variables. The debt variables is argued to have a strong potential for endogeneity especially with respect to reverse causation where low or negative GDP growth rates are likely to induce issuance of more debt. While on the other hand, excessive debt hampers economic growth rate by impacting negatively on determinant of economic growth (Checherita & Rother, 2010). In this case, the granger causality analysis can identify whether two variables move one after the other or contemporaneously. When they move contemporaneously, one provides no information for characterizing the other. If "X causes Y", then changes in X should precede changes in Y. These feedback effects will be analysed by a Wald test using the chi-square statistics for joint significance of parameters or through the significance of the error term in its lag.

The hypotheses for testing granger non-causality for the two models are specified below:

Model I

1 RGDP does not Granger-cause other explanatory variables

2 Other explanatory variables do not Granger-cause RGDP

Model II

1 PDGDP does not Granger-cause other explanatory variables

2 Other explanatory variables do not Granger-cause PDGDP

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3.4 SAMPLE DATA

Data employed in this research cover the period 2000 to 2015. The World Development Indicators (WDI) provided invaluable statistical data for most of the macro-economic variables. There was a preference for statistical data from the WDI given the inconsistence of the data in Zambia from the main data sources namely Central Statistics Office under the Ministry of Finance and Bank of Zambia. The public debt statistical data was however obtained from the Ministry of Finance and Bank of Zambia.

In both sources of data, there were a number of limitations particularly relating to missing values for at least one or two variables though not for extended periods. Particularly, public debt service had missing values and based on the passed trends data had to be interpolated. The limitation of missing values is also mitigated given the fact that the time series of 1980 to 2008 for sample data is adequate enough to capture any data lapses if not for a long period and therefore suffices to give a true picture of how variables relate to each other overtime. This study also acknowledges the limitation relating to the sample size. Data particularly for domestic public debt and Gross Fixed Domestic Investment (GDFI) for both private and public was only available from 1980 while data for most of the macroeconomic indicators for 2009 to 2010 was not available at the time of writing this thesis hence the study was limited to only 29 observations over the period of study.

The challenge of using limited sample size is noteworthy in this study particularly when it comes to defining the lag order length. This affects the estimation of results when data points are lost and the Degree of Freedom is reduced as alluded to earlier due to inclusion of more lags or can result in errors being correlated if the appropriate lag order is not defined. The application of lag selection order criteria based on the Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hanna and Quinn Information Criteria (HQIC) and Schwartz Bayesian Information Criterion (SBIC) was critical to ensure that the appropriate lag length in the two models were used before estimating the results.

Notwithstanding the above, some of the studies reviewed in our literature that had applied similar methodology were able to obtain estimates that are consistent and unbiased. Studies that have analyzed the growth effect of debt using small sample size include among many others; Chikuba (2003) who used a sample size of 30, Jayaraman, (2006) utilised a sample size of 35, El-Mahdy (2009) utilised 25 observations and Isu (2010) employed a sample size of 31. The unbiased and consistent results obtained in the studies referred to above gave compelling reasons to believe that the results of this study would be expected to be unbiased and consistent

[4] RESULTS AND DISCUSSION

3.1. Results / Research findings

4.1.1 Growth Model

A statistical analysis of the raw data employed in our analysis showed an in-built trend on some of the important variables. For instance, an upward trend is depicted in RGDP variable from 2000 upwards. This is indicative of the positive growth averaging 5.4% recorded in the economy and largely attributed by the irrevocable debt relief extended to Zambia under the MDRI and HIPC Initiative. A further augmenting factor in the growth is the inflow of Foreign Direct Investment especially in the mining sector following the privatization reforms that were embarked upon in 1991. Government expenditure (TGEGDP) on the other

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hand has an upward trend indicating a positive influence on economic growth especially if a bigger part of it is spent on capital goods, which is argued to crowd-in private investment.

The ratio of Public debt-to-GDP (PDGDP) also depicts a geometric increase reaching a record high in 2004. During this period the Country experienced a debt crisis that greatly impacted negatively on the economic growth of the Country. The period was also characterized by macro-economic instability and sometimes recording negative growth with high inflation rates as alluded to earlier in the study. Following the debt relief in 2005, PDGDP experienced a geometric reduction. In this regard, a downward trend continued to characterize the ratio of public debt-to-GDP but only for a short period from 2005 to 2007 after which the variable is depicted to rise again.

The ratio of PDGDP and the RGDP variables in their log form are presented in Figures 5 and 6 below

Figure 5: Zambia's Public Debt to GDP from 2000-2015

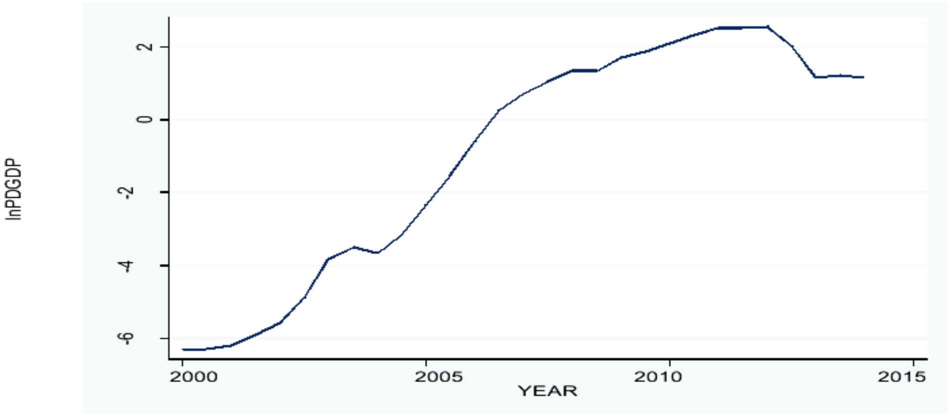
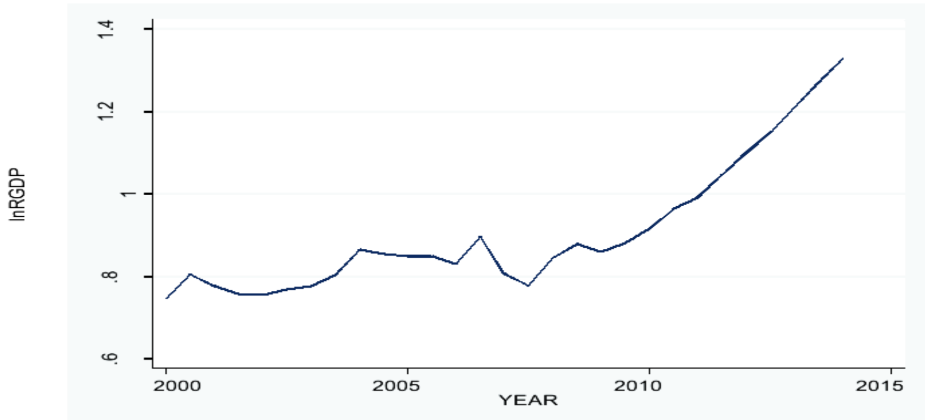


