AN ECONOMETRIC ASSESSMENT OF EXTERNAL DEBT SUSTAINABILITY INDICATORS IN ZAMBIA

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By

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ABSTRACT

Given inadequate domestic resources, as well as political and social pressures for development projects, Zambia will tend to run high budget deficits, and become very dependent on external debt. Thus debt sustainability becomes a major policy goal. This study investigated the significant macroeconomic factors that can influence external debt sustainability. These are GDP growth; Government revenues; exports; public expenditure; interest rate and exchange rate. The study employed simple Ordinary Least Squares (OLS) as well as a Vector Auto Regression (VAR) to capture dynamic relationships.

The results revealed that exports and interest rates were positively related to sustainability. Revenues, GDP growth and Exchange rate were inversely related to debt sustainability. The total expenditure to GDP was inversely related to sustainability while current expenditure was positively related to sustainability probably due to prudent use of current expenditure on economic factors that stimulated growth. Capital expenditure was not significant to sustainability which may reflect the poor attention paid to infrastructure development in Zambia.

The impulse response of the solvency indicator to revenue, GDP growth and total expenditure/GDP were generally negative over a ten year period. The policy implication is that in order to keep the debt sustainable, the debt resources must be used to maximise GDP growth and enhance public revenue.

The impulse responses from exchange rate and interest rates to shocks on the solvency indicator were positive. The impulse response of SI from impulses in exports was negative. These are factors that are not completely in the control of the Government. The policy implication in contracting international debt is that Government should go for the lowest possible interest rate. Government should do its best to develop credible export promotion policies that can directly impact on the SI and also help to stabilize the exchange rate.

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GLOSSARY OF TERMS

AIC	Akaike Information Criterion
BOZ	Bank of Zambia
CAP	Capital Expenditure
CUEP	Current Expenditure
CPIA	Country Performance Indicator Assessment
CEq	Cointegrating Equation
CSO	Central Statistics Office
DC	Developed Country
DSA	Debt Sustainability Analysis
EX	Exports
EXP_GDP	Expenditure to GDP
EXR	Exchange Rates
FPE	Final Prediction Error
GDP	Gross Domestic Product
GDPG	Gross Domestic Product Growth Rate
HIPC	Highly Indebted Poor Countries
HQIC	Hanna and Quinn Information Criteria
IFI	International Finance Institution
IMF	International Monetary Fund
INT	Interest Rates
LICs	Low Income Countries
MDG's	Millennium Development Goals
MOF	Ministry of Finance
NPV	Net Present Value
OLS	Ordinary Least Squares
O&M	Operating and Maintenance
PV	Present Value
PVD_GDP	Present Value of Debt to GDP
REV	Revenues
SI	Solvency Indicator
SIC	Schwartz Information Criterion
SSA	Sub-Saharan African

UNCTAD	United Nations Conference on Trade and Development
UNECA	United Nations Economic Commission for Africa
US$	United States Dollar
WB	World Bank
VAR	Vector Auto-Regression
VECM	Vector Auto Correction Model
ZMK	Zambian Kwacha
ZRA	Zambia Revenue Authority

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1 INTRODUCTION

1.1 Research Area

In 2012, Zambia was reclassified from a Low income country to a lower middle income country by the World Bank (WB), which translated into new opportunities for Zambia to access more non-concessional sources of finance. For the first time on 13th September 2012, Zambia issued the first Eurobond, joining the ranks of other African countries like Gabon, Ghana, Namibia, Nigeria and Senegal. The country managed to issue a $750 million 10 year bond even though the offer was oversubscribed to the tune of $11.9 billion (Chikwanda, 2012). Zambia has also issued a second Eurobond to the tune of $1 Billion in 2014 showing evidence of high investor confidence in the country. In 2011 rating agencies Fitch and Standard and Poor rated Zambia as a B+ which gave the country greater access to international capital markets.

In the last three years, Zambia has embarked on massive infrastructure projects, such as the link Zambia 8000, rehabilitation of railroads, energy, and telecommunication and water facilities. According to Dominguez, (2010), it would cost the country US$1.6 billion per year over the next decade in order to meet the infrastructure targets. Given low domestic revenue mobilization, this increase in expenditure could exert continuous pressure on the fiscal deficit that could lead to increasing reliance on external funding. This has raised concerns that the country will increase its sovereign borrowing to a level where external debt may not be sustainable. There is fear that the country could fall into a debt trap, similar to the one which was only resolved through the Highly Indebted Poor Countries Initiative (HIPC) in 2005.

A debt trap can compromise overall government development agenda. Persistent widening of the fiscal deficit can also lead to refinancing difficulties and consequently defaulting on debt. In the event of sovereign default, this may also lead to contagion effects within the region and affect lending to other developing countries. It is therefore very important to ensure that debt is sustainable so that it does not jeopardize long term development prospects.

Governments in low-income countries (LICs) have the difficult task of making wide-ranging decisions about public spending, taxation, and borrowing. The biggest challenge that most developing countries face is in determining how much they can borrow without jeopardizing

their long-term prospects (Danny Cassimon, 2008). For Zambia which is very exposed to external borrowing, the greatest challenge is to ensure that the external debt is sustainable. This study seeks to examine the dynamics of macroeconomic factors that impinge on external debt sustainability.

1.1.1 Overview of Zambia's Public External Debt

In the 1970's Zambia undertook substantial external borrowing from bilateral creditors particularly the World Bank (WB) and International Monetary Fund (IMF). By 1980, Zambia's stock of public debt was 123.3 % of GDP and external debt accounted for 85% of this. The country accumulated so much debt it was not able to fully service its obligations. This was worsened by the country's excessive dependence on copper. As the copper industry was experiencing fluctuating prices it was difficult to service the loans. This reduced the credit worthiness of the country and meant that Zambia needed to rely almost exclusively on concessionary facilities of the Multilateral and bilateral donors in order to keep access to international finance. The oil crisis of the 1970's made many countries including Zambia more dependent on WB and IMF debt (Zulu, 2004; Chongo, 2012).

The conditionalities for borrowing from WB and IMF included that the country had to go through some structural adjustment programs. These focused on export, import and interest rate diversification as well as restrictions on Government expenditure on food and fertilizers subsidies, as well as wage policies (Zulu, 2004). Although the programs included the country's public expenditure restraint, there was some protection of social sectors expenditure notably in health and education systems. In fact it had to maintain a social sector budget of at least 35%. Some conditionality, notably privatisation did not necessarily leave the countries economically viable as seen in Zambia (Zulu, 2004).

Zambia suffered from a debt overhang and instead of available resources going to investments in the country, they were going to service the external debt. Effects of debt over hang were that it inhibited economic activity so much that even creditors would benefit from a debt write down. A debt-overhang effect suggests that one should provide relief sooner rather than later as delayed relief may exacerbate the real effects of the crisis. Thus, if there is a debt overhang, only debt relief will lead to a resumption of economic growth (Roubini, 2001). It is only when

the debt is in the wrong region of the debt Laffer-curve, will debt reduction be pareto-improving to both the creditors and debtors benefit. Zambia's debt Laffer curve was on the wrong side and therefore needed a debt reduction.

The country's foreign debt only became sustainable after the completion of HIPC in 2005. Debt is sustainable if a country is able to pay its external obligation in the long-run without resorting to substantial readjustments of exchange rates, interest rates or default in repaying debts (ABM Nasir, 2012). According to the World Bank Group (2014), debt sustainability is the ability to manage debt so they do not grow to obstruct economic stability and growth. It has also been identified as a perquisite for countries trying to attain the Millennium Development Goals (MDGs). Debt sustainability requires that indebtedness be kept in line with the capacity of the borrower to repay (IMF, 2003). At a firm or project level, this means that borrowed funds should be invested productively with a return high enough to cover debt-service costs. This simple definition, however, is not as easily applied to countries as it is to firms or projects.

Due to the debt relief provided under the HIPC, Zambia's total public external debt stock decreased significantly from US$5.5 billion in 2005 to US$2.4 billion in 2006. However, public external debt has again doubled from US$ 2.4 billion in 2006 to US$ 5. 3 billion in 2012. The increase in the stock of external public debt has mainly been attributed to increased borrowing by the Government to finance the intensive infrastructure development program. Nevertheless, external public debt as a percentage of GDP has since 2006 remained well below the international debt sustainability threshold of 30% of GDP for low income countries in present value terms as seen in Figure 1. According to Figure 1, both debt services: GDP and Debt: GDP have significantly declined after 2005.

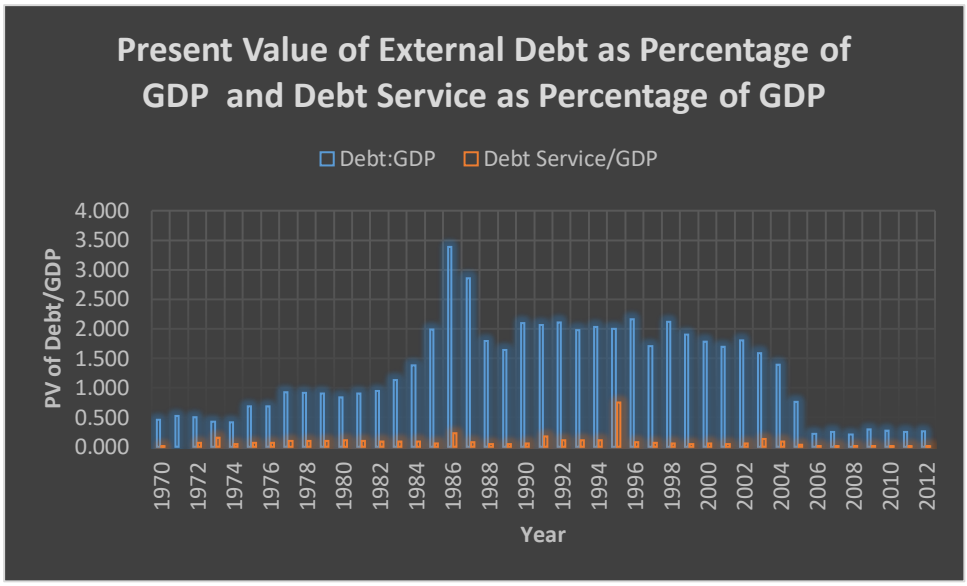

Figure 1: PV of Debt/GDP

Source: Author's graph using World Bank Data

1.1.2 Overview of the Zambian Economy

The Zambian economy has performed strongly over the past seven years. Over the period 2006-2012, real GDP growth averaged 6.6 percent per annum, with a peak of 7.6% in 2010. As shown in the Figure 2, Zambia's economic growth has been driven by good performance in services, construction, agriculture and mining. The contribution from mining has been low compared to previous years. This could be explained by the volatile copper prices on the London metal exchange. Construction on the other hand has been increasing due to the road construction, building of schools and health facilities by the Government, and private residential and commercial housing projects. A further source of growth has been the communications sector.