Figure 6: Zambia's RGDP from 2000-2015



The result of the summary of descriptive statistics of the variables used in our growth model is given in Table 2 below;

Table 2: Summary of Descriptive Statistics of Variables for the Growth Model

Variables	Obs	Mean	Std. Dev	Min	Max
RGDP	29	2.513728	0.4467722	2.106976	3.772799
GFCFGDP	29	0.1523427	0.0518245	0.066013	0.241805

FDIGDP	29	0.0408966	0.0291343	0.0063	0.116
TGEGDP	29	0.1832891	0.0618514	0.080431	0.304489
PDGDP	29	3.442557	4.21639	0.001776	12.76713

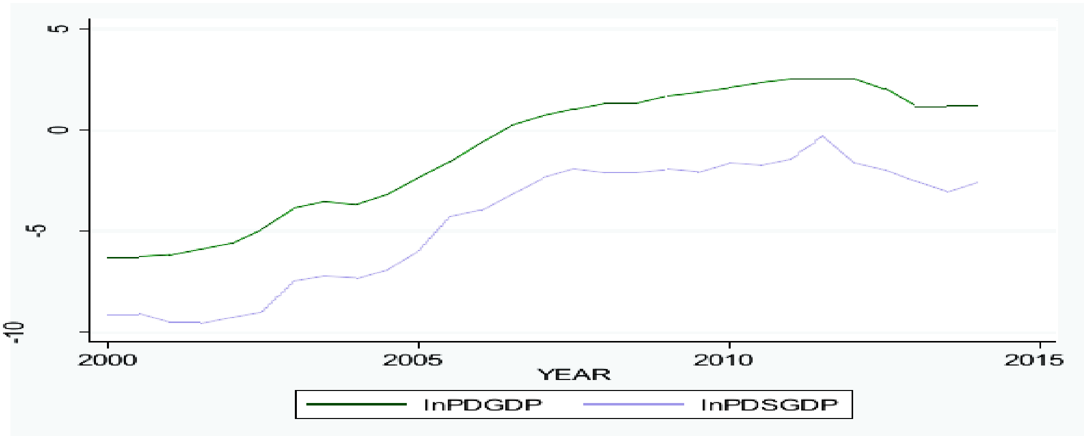
PUBLIC DEBT BURDEN ON THE EMPIRICAL DETERMINANT OF ECONOMIC GROWTH

4.2.1 The Public Debt Model

A statistical analysis of the data employed in this model reveals that there is an in-built trend in the ratio of Public Investment-to-GDP (GGDFIGDP) and Real Effective Exchange Rates (REER). The ratio of GGDFIGDP shows fluctuations during the period under review. The ratio of Private Investment-to-GDP (PGDFIGDP) is characterized by a downward trend from 1980 to 2000 and an increase thereafter.

Plotting PDGDP and PDSGDP in their log form shows an upward trend of both variables indicating a positive relationship. This reinforcing relationship helps us to understand that as the stock of public debt increases, there is an increase in the principle and interest repayments. However, between the periods 2005 to 2008, there is a sharp decline in the public debt stock and public debt service. The decline in the debt burden is indicative of the positive benefits arising from the MDRI and HIPC Initiatives. Reviewing the period 2008 onwards, PDGGP is depicted with a rising trend and consequently an increase in the PDSGDP. The ratio of Public Debt Service-to-GDP in its log form is graphically presented in Figure 7 below while the rest of the variables are graphically presented in Appendix A and B.

Figure 7: ***Trends in lnPDGDP and lnPDSGDP: 2000-2015***



A summary of descriptive statistics for the public debt model is presented below in Table 3.

Variables	Obs	Mean	Std. Dev	Min	Max
PDGDP	29	3.442557	4.21639	0.001776	12.76713
PGDFIGDP	29	0.0954685	0.0482056	0.017474	0.215471
GGDFIGDP	29	0.068804	0.0237841	0.034687	0.108595
DSGDP	29	0.1638033	0.098561	0.006467	0.315096
REER	29	0.1054577	0.0275324	0.051365	0.179955
PDSGDP	29	0.0929989	0.1432759	0.00007	0.730282

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TESTING FOR UNIT ROOTS USING THE AUGMENTED DICK-FULLER (ADF) TEST

It is necessary to verify the stationarity properties of variables included prior to attempting a multivariate cointegration analysis. This is vital because econometric analysis of non-stationary variables affects the efficiency and consistency of estimation results (Granger, 1974). To determine the order of integration, ADF unit root test was carried out on levels and differences for variables used in both models. The null hypothesis underlying unit root testing is that the variable under investigation has a unit root and the alternative is that it does not (Dick and Fuller, 1979). The results of the unit root test for variables used in the analysis in their log form are reported in Table 4 below;