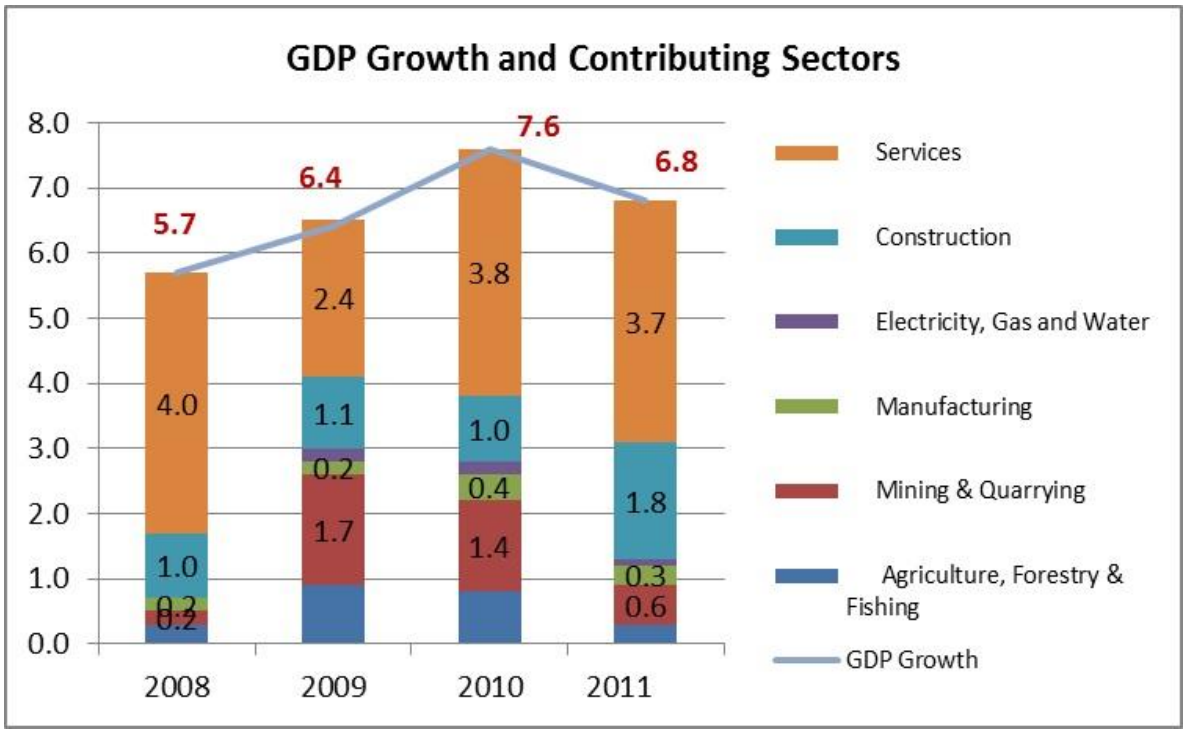

Figure 2: GDP Growth and Contributing Sectors

Source: Ministry of Finance, 2011

The major components of the country's revenues are domestic revenues and grants. According to the World Bank (2004), revenues as proportion of GDP averaged 19.3% during the 1990s, of which 8.7% of this figure was attributed to foreign grants. This reflects the country's high level of dependency on external financing. During the same period, income taxes amounted to 18.4% of total revenues which was above the average for fellow countries within the Sub Saharan Africa (SSA). This led the IMF (2001b), to conclude that Zambia's progressive income taxes were inequitable.

Since 2006, Zambia's revenues have been growing steadily at an average of 6%, however, expenditure has been growing at 12% which is double the growth rate of revenues. This could be explained by the intensified capital expenditure towards infrastructure in the country. The country has been running a fiscal deficit but the deficit in 2011 was more than double that of 2010 and has remained high in 2012 as shown in figure 3.

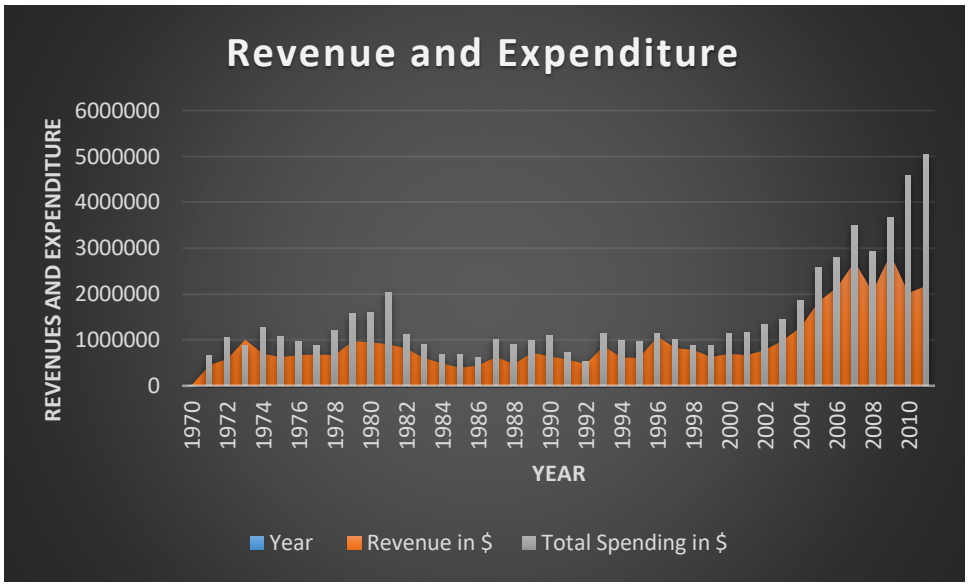

Figure 3: Revenue and Expenditure

Source: Author's graph using UNECA data

External borrowing by the Government is an integral part of resource mobilization to fill the financing gap in the budget. The Government secures financing externally to finance programs within the budget and capital projects in the Country. Domestic borrowing by the Government is mainly used to finance fiscal operations (Chongo, 2013). However, until 2011 the trend in the past seemed to have focused very little spending on capital projects as shown in figure 4. Although capital expenditure has been increasing, current expenditure continues to consume the lion's share of the national budget.

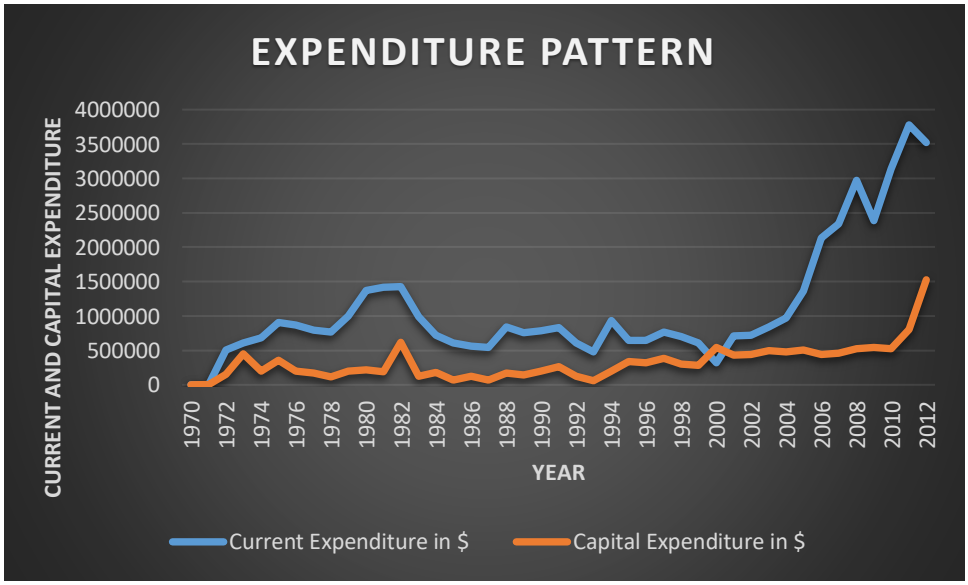

Figure 4: Expenditure Pattern

Source: Author's graph using UNECA data

According to Dominguez (2010), the annual funding gap in infrastructure can impose a substantial burden for the economy and is further complicated by overspending in the transport sector and operating and maintenance (O&M) in the power sector due to utility inefficiencies.

Notwithstanding this, the country's continued high growth will also depend on global developments such as global demand for Zambia's exports. The country's exports have been fluctuating in the past seven years with copper contributing around 79% to total exports. From 2009 the country had a positive balance of payments current account. The country rebased its currency in 2012, by dropping three zeros. The currency faced some serious fluctuations during the middle of the 2014 year imposing exchange rate risks.

1.2 Problem Statement

Zambia's reclassification as a low medium income country, with a B+ credit rating has increased its access to international capital. Given inadequate domestic resources, as well as political and social pressures for development projects, Zambia will tend to run high budget deficits which will increase dependency on foreign debt. The biggest policy challenge for Zambia will be how to maintain foreign debt sustainability.

Theoretical and empirical observations have focused on a number of macroeconomic factors that impinge on external debt sustainability. These factors include GDP growth; public expenditure; Government revenues; interest rates charged on foreign debt; exchange rates and exports. This study will examine how these factors have impacted on debt sustainability in the past so that the past relationships can help inform future projections of debt sustainability.

Most of the past foreign debt did not bring about the desired economic growth and consequent adequate capacity for servicing the debt which led to the debt trap. It is therefore important that the current ambitious national development program which will inevitably depend on some external debt is managed prudently to avoid a new debt trap.

1.3 Purpose and Significance of the Research

Although external debt in Zambia is sustainable at the moment, there are risks of falling back into a debt trap. To ensure debt sustainability, we need to understand the past macroeconomic factors that influenced the country's ability to manage the debt at sustainable levels. The study will identify critical factors that impinge on debt sustainability. It will focus on analysing various macroeconomic factors and their impact on economic growth that could have affected the servicing of the external debt from 1970 to 2012. The paper will also examine factors that are outside the control of Government but impact on debt servicing notably interest and exchange rates.

Given the high dependency on external debt, it is important that the country does not fall into a debt trap that can undermine macroeconomic development programmes. By identifying factors that help promote debt sustainability in Zambia, this study can help policy makers and development analysts with options on how to manage foreign debt to ensure it is sustainable.

1.4 Research Questions and Scope

The extensive borrowing the country has taken in the last two years has raised questions from the public as to whether this rising external debt is at all sustainable, and could this have negative implications for investor confidence? Could the country fall back into the old debt trap? Focus will thus be on analysing past relations among macroeconomic factors that impinge on debt sustainability to have an informed decision from which to anticipate and deal with future sustainability challenges. The overarching research question is: As the country's external debt is increasing, is the economy growing with capacity to service debt so that it is kept at sustainable levels? The operative question is:

To what extent do shocks or fluctuations in GDP, public expenditure, interest rates, exchange rate, exports and government revenue affect debt sustainability?

1.5 Research Assumptions

With regard to debt management it is beyond the scope of this study to investigate possible misuse or wastage of debt resources. The focus here will be on the macroeconomic efficiencies that are derived from Government expenditure patterns notably the relative importance given to capital expenditure and recurrent expenditure. The basic assumptions are that if debt is being targeted towards appropriate infrastructure spending on roads, railways, and energy and water facilities these will indirectly affect growth through improved exports and employment generation. Although the economy is heavily dependent on copper, the agriculture sector is the major employer of 70% of the Zambian population. However, the sector's potential to contribute to the country's development remains largely underexploited. Zambia is a landlocked country and depends on its neighbouring countries for transporting exports and imports (World Bank, 2014). However, this transportation system is inadequate, with poor administration capacities and therefore negatively impacts the flow of the country's exports and imports.

If the external debt is used on economic infrastructure and other productivity enhancing factors the economy will grow with capacity to service the loan, but if the loan is spent on operational and routine administration, economic growth will be sluggish and there may not be adequate capacity to service the loan. Expenditure on health, education, defence and general administration tend to contribute more to consumption rather than productivity in the short run. It is noted that health and education expenditure can have significant impact on national productivity in the long run but the impact of this expenditure has long lags. In a country like Zambia with mass unemployment (15% in 2010), the majority of beneficiaries from public health services do not translate their improved health in productive activities and the investment on such health services can be seen as social rather than economic investment. Similarly, education expenditure on unemployed high school leavers is more of social expenditure rather than investment in productive human capital.

Interest rate is the cost of finance. To ensure a manageable debt burden, the country will always go for the lowest interest rates. Interest rate will affect debt sustainability at two levels. It will be factored in the solvency indicator (Present Value of Debt: GDP) which is a proxy for debt sustainability. Interest will also determine the quantum of debt service repayments. If the

interest rate is high, it will mean a higher service burden. It is therefore expected that interest rate will be inversely related to debt sustainability.

The exchange rate is defined as the price of dollar in terms of Zambian kwacha (ZMK/$). If the kwacha is depreciating, it will mean an increased payment burden in kwacha terms for debt service denominated in dollar. Therefore, the exchange rate will be expected to be negatively related to debt sustainability.

The GDP growth will have implications for debt sustainability. Increased GDP will reduce the solvency indicator therefore improve debt sustainability prospects. It is further assumed that with a growing economy, tax revenues will increase and improve debt servicing capacity. Therefore, GDP growth will be positively related to debt sustainability.

If foreign debt helps to improve exports, this can help in stabilizing the exchange rate and increased contribution to GDP growth and public revenue. Exports will be expected to be positively related to debt sustainability.

2 LITERATURE REVIEW

According to Roubini (2001), there are a number of standards that can be used to measure external debt sustainability such as solvency and liquidity ratios. Solvency ratios would include ratios of debt to GDP, debt to revenues or debt to exports. These ratios all reflect the national capacity to absorb debt comfortably. Liquidity ratios on the other hand would include debt service to exports and debt service to revenue. These ratios focus on the economy's ability to mobilize adequate liquidity to meet day to day service obligations. In order for debt to be at sustainable levels, these ratios should not grow over time. Debt can be unsustainable based on solvency ratios or liquidity ratios.

The debt sustainability analysis (DSA) used by the World Bank and IMF assesses how a country's current level of debt and prospective new borrowing affects its ability to service its debt in the future, in the hope of maintaining public debt at sustainable level. The DSA is forward looking and thus uses annual historical and projected macroeconomic and debt data to make future projections. Forward looking stress tests are conducted on sustainability indicators to changes in key assumptions and parameters, such as economic growth and export growth, interest rates or /and the amount of new external financing.

However, the aim of this paper is not to forecast debt sustainability but to use historical data to understand the relationship dynamics between the solvency indicators and macro-economic factors. The empirical observations of this study can inform forward looking scenarios. The DSA uses indicative benchmarks to inform the overall assessment of sustainability; debt becomes unsustainable once it becomes higher than the threshold. Judgment in these numerical evaluations tends to focus on the conditions under which debt and other indicators would stabilize, on major risks, and on the need and scope for policy adjustments. Table 1 shows solvency Indicators and liquidity Indicators thresholds. Table 2 shows the debt ratio thresholds of three categories of indebted countries. According to this table, Zambia was in the category of severely indebted countries.

Table 1: Indicative External Debt Burden Indicators

DSA Indicators and Thresholds			
Indicators	**Assessment of institutional strength and quality of policies**		
	Poor	**Medium**	**Strong**
Solvency Indicators			
PV Debt/GDP	30%	40%	50%
PV Debt/Revenue	200%	250%	300%
PV Debt/Exports	100%	150%	200%
Liquidity Indicators			
Debt Service/Exports	15%	20%	25%
Debt Service/Revenue	25%	30%	35%

Source: Worldbank, 2009

Table 2: Debt Ratios of Indebted Countries

	Severely Indebted	Moderately Indebted	Less Indebted
Debt/GDP = *x*	X > 80%	48 < x < 80	X <48
Debt/ Exports = *y*	Y > 220	132 < y < 220	Y < 132

Source: Tahir Mahmood, 2009

Solvency Indictors

The fundamental measurement of sustainability is the long term ability to cover debt obligations. Net Present Value of Debt is the discounted sum of all future debt-service obligations (interest and principal). In order to be solvent, not more than 30% of the total value of all final goods and services produced in the economy (GDP) of a poor country should go to cover the debt obligations (see Table 1). For the economy to operate smoothly the remaining 70% of GDP must go to cover other demands of the economy. This implies that countries with growing GDP will be better able to service the debt in order to keep the ratio lower than 30% as shown below in the assumption.

$$\frac{\text{NPV of Debt}}{\text{GDP}} =$$

Other approaches to solvency, include export capacity and revenue mobilization capacity. In terms of exports, this is where an economy generates productive capacity and foreign currency with which to pay foreign debt. The volume of exports is therefore important in ensuring that the country is able to generate the necessary foreign exchange to discharge its foreign debt service obligations. If we are stimulating exports to a level where we can reduce this ratio to less than 100 for a poor country, it means there is ability to cover debt obligations and remain with room for manoeuvre in meeting other demands on foreign exchange with the available foreign exchange earnings from the exports. In practice this may mean for a country like Zambia that we have enough foreign exchange to pay debt obligations, current imports as well as build up foreign reserves.

In the same way, we service debt with available revenues. In developing economies there is always severe competition among multiple demands for available public revenue. Foreign debt demands that the specific debt service obligations are settled within the specified period and if the ratio of NPV of debt: revenue is above 200 for a poor country, this would imply that meeting the debt service obligations would eat into other public expenditure such as social services. If for political or economic considerations, the government decides to give top priority to these other expenditure items, then they will have to reduce their debt service payments below the actual obligations. Meaning there is no revenue capacity to service debt obligations as and when they are due. In countries like Zambia, these are real challenges, the choices between debt service payments and payments for social services, as well as other government obligations can be very complex. If the revenue is growing the government capacity to service the foreign debt and meet other expenditure obligations will improve and the risk of default on debt obligations will reduce.

The overall solvency challenge is premised on steady growth in GDP, exports and public revenues. To the extent we are seeking foreign debt, the challenge for sustainability in terms of solvency is for the government to spend its resources such that there is optimal growth in GDP and reasonable growth in the national export capacity, as well as stimulation of growth in the public revenues. The foreign debt is generally used to supplement and leverage local revenue to promote the economic objectives. Thus in terms of debt sustainability the real challenge is how to use the total government spending so as to optimize economic growth with incidental positive impacts on export growth and public revenues.

Liquidity Indicators

The liquidity indicators reveal a country's ability to meet its short term immediate obligations to discharge responsibility of regular payments (Colin Firer, 2004). Similar to the solvency indicators NPV of debt service: exports thresholds must be 15 and NPV of debt service: revenue 25 for poor countries (see Table 1). This means that within those specified limits the country is able to service the loan without undue compromise on other essential expenditure items.