Variables in them log form	Levels Lag (0)	Lag (1)	Difference Lag (0)	Lag (1)
RGDP	0.161	0.076	-5.738*	-4.449*
GFCFGDP	-2.292	-2.321	-6.073*	-5.508***
FDIGDP	-5.565*	-4.006*	-8.316*	-6.408*
TGEGDP	-0.898	-1.742	-4.101*	-4.171**
PDGPD	-1.090	-0.513	-3.113**	-3.565***
PGDFIGDP	-2.732	-2.209	-7.645*	-4.975*
GGDFIGDP	-3.934**	-2.605	-8.150*	-5.530*
DSGDP	-3.052	-2.011	-7.380*	-4.481*
REER	-2.446	-2.900	-4.743*	-5.761*
PDSGDP	-0.248	-0.636	-4.257**	-3.443***

Asterisk (*), (**) & (***) indicate significance at 1%, 5% & 10% respectively

The ADF unit root test above show that at levels we cannot reject the null hypothesis of unit root for almost all the variables implying that they were non-stationary. FDIGDP and GGDFIGDP were nevertheless stationary at levels. However, the null hypothesis of unit root test applied to the variables in their first differences was rejected for all the variables showing that they were stationary and integrated of order one-1(I).

Inferring from the results in Table 4 above, we can conclude that all the variables are stationary at first differencing and are integrated of the same order, giving rise to the possibility of the existence of a long-run relationship among the variables. To identify the long-run relationship among the variables included in both models, Johasen (1988) multiple cointegration test was employed.

TEST FOR COINTEGRATION

Underlying a VAR framework is the lag order selection criteria which is done on the basis of Final Prediction Error (FPE), Akaike Information Criterion (AIC), Hanna and Quinn Information Criteria (HQIC) and Schwartz Bayesian Information Criterion (SBIC). According to Johasen (1988), the procedure for selecting the lag length entails choosing an optimal lag with the minimum value using the above four selection criteria. The lag length of three (3) passed this test for both models and was therefore selected.

4.4.1 Cointegration Test for the Growth Model

On the basis of the optimal lag length of three, the Johansen test for cointegration was applied to analyse the presence of cointegration in the growth model. Table 5 below gives the results of the cointegration test;

Table 5: Johansen Cointegration Test using Trace Statistics

Number of Cointegrating Vectors	Eigen Value	Trace Statistic	5% Critical Value
$r = 0$	.	86.5787**	68.52
$r \leq 1$	0.78115	47.0749**	47.21
$r \leq 2$	0.61874	22.0040	29.68
$r \leq 3$	0.47505	5.2484	15.41

Asterisks (**) denote acceptance of the H0: r ≤ 1 at 5% level of significance

Table 6: Johansen Cointegration Test using the Maximum Eigen Value Statistic

Number of Cointegrating Vectors	Eigen Value	Max-Eigen Statistic	5% Critical Value
$r = 0$	.	39.5038**	33.46
$r = 1$	0.863	25.0710**	27.07
$r = 2$	0.828	16.7556	20.97
$r = 3$	0.471	0.47505	14.07

Asterisks (**) denote acceptance of the H0: $r = 1$ at 5% level of significance

The results of the test of cointegration in Table 6 above signify maximum and trace test statistics and their associated critical values. These test statistics help evaluate the null hypothesis of r =0 against the general alternatives of r = 0, 1, 2, or 3. The test for rank of cointegration was carried out with the optimal lag length of 3 determined by the AIC SBIC and HQIC. At 5% critical values for both the maximum and trace test statistics, we fail to reject the null hypothesis of $r \leq 1$ which shows that the model has at least one cointegrating Vector. On the basis of the above results, we thus conclude that a long-run relationship exists among RGDP, GFCFGDP, FDIGDP, TGEGDP and PDGDP.

A VECTOR ERROR CORRECTION FOR THE GROWTH MODEL

The VEC model enables us to measure not only the parameters of the cointegrating equations (β), but also the short-term adjustment parameters (α). The coefficient of the lagged error-correction term, according to (Miller & Russek, 1990) is the short-term adjustment coefficient that shows the speed at which the long-term disequilibrium in the dependent variable is being adjusted in each short-term period. Theoretically, it is expected that the error-correction term should have value between zero and one showing that the system has been brought back to equilibrium (Johansen & Juselius, 1992).

Accordingly, a VECM was conducted to estimate both models using Case IV (unrestricted intercepts and unrestricted linear trend and coefficients) of Johansen cointegration approach. The outcome of the empirical analysis for both the long-run and short run dynamics of the growth model are presented in the Tables 7 and 8 below respectively;

Table 7: Long Run Normalized Cointegration Equations for the Growth Model

Identifications: beta is exactly identified Johansen normalization restrictions imposed					
Beta (β)	Coef.	Std Err	Z	P>|z|	[95%Conf. interval]
lnRGDP			1		
lnGFCFGDP	-2.989969*	.2569012	-11.64	0.000	-.3.493486 -2.486452
lnFDIGDP	-2.158693*	.1657233	-13.03	0.000	-2.483505 -1.833882
lnTGEGDP	-1.292991*	.3781421	-3.42	0.001	.2025301 .3393352
lnPDGDP	0.2709326*	.0348999	7.76	0.000	.2025301 .3393352
_CONS -25.61727*					
Asterisks (*), (**) and (***) denote significance at 1%, 5% and 10% respectively					

Analysis of the Long-run Normalized Co-integration Equation for the Growth Model

Literature review showed that normalized co-integrating coefficients have been used to interpret the long-run elasticity of dependent and independent variables (Erdal, 2002; El-Mahdy, 2009; Isu, 2010). In this study, we normalize the co-integration with respect to the variables of interest so as to get better interpretation. Using the error correction results, the normalized cointegrating vector(β), for the growth model can be written as:

$$\hat{\beta} = \begin{bmatrix} 1 \\ -2.989969 \\ -2.158693 \\ -1.292991 \\ 0.2709326 \\ -25.61727 \end{bmatrix}$$

Thus, we formulate the long- run equation with respect to this model as follows;

$$InRGDP_t = 25.617\,27 + 2.989969InGFCFGDP_t + 2.158693InFDIGDP_t + 1.292991InTGEGDP_t - 0.2709326InPDGDP_t \cdots\cdots\cdots (Eqn\ 13)$$

The long-run equation above shows that GFCF, FDI, TGE are positively correlated with RGDP in the long-run while PDGDP and RGDP are negatively correlated. The outcome of the results in the growth model are statistically significant at all levels, thus supports the theory and our expected hypothesis.