The liquidity challenge is limited to the short term immediate requirements of liquidity to meet the obligations when they fall due. You can have a liquidity problem even if you are solvent but have a temporally shortfall in liquidity to service immediate obligations. If the problem is liquidity, a country can easily restructure the repayment schedule but if the problem is solvency it becomes very difficult because you have fundamental structural problems in generating enough revenue to meet your debt obligations. The solvency problem can only be solved by fundamental changes in the economy leading to increased productivity and increased exports.

Government debt is considered to be sustainable if the government will be able to continue servicing it, without the need to make an unrealistic large future correction to the balance of income and expenditure (budget balance). Inability to discharge obligations may result either from a solvency or a liquidity problem. According to Roubini, (2001), solving a solvency problem will require debt reduction, while debt rescheduling/restructuring can be used to solve a liquidity problem. In the case of Zambia, the country had a solvency problem and hence this paper will focus on the solvency indicator in analysing the sustainability challenge.

The use of debt burden indicators has been challenged by Nehru (2004), who argues that it may not be appropriate to use a common ratio, as government policies, institutions and shocks that countries experince also influence the probability of debt distress. Studies by Nehru, (2004) have analysed the determinants of debt distress among very low-income countries that resorted to debt relief efforts such as (HIPC) initiative using probit regressions, cross country and time series variations. The study found that since majority of the sovereign external borrowing is mostly, if not entirely, from official concessional sources few market indicators are available to signal risks of future sovereign debt default by low income countries. The paper also discovered that non-financial variables such as quality of policies and institutions are key determinants of debt sustainability. Nehru, (2004) also suggests that the history of non-

repayment and macroeconomic instability as well as by the size of the debt burden influence the probability of default. This paper recognises that non-financial variables notably policies and institutions can have a bearing on debt sustainability in Zambia but they will not be investigated in this study which is confining its investigations to financial variables.

A major cost of borrowing is the interest burden which also reflects the credit worthiness of the borrower. Lenders often offer credible borrowers good rates. However when borrowers accumulate too much debt, this might send signals to the lender that they might not be able to pay on time and in full. As a result lenders will adjust their exposure by increasing interest rates. According to Roubini (2001), interest rates have vicious effects on the dynamics of country or government debt which may lead to self-fulfilling solvency traps. If investors keep increasing the probability of default on a sovereign debtor, this may increase the sovereign spread which forces the borrower to default. In addition, the borrowing cost become exorbitant and thereby increasing the probability of defaulting. This paper examined the role of interest rates on debt sustainability. The basic assumption is that a higher interest rate increases debt burden and negatively affects debt sustainability.

Roubini (2001) further argues that an increase in the accumulation of external debt can still be sustainable as long as it does not grow faster than the real interest rates as this will increase the cost of borrowing. “If the real interest rate is greater than the rate of growth of an economy, solvency is consistent even with a foreign debt to GDP ratio that grows continuously over time” (Roubini,2001).

Probit and logit functions have been used to determine country creditworthiness and debt servicing capacity in cross country analyses. They have however been condemned to have serious limitations as they assumed a ceteris paribus, which prevents a realistic assessment of the effects generated by policy changes in countries. Studies by Kharas (1984) analysed determinants of long run creditworthiness relative to external debt of developing countries using probit analysis. The study found that creditworthiness depended on the “actual capital stock compared with a critical level, representing the gross wealth just sufficient to ensure that interest payments to foreigners never exhaust national output given expected gross inflows and existing outstanding debt” (Kharas, 1984).

He argued that using high level of external funds to finance balance of payment deficit is not sustainable in the long run, as this would create payment burdens and therefore exert pressure on foreign exchange. This supports Domar's (1994) idea of defining domestic debt burden as the tax rate necessary to finance interest payments, when a government borrows a fixed fraction of output each period. This theory was extended to external borrowing and concluded that the key relationship in assessing the debt burden is that between the interest rate on debt and the growth rate of output in the economy. The models used debt to income ratios or debt service to income ratios to assess sustainability of external debt.

If the country is not creditworthy the debt-income ratio will have an exponential curve, implying that debt is consistently higher than incomes as shown in line bb of Figure 5. These debt payments are therefore deteriorating the capital stock and can stagnate the economy. If on the other hand, the country is credit worthy, the ratio will rise but stabilize and start sloping downwards as shown in Figure 5 line aa. This will imply that the economy is growing with capacity to service debt (Rewane, 2007).

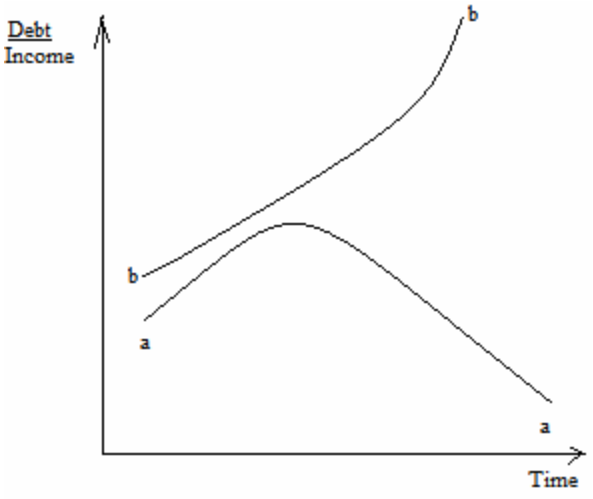

Figure 5: Debt: Income

Source: Rewane (2007)

This study also extended the debt to income ratio analysis on the Zambian data. The results showed that during the time when Zambia's external debt was unsustainable, the external debt/revenue ratio was exponential as shown in figure 6. Although the curve started sloping downwards in 1986, the ratio was still high till the completion of HIPC in 2005. The significance of external debt to revenues ratios is that it mimics that of present value of external

debt to GDP as shown in figure 7. This could imply that revenues are positively linked to GDP and if revenues are growing enough to service debt, the debt will be more sustainable in the future.

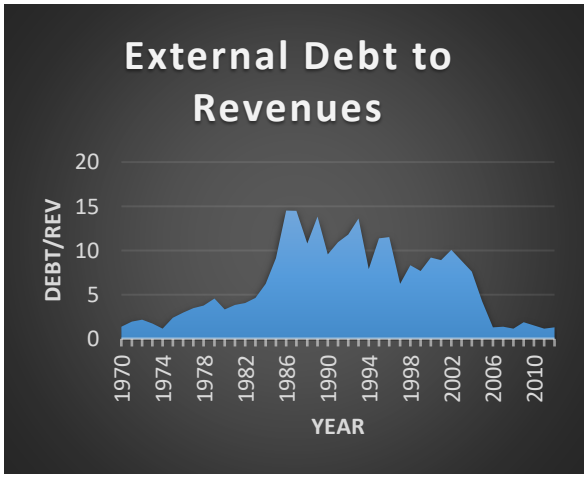

Figure 6: External Debt/ Revenues

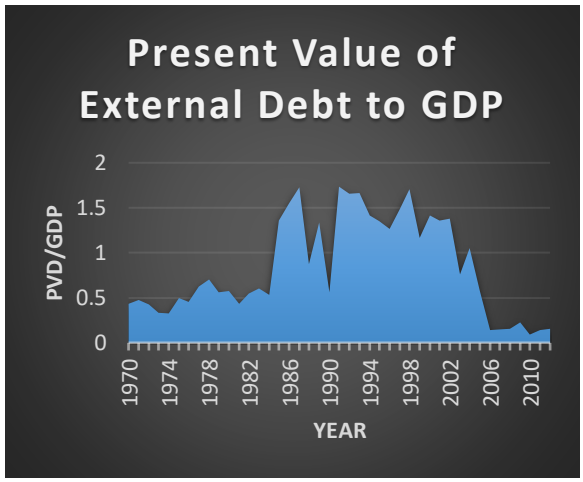

Figure 7: PV Debt/ GDP

Source: Author's graphs using world bank data.

With a similar line of thought, studies by Feder (1985) used a dynamic simulation model and found that a higher GDP growth rate with acceleration in export revenue growth reduces borrowing requirements in every period, thus generating lower debt/GDP ratios. This implies that GDP growth and exports are significant factors that impact positively on debt sustainability.

Studies by Chongo (2013) employed Ordinary Least Squares (OLS), Instrumental Variables & Generalised Methods of Moments and the Vector Auto- Regressive (VAR) framework in the analysis of effects of public debt on growth in Zambia. The study found an inverse relationship between public debt and GDP growth. The paper suggested that promotion of conservative borrowing was required to reduce the adverse effects of public debt on GDP growth. However one would argue that low growth in the economy could result in higher borrowing which would not be sustainable. This paper therefore assessed effects of GDP growth rate on debt sustainability.

Kharas (1984) argued that Governments invest in infrastructure so that revenue from the project accrues to the private sector. If the Government is constrained in its ability to raise tax rates, then the benefits of foreign borrowing will depend not just on the marginal social return to investment, but also on the impact of borrowing on national savings. This implies that the critical relationship in the debt analysis is the dynamic relationships that impact on national economic growth including the accumulations of productive capital relative to external debt.

Studies have shown that improvements in infrastructure positively contribute to per capita growth of GDP. In 2010, infrastructure improvements led to 0.6% increase in the annual per capita growth of Zambia's GDP. However if the infrastructure programme had progressed to the level of middle income countries in the region, per capita growth rates could have increased by 2% per year (Dominguez, 2010). Figure 8 shows the historic changes to growth per capita due to infrastructure in Sub-Sahara Africa.

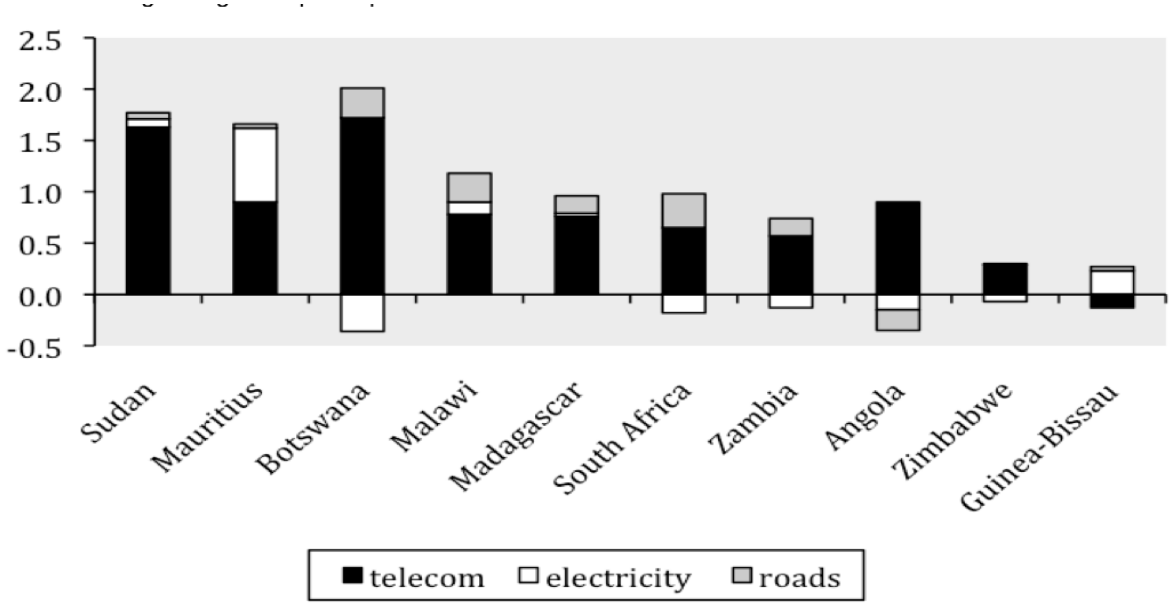

Figure 8: Historic Changes in Growth per Capita Due to Infrastructure

Source: Domiguez, 2010

Zambia is one of the few countries in the region with a road sector budget in excess of what is needed to maintain the main road network, and adequate to address the rehabilitation backlog as shown in figure 9.

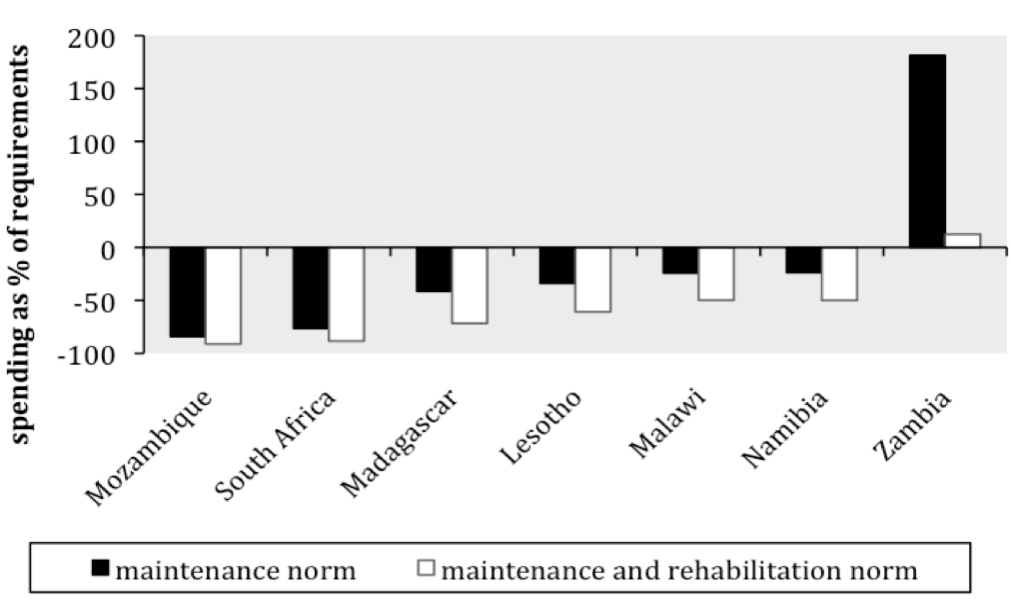

Figure 9: Spending on Maintenance as % of Requirements

Source: Gwilliam, 2008

According to the World Bank (2004) Zambia's public resources are not well spent and budgetary allocations can go to where they are not supposed to go. Priority areas such as rural road networks appear to be neglected. Zambia's rural road accessibility is poor compared with other sub Saharan countries. While 70% of Zambians depend on agriculture for their livelihood, only 17% of this population lives within 2 km of an all-season road—about half the African average. The condition of the existing rural networks is exceptionally poor, with only 21% in good or fair condition, compared with around 60% in the relevant peer groups. There may thus be a case for shifting attention and resources to the rural networks in the future (Dominguez, 2010).

Growing infrastructure demand puts intense pressure on public budgets especially in countries with fiscal deficits (Foster, 2008). Huge funding gaps exist and current receipts, savings, and central government transfers fail to finance large-scale infrastructure projects while private sector infrastructure investment in developing countries remains highly volatile (Kehew et al., 2005; Martell and Guess, 2006; Beck et al., 2007; UNECF, 2008; Platz, 2009) as cited by E. Badu (2012). This paper will investigate will investigate the impact of capital expenditure on growth and debt sustainability.

The findings from Turnovsky (2008) also suggest that the form in which the government carries out its productive expenditures is important. According to Mwaba, (2005) multilateral lenders as well as private banks were eager and willing to make loans available to the low income countries to finance roads and railways, as well as ports, schools and clinics. It was expected that the external finance would yield the permanent positive results and incomes associated with the debt-growth cycles, and that with increasing prosperity and access to direct foreign investment, the countries would graduate from external borrowing and become creditors.

Mwaba (2005) argued that many African states had a significant departure from the predicted path, with many entering a prolonged economic decline from the mid-1980s, fuelled by increases in debt service payments on borrowings accumulated mainly from the 1970s and early 1980s. This paper seeks to assess whether capital expenditure is a significant factor that can influence debt service capacity. In the case of Zambia, the poor response of growth to foreign debt may have reflected the poor expenditure decisions that neglected economic infrastructure spending. At 11.6% for the period 1975 – 1984 and 2.2% for the period 1985 – 1989, government capital expenditure as a percentage of total expenditure for Zambia was the lowest in Africa (United Nations Economic Commission for Africa, 2003).

A similar view is held by Fosu (2010) who explored the extent that fiscal constraints posed by debt servicing and how this can affect the fiscal allocation in the developing economies, particularly in Africa where the constraint has been historically binding. Given that government spending in developing countries is dominant in the education and health sectors, while public investment in infrastructure is a key to determining productive private investment. Thus if share of public investment in infrastructure is low, the growth momentum of private sector is undermined with serious consequences for economic growth. In the case of Zambia, this can also undermine prospects for non-traditional exports which require significant growth in economic infrastructure notably roads.

Mahdavi (2004) focused on the impact of external debt on the composition of government spending and disaggregates public expenditure into wages and salaries of public employees, nonwage purchases of goods and services, interest payments, subsidies and other current transfers, and other (residual) economic categories. While such categorization is useful, it does not shed light on spending in the functional sectors such as the social sector (health and education), economic services, public investment, or agriculture. To the extent the debt

improves the revenue, it can extend the expenditure capacity which in turn can broaden the flexibility of the government in dealing with various expenditure demands. In line with this approach, this study recognises the fact that the debt expands expenditure capacity, but the primary focus of this study is on how expenditure decisions affect economic growth and ultimately sustainability of the debt. In this study expenditure is broken into capital and current expenditure without detailed breakdowns. Under current expenditure the major components are wages and social services, while the major component of capital expenditure is infrastructure spending.

Turnovsky (2008) proposed that productive government expenditure can take many forms, such as devotion to improving the physical resources of the economy such as its roads and airports. Alternatively, it may be applied to augmenting the economy's human resources, in form of education (human capital). Given the constraints that inevitably face an economy, any government necessarily confronts trade-offs between these two forms of expenditures, raising the question of how it should allocate its resources between infrastructure and social services. Previous analyses have focused separately on the effect of public investment in infrastructure, on the one hand, and on investment in education, on the other. Yet governments inevitably face resource constraints that force them to allocate their expenditures between these two alternatives.

In contrast, studies by Levine and Renelt (1992) as cited by (Turnovsky, 2008) are of the view that government spending on education is not robustly correlated with the growth rate of income. Though a substantial theoretical literature has evolved emphasizing the role of government spending on education for the accumulation of human capital and consequently for long run economic growth. The general observation in Zambia is that with high unemployment levels, the consumers of education and health services do not always translate that input into product activities. Therefore most spending on education and health services can be seen as mere social spending rather than productive investment.

According to Ayadi (2008), the burden and dynamics of external debt show that they do not contribute significantly to financing economic development in developing countries. In most cases, the debt accumulates because of the servicing requirements and the principal itself. In view of the above, external debt becomes a self-perpetuating mechanism of poverty aggravation, work overexploitation, and a constraint on development in developing economies.

By investigating the expenditure decisions, this study may help to show how best to approach debt servicing so that debt does not aggravate poverty.

The act of acquiring external funds however depends on the relationship between domestic savings and foreign funds, investment and economic growth. The main guiding principle on when to borrow is a simple one. Borrow abroad so far as the funds acquired generate a rate of return that is higher than the cost of borrowing the foreign funds (Ajayi and Khan, 2000) as cited by (Esther O. Adegbite, 2008).

External debt does not automatically transform into debt burden when funds are optimally utilized. In an optimal condition, the marginal return on investment is greater than or equal to the cost of borrowing. According to Edelman (1983), the critical factors affecting debt service capacity are returns on investment, the cost of borrowing and the rate of savings. The benefits of external borrowing have been emphasized in the literature to the neglect of the costs. Ubok-Udom (1978), enumerates the costs of external borrowing to include debt service burden which incorporates costs implied by the term structure of external loans; costs of resultant liquidity crisis; costs of the viciously cumulative debt and the manageability of the debt; costs of debt rescheduling and costs of import substitution. According to Adegbite, 2008 optimal utilisation of debt is premised on choice between productive investment and consumption. These observations are in line with what this paper is attempting to investigate for Zambia as the focus is on optimal decisions for public expenditure.