Deriving from the estimated elasticises of these variables as contained in the long-run normalized vector, a 10% increase in GFCF, FDI and TGE would bring about an increase in RGDP by 29.8%, 21.5% and 12.9% respectively. According to theory, the negative relationship between RGDP and PDGDP suggests that a decline in RGDP of 2.7% is accounted for by a 10% increase in PDGDP.

Analysis of the Short-Run Co-integration Equation for the Growth Model

In order to study the short-run behaviour of each variable in response to the residual from the co-integrating equation in the growth model, the short-run model is imperative in this study. As noted by Johansen (1988), the ECT or co-efficient given by the short-run model measures the speed of adjustment of each variable in response to a deviation from the steady state equilibrium relationship. The results indicating the speed of adjustment are therefore presented in Table 8 below;

Table 8: Short Run Cointegration Equations for the Growth Model (Adjustment Parameters)

Alpha	Coef.	std. Err	Z	P>|z|	[95% Conf. Interval]
lnRGDP	-.0133579	.0121604	-1.10	0.272	-.0371919 -.0104761
lnGFCFGDP	.144915**	.0700197	2.07	0.038	.007679 .2821511
lnFDIGDP	.5521503**	.2480904	2.23	0.026	.065902 1.038399
lnTGEGDP	.0032135	.0708356	0.05	0.964	-1.1356218 .1420487
lnPDGDP	0.1512308	.1394814	1.08	0.278	-.1221478 .4246093

Asterisks (*), (**) and (***) denote significance at 1%, 5% and 10% respectively

From the vector error estimation results in Table 8 above, the short-run adjustment vector *(α)* for the growth model can be specified as follows:

$$\hat{\alpha} = \begin{bmatrix} -0.0133579 \\ 0.1449150 \\ 0.5521503 \\ 0.0321350 \\ 0.1512308 \end{bmatrix}$$

The short run model will be specified as follows:

$$\ln RGDP_t = 0.144915 \ln GFCFGDP_t + 0.55215 \ln FDIGDP_t + 0.03213 \ln TGEGDP_t$$

$$+0.15123 \ln PDGDP_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots . Eqn\ 14$$

The estimate of the coefficients on the adjustment matrix *(α)* helps to understand the co-movement of the variables in the short-run. The adjustment coefficients for the growth model are: -0.0133579, 0.144915, 0.5521503, 0.032135 and 0.1512308. This means that given any disequilibrium in the short-run the variables RGDP has 1.34%, GFCF (14.50%), FDI (55.21%), TGE (3.21%) and PDGDP (15.12%) speed of adjustment towards long-run equilibrium condition. By implication, this means that when the average level of RGDP is too high, it falls back towards the PDGD by 1.34%. Similarly, given any disequilibrium in the previous period PDGDP adjust itself upwards towards RGDP by 15.12%.

POST ESTIMATION DIAGNOSTIC TESTS

The post estimation tests to ascertain the validity and stability of the specified model in a VEC were carried out. This is important because inference on the results of the diagnostic test would help to see if the estimates of a VEC satisfy the BLUE assumptions implying that they have the minimum variance, unbiased, consistent, linear and normally distributed in class of all linear, unbiased estimators (Gujarati,1995). In this regard, the study carried out important diagnostic tests in order to ascertain if the models employed have a desired fit. The results of the diagnostic test are indicated in Tables 9 and 10 and Figure 8 below;

Test for Serial Correlation

Table 9: Lagrange Multiplier Test Results for the Growth Model

Lag	x^2	p-value
1	22.6178	0.59987
2	20.7232	0.70794
3	35.6771	0.07664**

Asterisks (**) denote acceptance of HO at 5% level of significance

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To ascertain that the residuals were not serially correlated, the Lagrange Multiplier (LM) test was employed. According to the test results the null hypothesis of no autocorrelation was not rejected at 5% level of significance and at the optimal lag length of 3.

Test for Normality of Residuals

Table 10: Jarque-Bera Test Results for the Growth Model

Equation	Jarque-Berra Statistic	p-value
ΔlnRGDP	0.287	0.86635*
ΔlnGFCFGDP	0.491	0.78248*
ΔlnFDIGDP	0.019	0.99051*
ΔlnTGEGDP	1.588	0.45211*
ΔlnPDGDP	1.557	0.45915*
ALL	3.941	0.94007*

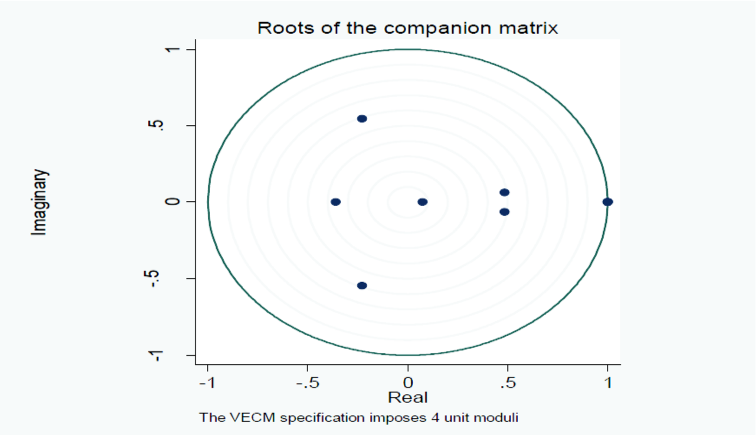
Asterisks (*) denote acceptance of HO at all levels of significance

To test for normality of residuals, the Jarque-Bera normality test was employed. The test showed that the null of independently and normally distributed errors was not rejected at all levels of significance.