Movements in exchange rate also affect debt dynamics. Studies by Chongo (2013) suggested that currency variations have adverse effects on the stock of public debt, especially when a large component of public debt is held in foreign currency. Roubini (2001) also argues that “a real depreciation of the currency leads to an increase in the foreign debt to GDP ratio as it increases the real value of foreign currency denominated liabilities of a country and will worsen the debt sustainability of a country: i.e. a larger trade surplus will be required to stabilize the debt to GDP ratio when a real depreciation increases the debt to GDP ratio. Similarly, a negative terms of trade shock (a fall in the relative price of the exports of a country) will also lead to an increase in the debt to GDP ratio (as it reduces the real income of the country) and will thus require a larger trade surplus adjustment to avoid an unsustainable increase in the debt to GDP ratio. Note, however, that while a real depreciation increases the stock for debt (relative to GDP), it

may also improve the external balance (especially if the traded sector is large relative to GDP) and does help to improve sustainability."

In conclusion, the theoretical and empirical literature covers mainly developing countries like Zambia and cross country analysis of mainly Low Income Countries (LICs). Some of these studies did not focus on external debt sustainability but on the dynamics of economic growth which is at the centre of debt sustainability. Other key macroeconomic factors associated with debt sustainability where interest rates and exchange rates. Interest rate is the cost of borrowing; the theoretical and empirical observations are that interest rates are adversely affecting debt sustainability. Exchange rate depreciation tends to increase external debt burden which negatively affects debt sustainability. The gains from economic growth are associated with increased revenue which faces competing demands that can affect final allocation to debt servicing. Thus increases in GDP can easily translate into increased revenue but may not automatically translate into increased allocation for debt service and thus the impact on debt sustainability may be ambiguous.

Exports are associated with increasing national output and improving or stabilising the exchange rate. Therefore exports are generally associated with positive impact on debt sustainability. Expenditure decisions on capital and current have implications for debt sustainability. Expenditure on capital is associated with increased stimulation of the productive sector and is therefore associated with positive impact on debt sustainability. There are two schools of thought on current expenditure. One school associates current expenditure with increased productivity of the public service which in turn can contribute to overall economic growth and debt sustainability. The other school regards current expenditure as promoting more consumption rather than enhancing national productivity and therefore current expenditure is associated with low economic growth and negative impact on debt sustainability. The impact of expenditure decisions (i.e the choices between current and capital expenditure) on debt sustainability will be investigated in this study. This study like Chongo (2013) employs the ordinary least squares (OLS) and vector auto regression (VAR) techniques to determine macroeconomic factors and debt sustainability.

3 RESEARCH METHODOLOGY

This chapter attempts to develop a model that can be used to test the relationship between external debt sustainability and macroeconomic factors. The model will be specified in terms of the relevant solvency indicators and other control variables which are known to affect growth. The following section gives a detailed analysis of the research approach methodology which will be followed by the findings in the next chapter.

3.1 Research Approach and Strategy

The research technique is mainly quantitative and analytical. Historical models were conducted to see how macroeconomic indicators in the use of both foreign debt and local resources can relate to the promotion of solvency. Different multivariate regressions were run using E-views 3.1. To determine which macroeconomic factors influence sustainability, the models used simple Ordinary Least Squares (OLS) as well as a Vector Auto Regression (VAR) to capture dynamic relationships.

Most time series errors tend to be correlated over time. Trending factors that affect the response variable may be correlated with the explanatory variables. Therefore, the dynamic structure of time series models makes the Ordinary Least Squares (OLS) estimator upwards biased and may lead to spurious regression results unless a time trend is added to eliminate this problem (Wooldridge, 2009). A further constraint is the failure of the technique to capture both short-run and long-run dynamics of the macroeconomic variables in a specified model according to Omotoye, (2006) and Sachs (1989). In addition if variables are non-stationary, it can lead to spurious regression, so the time has to be incorporated. Unit roots were used to check for stationarity of the data.

Due to the OLS model limitations and avoiding the risk of the regressions being spurious, the vector auto regression model (VAR) was employed. The Vector Error Correction Model (VECM) of the VAR is better able to estimate a structural equation which may contain non stationary variables. This was used to capture many interesting dynamic relationships using single equation time series. The VECM is used to measure short run relations among the variables, as well as the adjustment mechanism that take place to restore the long run

equilibrium when variables deviate from it. Before proceeding with the VECM, a cointegration analysis was conducted to assess whether there was long term relationship among variables that are integrated of the same order. According to Enders (2008), cointegration refers to a linear combination of non-stationary variables which implies that there is a possibility that nonlinear long run relationships exist among integrated variables. A lack of cointegration suggests that the variables have no long term relationship. The Johansen cointegration test was used to determine these cointegrating vectors.

Once a long run relationship has been established between series, a vector error correction model can be applied. The VECM takes into account non-stationarity of variables and automatically corrects for this. The number of cointegrating factors was used to estimate the VECM. The VECM indicates that any short-term fluctuations between the independent variables and the dependent variable will give rise to a stable long run relationship between the variables. The paper followed the rule of thumb, that if the T-stat is above two, then you reject the hypothesis:

H0: $\beta = 0$ (variable not significant)
H0: $\beta \neq 0$ (Variable is significant)

Once the VECM was estimated, the study used the Granger causality test to determine the direction of the causality and to show whether; the variables have causal effects on each other, both individually and jointly in the short run. Impulse response functions were also conducted to show the dynamic interrelationships among variables in the VECM.

3.2 Data Collection, Frequency and Choice of Data

3.2.1 Data Collection

The study employed secondary data. The data on exchange rates, interest rates, GDP and GDP growth rates were taken from the World Bank development indicators. The expenditure and revenue figures were taken from publications of the United Nations Economic Commission for Africa (UNECA) statistical yearbook in various issues. Where there was missing data from these principal sources, data was supplemented from National Bureau of Economic Research

(NBER) working papers and publications. The following section gives a more detailed analysis of the frequency and choice of the data as taken from these sources.

3.2.2 Frequency and Choice of Data

Response Variable: Solvency Indicator (SI) or (PVD_GDP)

The response variable used as a measure of debt sustainability was the solvency indicator (SI), and the proxy used to measure this was the ratio of present value of external debt to GDP (PVD_GDP). The "SI" and "PVD_GDP" are therefore interchangeably used to mean the same thing. Sustainability can also be measured by the ratio of present value of external debt to revenue (PVD_REV) and the ratio of present value of external debt to exports (PVD_EX). The PVD_GDP was used because Zambia's debt was unsustainable using this ratio but sustainable using other ratios.

The annual data on GDP in dollars were converted from domestic currencies using single year official exchange rates as taken from the World Bank Data. External debt in dollars was also taken from the same source, but because WB did not have external debt data in 1970 and 1971, the missing data was derived from the Debt: GDP ratios from NBER working papers (Reinhart, 2010). PVD_GDP was calculated by dividing external debt by one plus average interest rate on external debt commitments while taking into account the time value of money and present valuing it back to time zero. This was then divided by annual GDP.

From a policy perspective, an increase in SI means a movement towards unsustainable debt. The paper seeks to assess the impact of key economic variables on SI. These variables are examined in the following section. As shown from literature, in order for debt to be at sustainable levels, the ratios should not grow over time so that it is kept below the given thresholds. Therefore economic variables were assessed to identify those that were inversely and positively related to SI. Those variables that were inversely related to SI had a positive impact on external debt sustainability and those that were positively related to SI had a negative impact on sustainability.

Explanatory Variables

GDP Growth (GDPG)

GDP growth is an important factor that can improve debt sustainability prospects. This is because a growing GDP will be better able to service the debt and will keep the SI below the threshold. It is therefore expected that an increase in GDP growth will lead to an inverse relationship with SI. The data on GDP growth rate were taken from WB as annual percentage GDP growth at market prices.

Exchange Rate (EXR)

Movements in exchange rate can affect sustainability. If the kwacha is depreciating, the debt service burden in kwacha terms will increase. The expectation is that a depreciating currency will lead to an increase in the response variable making external unsustainable, while an appreciation will lead to a negative response. The exchange rate sourced from the World Bank Data was calculated as an annual average based on monthly averages in kwacha/Dollar terms.

Interest Rates

Interest rates affect debt sustainability at two levels, it will determine the quantum of debt service repayments. Increasing interest rates will lead to higher outflows of debt service which may consequently lead to a default and slow down growth of the economy. Therefore it is expected that increasing interest will push up the solvency indicator making it unsustainable. On the other hand, Interest rates are also factored in the solvency indicator (Present Value of Debt: GDP) which is a proxy for debt sustainability. Sovereign creditors often charge interest rates that match the riskiness of the borrower. If higher interest rates correctly reflect the risk of the country, then one can expect to see more sustainability and therefore a declining solvency indicator.

The interest rate used from World Bank data (2014) were the average interest on new external debt commitments, publicly contracted during the year. To obtain the average, the interest rates for all public and publicly guaranteed loans were weighted by the amounts of the loans. Debt from official creditors included loans from international organizations (multilateral loans) and loans from governments (bilateral loans). The data left out loans from funds administered by an international organization on behalf of a single donor government; loans from autonomous bodies, and direct loans from official export credit agencies. These interest rate as taken from

the World Bank were only given from 1972 to 2012. The interest rate for 1970 was estimated using the actual interest payment in 1970 divided by external debt. The interest rate for 1972 was derived from the average interest rates from 1973 to 1980.

Revenues (REV)

It is assumed that with a growing economy, tax revenues will increase and improve debt servicing capacity. If revenues are growing, this will build government capacity to service the foreign debt as well as reduce the risk of default on debt obligations. It is therefore expected that an increase in revenues will lead to a decrease in SI, therefore promoting sustainability. The annual revenue data in kwacha was taken from the African statistical year books, various issues were converted into dollars using annual exchange rate from the World Bank. The revenues comprised taxes, non-taxes and grants. However, in 1979, there was no publically available data for revenues, so the revenues for that year were estimated from GDP growth rate.

Exports (EX)

The volume of exports are a useful indicator influencing debt sustainability, as the economy generates productive capacity and foreign currency with which to pay foreign debt. Exports can help in stabilizing the exchange rate and by increasing contribution to GDP growth and public revenue. Exports will be expected to be positively related to debt sustainability, thus an increase in exports should lead to a decrease in the solvency indicator. Annual exports data on goods and services were obtained from WB (2014).

Expenditure (EXP_GDP, CAP,CUEP)

Expenditure figures were obtained from UNECA statistical yearbooks in various issues. The figures were given in kwacha and were converted using the annual exchange rates from WB(2014). There are various views on the impact of expenditure on debt sustainability. While some scholars argue that capital expenditure will lead to growth and consequently greater capacity for servicing the debt, others argue that expenditure on operation is more important and the other school of thought argues that it does not matter what you spend on, as long as you are spending.

Capital Expenditure (CAP)

Capital expenditure as taken from the statistical year books consisted of expenditure for acquisition of fixed capital assets, stocks, land or intangible assets plus unrequited transfers for the purpose of permitting the recipient to acquire such assets to be used for more than one year. This capital expenditure was used as the proxy for infrastructure expenditure. The assumption is that if the external debt is used on economic infrastructure and other productivity enhancing factors the economy will grow with capacity to service the loan. So one would expect to see an additional percentage increase in capital expenditure leading to a decrease in SI.

Current Expenditure (CUEP)

Current expenditure as defined by OECD is expenditure on goods and services consumed within the current year, which needs to be made recurrently such as salaries and social assistance. Contrary to the capital expenditure argument, it is assumed that if external borrowing is spent on operational and routine administration, economic growth will be sluggish and there may not be adequate capacity to service the loan. The expected relationship will therefore be that, an increase in current expenditure will lead to an increase in SI and hence make debt unsustainable. There is another school that believes current expenditure promotes growth. Given the two different schools, the expectation of impact of current expenditure on debt sustainability is ambiguous.

Total Expenditure to GDP (EXP_ GDP)

The other school of thought follows Keynes idea that it doesn't matter what government is spending on, as long as its spending money, this will bring about growth. The assumption is that total expenditure will lead to growth and consequently build capacity to service the debt. The ratio of total expenditure as a proportion of GDP (EXP_GDP) was considered a better measure as this puts total expenditure in the context of overall national activities. It was expected that an increase in EXP_GDP will lead to a decrease in SI.

3.3 Sampling

The study used annual time series data for several variables over the period 1970 – 2012. Since past events can influence future events, lags are predominant in times series. This makes analysing time series data a challenge as variables can rarely be independent across time. However, econometric techniques have been developed to address the interdependent of economic time series (Wooldridge, 2009). The vector error correction model was a useful technique employed to capture the lag effects.

3.4 Data Analysis Methods

The paper used time series data analysis using multiple regression analysis. According to Kothari (2004), the analysis of time series is a good way to understand the dynamic conditions for achieving the short term and long-term goals of business. Due to the fact that there was high multicollinearity in some of the key explanatory variables, the variables could therefore not be used in one single equation. Three models were established using multiple regression equations. Some inferential analysis was also conducted to determine what validity data can be said to indicate some conclusions. Causality tests were also included and descriptive stats were also conducted to check for normality.

3.5 Research Reliability and Validity

To ensure reliability, the paper conducted diagnostic tests on normality, heteroskedasticity, autocorrelation, multicollinearity and unit roots. Some tests had no problems while others had problems which were however corrected for, hence making conclusions from the T and F tests valid. The coefficient of determination R – squared (R^2) and R adjusted (R Adj) were used to measure the goodness of fit of a regression model. This measure lies between zero and one, the closer it is to one, the better the fit for the model. The problem with R^2 is that, the figure goes up every time regressors are added to the model, so the R Adj takes into account this problem and is therefore a better measure. The Akaike Information Criterion (AIC) and Schwarz Information Criterion (SIC) were also used to compare in-sample or out-of-sample forecasting performance of a model . AIC further carried the idea of imposing a penalty for adding regressors to the model which is harsher than R^2. According to Gujarati (2004), for comparison purposes, the model with the lowest value of AIC is preferred. SIC is also similar to AIC but

harsher. All of this was done to maximise reliability of the evidence collected and conclusions from the models.

3.6 Limitations

The challenge with using annual data was that while some figures were taken as an annual average such as (exchange rates), others were taken as weighted average such as interest rate which may have affected the results of the model. The other challenge with annual figures, is that the period may be too long and may not fully capture short term effects which may not be reflected in the results. The macroeconomic environment of a country is always changing from year to year such as new economic policies and regulations. In future it will definitely be better to use more frequent data to capture all these small effects. Some figures such as expenditure are only given from the budget at the beginning of the year and may also have lags when they are to be implemented.

Public finance figures were taken from the United Nations Economic Commission for Africa (UNECA) statistical year books for various issues. The year books cover various country statistics for nine year periods. There were a few discrepancies in the year books, so the data relied on more recent end of year books notably; 1975, 1985, 2001, 2002, 2005, 2008, 2011 and 2013.

4 RESEARCH FINDINGS, ANALYSIS AND DISCUSSION

This section presents and discusses the empirical findings of this study. Before proceeding with the OLS and VAR estimating techniques, some diagnostic tests were conducted for both estimating techniques. This was then followed by interpretation of the results of OLS and finally VAR.

4.2 Diagnostic Tests

4.2.1 P-Value

The study based the significance of estimates on 5% significance level. A P- value refers to the probability that if the hypothesis is true, the test statistic would have as extreme as or more extreme than the one obtained. This implies that if the P-value is greater than the 5% significance level, we fail to reject the hypothesis and if it is less than the 5% significance the hypothesis is rejected. Based on single parameters the T- test was used and the hypothesis is given as:

H0: $\beta 0 = 0$

H1: $\beta 0 \neq 0$

The hypothesis of the overall model F- test is given as:

H0: $\beta 0 = \beta 1 = \beta 2 = \beta 3 = \beta 4 = 0$

H1: $\beta 0 \neq \beta 1 \neq \beta 2 \neq \beta 3 \neq \beta 4 \neq 0$

4.2.2 Test for Normality

It is always important to check residuals for normality as this could lead to biased estimates. The Jarque –Bera test was used to test the normality of residuals in the model. The hypothesis for Jarque – Bera is given as:

H0: Data is normal

H1: Data is not normal

As shown in Table 3, the SI, INT, EXR, GDPG were normally distributed with a P-Value greater than 5%. The remaining variables were not normal distributed and were therefore

transformed using Johnson transformation using (Minitab 17) as shown in Appendix 1. It is clear that after correcting for this, the data became normal with p-values greater than 5%. This is in line with Brooks's (2001) findings that financial variables are almost always non-normal in distribution.

Table 3: Descriptive Stats

	SI	INT	LNEXR	REV	CAP	CUEP	EXP_GDP	GDPGR	EX
Mean	0.837	0.028	4.452	1810219.000	323974.700	1106390.000	296.348	2.517	1982.997
Median	0.606	0.022	6.115	694833.900	260613.800	789623.800	300.455	3.299	1158.267
Maximum	1.735	0.066	8.546	21794618.000	1526245.000	3778289.000	528.051	9.209	9362.470
Minimum	0.094	0.005	-0.441	432.600	209.860	385.000	0.333	-8.625	700.840
Std. Dev.	0.541	0.020	3.675	4336072.000	263496.400	883332.100	99.971	4.085	2133.800
Skewness	0.310	0.484	-0.220	4.189	2.302	1.680	-0.592	-0.522	2.352
Kurtosis	1.629	1.744	1.310	18.946	11.164	5.008	5.372	2.512	7.533
Jarque-Ber	4.055**	4.507**	5.467**	581.314	157.388	27.452	12.592	2.380**	76.455
Probability	0.132	0.105	0.065	0.000	0.000	0.000	0.002	0.304	0.000
Observatio	43	43	43	43	43	43	43	43	43

Source: Output from Eviews.

SI= solvency Indicator, Int= interest, Lexr=Exchange rate, Rev = revenue, Cap= capital expenditure, CUEP= current Expenditure, Exp_GDP = Expenditure/GDP, GDPG = GDP growth, Ex= Export

4.2.3 Test for Unit Root

If time series data has a trend, this means that the mean and variance are not constant over time and this may lead to spurious regressions. The paper determined whether variables were stationary before drawing inferences from them. In order to transform the non-stationary series, the variables were differenced of the same order to become stationary. The hypothesis for a unit root is stated as:

H0: $\beta = 0$ (unit root exits or non-stationary)
H1: $\beta = 1$ (no unit root or stationary)

The Augmented Dickey-Fuller (ADF) test was used to test for stationarity and the results are shown in table 4 below. According to table 4, the ADF test showed that GDPGR and EXP_GDP were stationary in levels. The variables SI, INT, EXR, CUEP, EX were stationary in first difference and these variables need to be differenced before they are used in a regression. Therefore running a regression with these variables cannot lead to a spurious regression.

Table 4: Augmented Dickey – Fuller Unit Root Tests

Variable Code	ADF STATISTIC	ORDER OF INTEGRATION
SI	1.224738	I(1)
INT	-1.453056	I(1)
EXR	0.562164	I(1)
CUEP	0.394249	I(1)
EX	2.857788	I(1)
REV	2.398895	I(1)
GDP	-0.176113	I(1)
CAP	0.534638	I(1)

Source: Output from Eviews

McKinnon critical values are used for rejection of hypothesis of a unit root.

(ii) Critical values for ADF statistics are -3.5778, -2.9256 and -2.6005 at 1%, 5% and 10% Significance level respectively.