Test for Stability of the Model

To ascertain that the specified growth model was stable, a VEC stability test was undertaken. Analysis of the results showed that 4-unit moduli were imposed with a value of unity (1) and the Eigen-values are strictly less than one. The VEC stability graph below also shows that none of the Eigen-values appear close to the unit circle. The stability check thus confirms that the Growth model is well specified.

Figure 8: Eigen Stability Test for the Growth Model



Note: the dots represent the eigen-values that do not appear close to the unit circle

Overall results of the three most important diagnostic test indicate that the growth model employed in this study have the desired fit and is well specified.

ESTIMATES OF A VECTOR ERROR CORRECTION FOR THE GROWTH MODEL

According to Engle and Granger (1987), if two series are co-integrated of order one, *i.e.* I (1), then there must exists VECM representation in order to govern joint behaviour of the series of the dynamic system. In a VECM specification, short run as well as long run adjustments are made. VECM also provides information

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about the causal factors that may affect variables. Pre-requisites for the application of a VECM is that, all variables must be integrated of the same order and then there should exist at least one co-integrating relationship among the variables. A VECM was estimated without restrictions and results of the VEC estimates for the growth model are presented in Table 11 below;

Table 11: Estimates of a Vector Error Correction Model

EQNS:	InRGDP	lnGFCFGDP	lnFDIGDP	lnTGEGDP	lnPDGDP
Constant	0.264** (0.014)	-0.090 (0.081)	-0.035 (0.290)	0.046 (0.082)	0.216 (0.163)
Δ(lnRGDP)t-1	0.169 (0.297)	-1.017 (1.710)	1.290 (0.989)	1.308 (1.730)	-1.231*** (3.407)
Δ(lnRGDP)t-2	-0.213 (0.239)	2.505*** (1.380)	3.837 (4.890)	-1.512 (1.396)	-0.438 (2.749)
Δ(lnGFCFGDP)t-1	-0.065 (0.048)	0.260 (0.233)	1.442 (0.989)	-0.137 (0.282)	0.483 (0.556)
Δ(lnGFCFGDP) t-2	-0.029 (0.040)	0.386*** (0.233)	0.105 (0.829)	0.164 (0.236)	0.227 (0.466)
Δ(lnFDIGDP)t-1	-0.014 (0.018)	0.171 (0.108)	-0.121 (0.383)	0.172 (0.109)	0.072 (0.215)
Δ(lnFDIGDP)t-2	-0.019 (0.015)	0.011 (0.085)	-0.149 (0.302)	0.151*** (0.086)	-0.001 (0.170)
Δ(lnTGEGDP)t-1	0.080*** (0.049)	0.185 (0.285)	-0.071 (1.010)	0.581** (0.288)	-.299 (0.576)
Δ(lnTGEGDP)t-2	0.013 (0.053)	0.196 (0.307)	0.262 (1.088)	-0.517** (0.310)	-0.050 (0.612)
Δ(lnPDGDP)t-1	-0.028 (0.029)	-0.002 (0.171)	-0.136 (0.607)	0.175 (0.173)	-0.732** (0.341)
Δ(lnPDGDP)t-2	0.040 (0.036)	-0.118 (0.209)	0.817 (0.740)	-0.045 (0.211)	-0.654 (0.416)
(ECT1) t-1	-0.013** (0.012)	0.144** (0.070)	0.552** (0.248)	0.032 (0.070)	0.151 (0.139)
R2	0.663	0.510	0.6263	0.5932	0.6863

Asterisks (*), (**) and (***) denote significance at 1%, 5% and 10% respectively

In the table above, Δ is the first difference operator and "ECTt-1" is the lagged error correction term. R2 indicates the goodness of fit and measures how much of the variations between the dependent and independent variables have been explained by the model (Gujarati, 1995). The term ECTt-1 shows the degree of disequilibrium level of the variables in the previous period. Thus, above specification of the VECM states that change in a variable depends on other variables, on its own past values as well as on the degree of disequilibrium among the variables. The VEC specification above has five equations explaining the short-run and long-run dynamics in the growth model. In order to have a stable long-run equilibrium path, the ECT in its lag form should be negative and statistically significant (Johansen, 1988).

Analysis of the results in Table 11 indicates that equation 1 has a stable long-run relationship between RGDP and the explanatory variables since the ECTt-1 carried the correct sign and was statistically significant at 5%

level of significance. The results from equation 1 also affirm absence of no short-run relationship except for past values of TGEGDP which exhibited a significant short-run relationship with RGDP at 10% level of significance. The inverse relationship between our variables of interest RGDP and PDGDP supports theoretical argument that in the long-run, growth effects of public debt on economic growth are negative (Mankiw, 1956). However, the coefficient of ECTt-1 is given by -0.013 showing a very low speed of adjustment towards long-run equilibrium. This indicates that given any disturbance in the system in the long-run, in every short period only 1.3% correction to equilibrium would take place.

In the case of equation 2, the coefficient of ECTt-1 for gross fixed capital formation was statistically significant but it carried a positive sign which indicated that in case of any disturbance there would be divergence from the equilibrium making the whole system helpless in achieving equilibrium position. In the case of short-run relationship, it is indicated that gross fixed capital formation exhibits a positive relationship with its passed values and Real GDP at 10% level of significance respectively. The equation shows that 51% of the variations between the dependent variables and regressors are explained.

The ECT for equation 3 is also significant but has a positive sign and thus does not warrant stability of the whole system of equation in case of any disequilibrium. No short-run relationship is deduced between Foreign Direct Investment and its determinants. The equation shows that 63% of the variations between the dependent variables and regressors in equation 3 have been explained.

Equation 4 and 5 does not indicate any long-run relationship between variables as the error terms are not statistically significant and do not carry the expected negative signs. However, total Government expenditure in equation 4 has shown to have significant positive relationship with its passed values and foreign direct investment respectively at their level of significance. In equation 5, the coefficient of Real GDP and public debt in the previous period are statistically significant at 10% and 5% level of significance indicating a significant impact on public debt in the short- run. R2 of 59% and 69% for equation 4 and 5 respectively explains how much of the variations between the dependent and independent variables have been explained.

4.8 VECM BASED GRANGER CAUSALITY TEST FOR THE GROWTH MODEL

Eagle and Granger (1988) states that if two variables are stationary of order one and co-integrated, then either the first variable granger cause the second variable or the second variable granger cause the first variable. In this study, multivariate granger causality test based on a VECM is utilized in order to capture all possible channels of the causality among variables. The causality between dependent and independent variables was informed by conducting a Wald test, that is, by calculating the $\Sigma\chi2$ based on the null hypothesis that a set of coefficients on the lagged values of the independent variables are equal zero. By adding the error correction term in a VECM, it provides an additional channel for long-run causality which is ignored in a standard Granger non-causality test. Long-run causality is confirmed through the significance of the coefficient of lagged error term and short-run causality is confirmed through the joint significance of coefficients of lagged variables as well as the overall significance of $\chi2$. The VECM based granger non-causality results are presented in Table 12 below;

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Table 12: VEC Granger Non-Causality Test Results for the Growth Model

Null Hypothesis: Independent Variable (X) does not Granger Cause Y	Dependent Variable(Y)	Chi2	Prob>chi2	Decision for the Null
lnGFCFGDP	lnRGDP	1.90***	0.0386	Rejected
lnFDIGDP	lnRGDP	1.71	0.4254	Cannot be Rejected
lnTGEGDP	lnRGDP	4.76***	0.0926	Rejected
lnPDGDP	lnRGDP	1.62	0.4451	Cannot be rejected
ALL	lnRGDP	15.16***	0.0164	Rejected
	ECTt-1	1.21**	0.0272	Rejected
lnRGDP	lnGFCFGDP	3.69**	0.1584	Rejected
lnFDIGDP	lnGFCFGDP	3.92	0.2380	Cannot be rejected
lnTGEGDP	lnGFCFGDP	1.97**	0.1409	Rejected
lnPDGDP	lnGFCFGDP	0.38**	0.8287	Rejected
ALL	lnGFCFGDP	10.50***	0.3975	Rejected
	ECTt-1	4.28**	0.0385	Rejected
lnRGDP	lnFDIGDP	0.66	0.7204	Cannot be rejected
lnGFCFGDP	lnFDIGDP	2.29	0.3179	Cannot be rejected
lnTGEGDP	lnFDIGDP	0.07	0.8850	Cannot be rejected
lnPDGDP	lnFDIGDP	1.67	0.9680	Cannot be rejected
ALL	lnFDIGDP	7.93	0.6352	Cannot be rejected
	ECTt-1	4.95**	O.0260	Rejected
lnRGDP	lnTGEGDP	1.77*	1.4124	Rejected
lnGFCFGDP	lnTGEGDP	0.55	0.7595	Cannot be rejected
lnFDIGDP	lnTGEGDP	3.40	0.1829	Cannot be rejected
lnPDGDP	lnTGEGDP	1.42***	0.4918	Rejected
ALL	ALL	18.65*	0.0449	Rejected
	ECTt-1	0.00	0.9638	Rejected
lnRGDP	lnPDGDP	0.15***	0.9258	Rejected
lnGFCFGDP	lnPDGDP	0.80***	0.6715	Rejected
lnFDIGDP	lnPDGDP	0.20	0.9038	Cannot be rejected
lnTGEGDP	lnPDGDP	0.50**	0.7780	Rejected
ALL	lnPDGDP	11.79	0.2994	Cannot be rejected
	ECTt-1	1.18***	0.2783	Rejected

*Asterisk *(**) *** indicates rejection of H0 at 1%, 5% and 10% respectively*

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The equation of Real GDP in equation 1 indicates that gross fixed capital formation and Government expenditure individually granger cause Real GDP in the short-run at 10% level of significance while long-run granger causality running from Real GDP to other variables in the equation has been indicated to exist at 1% level of significance. All variables are said to jointly granger cause Real GDP in the short-run.

Equation 2, long-run causality of variables is indicated at 5% level of significance while in the short-run all variables except foreign direct investment are said to granger cause gross fixed capital formation. The cause effects of Government expenditure on gross fixed capital formation could indicate that significant expenditure by Government is channelled toward education and health resulting in Human Capital Development (HCD), which according to Solow (1956) is an important component of capital formation. The causal effect of public debt on gross fixed capital formation in the short-run was also empirically confirmed by Cholifihani (2008) in a study done on Pakistan. This outcome also supports theoretical argument that in the short-run public debt if channelled to productive sector would contribute to accumulation of capital stock. All variables are however said to jointly granger cause gross fixed capital formation in the short-run.

The third equation shows that all variables do not granger cause Foreign Direct Investment. The significance of the ECTt-1 at 5% level of significance does however indicate the long-run causality from foreign direct investment to other variables in the equation. In the fourth equation, Public Debt and Real GDP have shown to granger cause Government expenditure in the short-run. On the overall, all variables are said to jointly granger cause Government Expenditure in the short-run. The equation however does not exhibit any long-run causality effects for the fourth equation.

The last equation informs existence of long-run causality of variables given that the ECTt-1 is statistically significant at 10% level of significance. In the short-run, only Real GDP, Gross Fixed Capital Formation and Government Expenditure have shown to statistically granger cause Public Debt.

4.8.1 Analysis of Direction of Granger Causality in the Growth Model

In the case of uni-direction granger causality, Real GDP is said to granger cause Public Debt in the short-run. Granger causality in the short-run is also indicated to run from Government Expenditure to Gross Fixed Capital Formation. Given the direction of causality in this case and the outcome of the relationships of these variables in the model, Real GDP and Government Expenditure would then be our target variables to guide policy decision.

Gross Fixed Capital Formation is said to exhibit bi-granger causality with Real GDP and Public Debt in the short-run respectively. This outcome is also supported by the positive relationship between Public Debt and Gross Fixed Capital Formation shown in equation 13 above. Government Expenditure and Public Debt have also shown to granger cause each other. And by implication, this shows that borrowing has been an important component of GRZ‟s budget to finance the deficit. To the extent that this will contribute to economic growth will largely depend on how Government utilises the debt component within the budget.

4.9 Summary of Results for The Growth Model

The overall results of the Growth Model confirm our earlier expectation of long-run negative effect of Public Debt on growth and supports the theoretical argument given by the neoclassical economists. The estimates of the normalised long-run equation were also statistically significant thus fulfilling the objective of this

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study to guide policy decision. The long-run inverse relationship and the presence of feedback effects from Real GDP to Public Debt informs the negative effect that the accumulative stock of Public Debt could have on growth.

Cointegration Test for The Public Debt Model

The Johansen test for cointegration was also applied on the Public Debt Model to investigate the number of cointegrating vectors. The results of the test of cointegration are indicated in the table 13 and 14 below; The Johansen test for cointegration was also applied on the Public Debt Model to investigate the number of cointegrating vectors. The results of the test of cointegration are indicated in the table 13 and 14 below;

Table 13: Johansens Cointegration Test using the Trace statistic

Number of Cointegrating Vectors	Eigen Value	Trace Statistic	1% critical Value
$r = 0$		121.2628*	103.18
$r \leq 1$	0.78755	79.4380	54.46
$r \leq 2$	0.61294	53.8101*	35.65
$r \leq 3$	0.49938	35.1283	20.04

Asterisks (*) denote acceptance of the H0: $r \leq 2$ at 1% level of significance

Number of Cointegrating Vectors	Eigen Value	Max-Eigen Statistic	1% critical Value
$r = 0$		41.8248*	45.10
$r = 1$	0.78755	25.6280*	38.77
$r = 2$	0.61294	18.6818*	32.24
$r = 3$	0.49938	14.2373	25.52

Asterisks (**) denote acceptance of the H0: $r = 2$ at 5% level of significance

The above results show that at the optimal lag length of 3, we failed to reject the null hypothesis of $\gamma \leq 2$ for both statistics given by the maximum and trace test statistics. This is an indication that the cointegrating matrix Π has full rank at 1% level of significance.

The result therefore shows that the model has at least 2 cointegrating Vectors, implying a long-run relationship among the variables. On the basis of the cointegration test, we proceed to estimate the long-run dynamics of the Public Debt model.

4.10.1 Analysis of a Vector Error Correction for the Public Debt Model

Application of a VEC model is premised on the fact that all the variables were stationary in their first differences i.e. thus integrated of order one I (1). The results for the long-run normalized cointegration equations are presented in Table 15 below;

Table 15: Cointegration Normalised Equation for the Public Debt Model

	Identifications	: beta is exactly identified Johansen normalization restrictions imposed			
Beta	Coef.	Std Err	Z	P>|z|	[95%Conf. interval]
lnPDGDP	1				
lnPGDFIGDP	-.4242044*	.0154151	27.52	0.000	.3939913 .4544175
lnGGDFIGDP	-1.014045*	.0190004	-53.37	0.000	-1.051285 - .9768045
lnDSGDP	.3269863*	.0095304	-34.31	0.000	.3083071 3.456656
lnREER	2.31128*	.0324137	71.31	0.000	2.24775 2.374809
lnPDSGDP	-.9410089*	.0020943	-449.32	0.000	-9451136 - .9369042
_CONS	-.4308151				

Accordingly, we define the normalized co-integration Vector (β) for the Public Debt model as follows;

$$\widehat{\beta} = \begin{bmatrix} 1 \\ 0.04242044 \\ -1.014045 \\ 0.3269863 \\ 2.31128 \\ -0.9410089 \\ 0.4308151 \end{bmatrix}$$

The long-run equation for the Public Debt model can then be written in this format

$$InPDGDP_t = -0.4308 - 0.0424InPGDFIGDP_t + 1.0140lnGGDFIGDP_t - 0.3269InDSGDP_t$$

$$- 2.3112InREER_t + 0.9410InPDSGDP_t \cdots\cdots\cdots (Eqn\ 15)$$

Results for the normalized equation of the Public Debt model show that all independent variables are statistically significant at 1% level of significance. And the long-run normalized equation above shows a negative correlation between PGDFIGDP, DSGDP and REER. A positive correlation is however depicted between GGDFIGDP and PDSGDP with PDGDP respectively.

Explaining the elasticity of these variables shown in the long-run adjustment parameters above, a 10% increase/decrease in PGDFIGDP, DSGDP and REER would bring about 0.4%, 3.2%, and 23.1% decrease/increase in PDGDP. On the other hand, a 10.1% and 9.4% decrease/increase in PDGDP is accounted for by a 10% decrease/increase in GGDFIGDP and PDSGDP respectively.

The co-efficient for PGDFIGDP, DSGDP, REER and PDSGDP are in line with our hypothesis statement and supports theory. The outcome of the PGDFIGDP and DSGDP both supports the theoretical arguments of crowding out effect of public borrowing. Government is actually borrowing from the domestic savings which results in depleting investible funds and drives up interest rates.

The paradoxical outcome of the GGDFIGDP coefficient is however converse to theory. This outcome is however supported by Piana (2001) who argues that investment by Government especially on core functions

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(i.e. infrastructure, human capital development etc) has a positive effect on the economy even when financed through borrowing. And this scenario is true for Zambia because the loans contracted by Government save for programmes loans such as the PRBS are for project financing and not to finance operations of the public sector.

Table 16: Short Run Cointegrating Equations -Adjustment parameters (α)

Alpha	Coef.	std. Err	Z	P>|z|	[95% Conf. Interval]
lnPDGDP	-.682296*	.2658831	2.57	0.010	-.1611747 1.203417
InPGDFIGDP	-.2950631	.4817329	-0.61	0.540	-1.239242 .649116
lnGGDFIGDP	.3132044	.27734491	1 .13	0.259	.2303899 .8567987
lnDSGDP	.7184559	.7408697	0.97	0.332	-.7336221 2.170534
InREER	-.694559*	.087612	-7.93	0.000	-.8662668 -.5228341
InPDSGDP	.19048179**	.4514632	2.00	0.045	-.4008739 .0327273

Asterisks (*), (**) and (***) denote significance at 1%, 5% and 10% respectively

Table 16 above gives results for the short-run cointegrating equation or adjustment parameters which measure the speed of adjustment toward the long-run equilibrium for the Public Debt model. From Table 16 the short-run speed of adjustment vector (ά) as follows;

$$\hat{\alpha} = \begin{bmatrix} 0.682296 \\ -0.2950631 \\ 0.3132044 \\ 0.7184559 \\ -0.6945504 \\ -0.9048179 \end{bmatrix}$$

The short-run model is therefore specified below;

$$ln\,PDGDP_t = -0.29506\,ln\,PGDFIGDP_t + 0.31320 ln\,GGDFIGDP_t + 0.71845 ln\,DSGDP_t$$

$$-\,0.69455 ln\,REER_t - 0.90481\,ln\,PDSGDP_t \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots \ldots\, Eqn\ 16$$

The adjustment coefficients for the variables in the Public Debt model are given as: -0.682296, 0.2950631, -0.3132044, -0.7184559, 0.6945504 and 0.9048179. The results show that PDGDP has 68.23%, PGDFIGDP (29.51%), GGDFIGDP (31.32%), DSGDP (71.85%), REER (69.46%) and PDSGDP (90.48%) speed of adjustment to long-run equilibrium if there is disequilibrium in the short-run. In this case, the estimate of the adjustment Vector of PDGDP in cointegrating equation 1 is -0.682296. This implies that when the average level of PDGDP is too low, it quickly adjusts upwards by 68.2% towards the average level of PGDFIGDP at -0.2950631. PGDFIGDP will similarly adjust downward by 29.50% towards the long-run relationship with PDGDP.

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4.11 POST ESTIMATION TESTS

The post estimation tests were also applied in the public debt model to ascertain if the specified model has a desired fit. Similar to the growth model the LM test for serial autocorrelation, the Jacque-Berra test for normality of residual and the model stability test were employed and the results are presented and discussed in Table 17 below;

4.11.1 Test for Serial Correlation

Table 17: Lagrange Multiplier Test Results for the Public Debt Model

Lag	Chi-Square (x^2)	p-value
1	29.2621	0.77931
2	67.3815	0.00117
3	44.3008	0.16131*

Asterisks (*) denote acceptance of HO at 1% levels of significance

With respect to the LM test, the null hypothesis of no autocorrelation could not be rejected at 1% level of significance and at the optimal lag length of 3. No serial correlation of errors is therefore present in the public debt model.

4.11.2 Test for Normality of Residuals

Table 18: Jarque-Bera Test Results for the Public Debt Model.

Equation	Jacque-Berra Statistic	p-value
ΔlnPDGDP	0.718	0.69849*
ΔlnPGDFIGDP	0.081	0.96010*
ΔlnGGDFIGDP	0.142	0.93160*
ΔlnDSGDP	1.792	0.40812*
ΔlnREER	0.205	0.90256*
ΔlnPDSGDP	0.454	0.79684*
ALL	3.392	0.99208*

Asterisks (*) denote acceptance of HO at all level of significance

To test for normality of residuals, the Jarque-Bera normality test was employed. The test results in Table 18 shows that the null of independently and normally distributed errors are not rejected at all levels of significance.

CONCLUSIONS

This study highlights some important findings for policy. The outcome of the results in the first model satisfactorily explains the long-run inverse relationship between public debt and economic growth thus supporting the neoclassical proposition. According to empirical literature, the study also affirms the positive relationship between economic growth and the explanatory variables. As regards the impact of public debt on the empirical determinant of economic growth, the results of the second model further confirms the presence of crowding out phenomenon and debt overhang effects. Given the positive relationship between public debt and public capital investment, the study strongly recommends that Government must ensure that loans are diverted to finance capital projects that enhances private sector participation. This will mitigate the negative effect of crowding out of private sector capital development as indicated by the regression results. In this regard, effective debt management policies and strategies aimed at reducing the cost and risks associated to public debt are a must for ensuring a sustainable path of public debt to promote economic growth.

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Recommendations

Recommendations for Future Research

An aspect worthy noting in this study is the dearth of data necessary to carry out an econometric analysis especially using cointegration procedure. The Country needs to seriously embark on putting in place a reliable macro-economic database to support more research necessary to provide policy guidance. Efficient management of public debt statistics would also warrant efficient estimation of results to support policy recommendation necessary to ensure that the progression of Zambia's public debt is maintained within a sustainable path. The presence of a negative long-run relationship of public debt and its effect on the economic growth indeed gives credence to the need for undertaking further research in this area, in particular to determine what drives the increase in public debt with a focus on policy recommendations and debt management strategies that tend to have a bearing on government borrowing. Another important aspect for future research is the quality of the legal and institutional framework as it relates to efficient management of public debt. Emphasis on undertaking the future research in this area is premised on the fact that the current existing structures for managing public debt in Zambia have serious weakness to warrant effective and efficiency public debt management.

Since this study focused on the impact of the stock of total public debt on economic growth, it would be important for future research to decompose the public debt into domestic and external to see how each component affects Zambia's growth rate.

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