4.2.4 Test for Autocorrelation/ Serial correlation

Autocorrelation occurs when successive error terms are interdependent which may lead to inefficient estimators. To test for this, the Breusch Godfrey serial correlation for Lagrange Multiplier (LM) was used. The results for all the models are shown in table 6 which revealed that there was no problem of serial correlation. The hypothesis for autocorrelation is given as:

H0: no serial correlation of any order

H1: there is serial correlation

4.2.5 Multicollinearity Tests

To test whether there was a high degree of correlation between independent variables a correlation matrix of independent variables was used as shown in table 5. The results showed that there was very high correlation between exports and current expenditure, exports and capital expenditure as well as capital expenditure and current expenditure. Using these variables in one equation may result in distorting values of regression coefficients. The paper therefore used these variables in separate equations as shown in equations (1), (2) and (3).

Table 5: Multi- Collinearity Matrix

	REV	GDPG	EX	CAP	CUEP	EXP_GDP	INT	EXR
REV	1.000							
GDPG	0.188	1.000						
EX	0.574	0.465	1.000					
CAP	0.611	0.318	**0.718**	1.000				
CUEP	0.661	0.386	**0.949**	**0.732**	1.000			
EXP_GDP	0.477	-0.317	-0.213	0.074	-0.024	1.000		
INT	-0.273	-0.184	-0.352	-0.362	-0.264	0.394	1.000	
EXR	0.389	0.506	0.611	0.315	0.289	-0.313	-0.520	1.000

Source: Output from Eviews

4.2.6 Test for heteroskedasticity

Heteroskedasticity occurs when the variance of the error term given the explanatory variables is not constant which can lead to inefficient estimators. Although this not particularly necessary in time series, the study used the White Heteroskedasticity test with no cross terms to test for this on the models. The probability value in all three models was greater than 5% as attached in Appendix 2. This means we fail to reject the null hypothesis and concluded that there was no heteroskedasticity in all the models. The hypothesis is given as:

H0: there is no heteroskedasticity
H1: there is heteroskedasticity

4.2.7 Test for Structural Break

Given that Zambia's external debt was unsustainable prior to 2006, it is easy for one to conclude that there were structural break in 2005. The chow test was used to test for structural breaks in the models and found that there was no structural break at 5% significance level for all the models as shown in table 6. The hypothesis for chow breakpoint test is given as:

H0: there is no structural break
H1: there is structural break

4.3 OLS Models

The estimation analysis was based on the three equations as shown below, which gave output to three models. Table 6, shows outputs of the tables, followed by the discussion of the results.

Equation 1

$$\Delta SI = C + \Delta REV + \Delta EXP\_GDP + \Delta LEXR + \Delta EX + \Delta INT + \varepsilon \quad (1)$$

Equation 2

$$\Delta SI = C + \Delta REV + \Delta GDPG + \Delta INT + \Delta EXR + \Delta CUREXP + \varepsilon \quad (2)$$

Equation 3

$$\Delta SI = C + \Delta REV + \Delta GDPG + \Delta INT + \Delta CAP + \Delta EXR + \varepsilon \quad (3)$$

Table 6: Regression Output and Diagnostic Tests

Dependent Variable: D(PVD_GDP) Method: Least Squares Date: 11/20/14 Time: 13:02 Sample(adjusted): 1971 2012 Included observations: 42 after adjusting endpoints			
	Model 1	Model 2	Model 3
Dependent Variable			
D(SI)			
Response Variables			
C coefficent Std.E Tstat Pvalue	-0.000695 0.043511 -0.015982 0.9873	-0.001064 0.045291 -0.023489 0.9814	0.038189 0.060449 0.631748 0.5315
D(REV) coefficent Std.E Tstat Pvalue	0.001753 0.091249 0.01921 0.9848	0.033445 0.096475 0.346675 0.7309	-0.041827 0.069006 -0.606142 0.5482
D(Exp_GDP) coefficent Std.E Tstat Pvalue	0.000497 0.000504 0.986089 0.3307		
D(EXR) coefficent Std.E Tstat Pvalue	0.009281 0.087763 0.105752 0.9164	-0.005751 0.091749 -0.062684 0.9504	-0.012438 0.010325 -1.204582 0.2362
D(EX) coefficent Std.E Tstat Pvalue	-0.377686 0.164754 -2.292422 0.0278 *		
D(INT) coefficent Std.E Tstat Pvalue	-14.59865 1.968334 -7.416755 0.0000 *	-13.90123 1.976255 -7.034127 0.0000 *	-14.46025 2.088635 -6.923301 0.0000 *

D(GDPG) [coefficent, Std.E, Tstat, Pvalue]		[-0.009138, 0.006842, -1.335553, 0.1901]	[-0.004382, 0.007493, -0.584768, 0.5624]
D(CUEP) [coefficent, Std.E, Tstat, Pvalue]		[-2.78E-07, 1.37E-07, -2.030390, 0.0498*]	
D(CAP) [coefficent, Std.E, Tstat, Pvalue]			[0.046992, 0.067710, 0.694014, 0.4921]
R-squared	0.649544	0.618995	0.596019
Adjusted R-squared	0.600870	0.566077	0.539911
F-statistic	13.34469	11.69738	10.62263
Prob(F-statistic)	0.00000	0.000001	0.000003
Durbin-Watson stat Prob(Fstat)	2.476517 0.000000	2.193709	2.168427
Mean dependent var	-0.006643	-0.006643	-0.006643
S.D. dependent var	0.357483	0.357483	0.357483
Akaike info criterion	-0.006365	0.077214	0.135768
Schwarz criterion	0.241873	0.325452	0.384007
LM - Statistic LM – Prob	1.276038 0.292171	0.093 0.9108	0.202667 0.817529
Chow breakpoint test :2005 Fstat Prob	 0.657463 0.684051	 0.610010 0.720337	 0.259646 0.951312

Source: Output from Eviews

4.3.1 Interpretation of OLS findings

In the first model, the study found interest and exports to be significant factors at 5% significance level. A percentage change in exports leads to 0.377% decrease in the solvency indicator while holding other variables constant. This result was expected as the increase in

exports tends to increase national income and improves exchange rate. A percentage increase in interest rate also leads to 14.59% decrease in SI ceteris Paribas. This is contrary to expectation that high interest may impose higher debt burden payment which may negatively affect sustainability. However, this result could imply that interest rates were fairly priced.

The model had a good fit with 64.95% of variation in the solvency indicator being explained by expenditure/GDP, exports, exchange rates, revenues and interest rates. The remaining 35.35% of variation in the model remained unexplained. The R Adj was also fair with 60.08% of variation in the model being explained by the explanatory variables. The overall model was valid with a significant F-stat indicating the model is robust and all the diagnostic tests were okay.

In model 2, the results show that interest rate is again significant. A percentage increase in interest rate led to 13.90% decrease in the present value of external debt to GDP while holding other variables constant. Current expenditure is also significant at the 5% significance level. A percent change in current expenditure leads to 0.00000027% decline in the PVD/GDP ceteris Paribas. This result is probably due to prudent use of current expenditure on economic factors that stimulated growth. Although the percentage change is really small, this could support the school of thought that believes current expenditure leads to growth, which consequently led to the debt being more sustainable.

The model had a fair fit with 61.89 % of variation in SI being explained by variation in revenues, GDP growth, interest rates, exchange rates and current expenditure. The remaining 38.11% remains unexplained. Taking into account the number of regressors, R Adj was also fair with 56.60 % of variation in the response variable being explained by the independent variables. All diagnostic tests were conducted; there was no problem of multicollinearity, serial correlation and heteroskedasticity.

In the third model, only interest rate was significant as was reported in the other two models. The model had an okay fit with 59.60% of variation in SI being explained by variation in the independent variables. Comparing all three models based on the goodness of fit, model 1 is preferred as it had the highest R^2, followed by model 2 and then model 3. It is valid to compare all the models based on R^2 as the models used the same dependent variable. Based on AIC

results, the best model with the lowest AIC value, model 1 was preferred, followed by model 2 and model 3. This collaborates with the rankings based on R^2.

4.4 VAR Models

The paper also used VAR models to capture the dynamic relationships. The methodology of this technique is similar to simultaneous-equation considering several endogenous variables together. Each endogenous variable is explained by its lagged values and the lagged values of all other endogenous variables in the model (Gujarati, 2004). The VECM was used to analyse the channels through which the key variables interact to impact external debt sustainability. This entailed short run and long run adjustments being made within the model.

The same models of equations (1), (2) and (3) were used with the same diagnostic tests. Before proceeding with the VECM, the number of lags to be included in the models was estimated by the Varsoc function. The results attached in Appendix 3 reveal that for model 1, Final Prediction Error (FPE), Akaike Information Criterion (AIC) and Hanna and Quinn Information Criteria (HQIC) chose four lags. However using this number into the VECM function could not work as the given data set was insufficient. The challenge with the VECM is that it is a restricted form of VAR which requires large data set. Due to this problem, the lag pair was set to the default of two lags. The varsoc model 2 also showed that FPE and AIC chose four lags as shown in appendix 3, but due to the same problem, optimal lag of two was used. The varsoc model 3 showed that FPE, HQIC and Schwartz Bayesian Information Criterion (SBIC) chose one lag, however the VECM function in Eviews 3.1 will not work unless there are at least two lags.

4.4.1 VECM Results: Model 1

Model 1 of VECM used the same variables of OLS equation (1) as shown below:

Equation 4

$$\Delta SI = C + \Delta REV + \Delta EXP\_GDP + \Delta LEXR + \Delta EX + \Delta INT + \varepsilon \quad (1)$$

Results from the VECM tables show the coefficient, the standard error and T-stat as shown in tables 7, 8 and 9. The VECM models were based on the T statistics and the general rule of thumb is to reject the null hypothesis if the T- stat is greater than two. The results from table 7 show that, there were three cointegrating equations (CEq). This means that there was long term, or equilibrium relationships among the variables within the equations. The first cointegration revealed that there were long run relationships among solvency indicator, revenues and interest rates. The second cointegration equation disclosed that there were long term relations with present value of debt/GDP, revenues and total expenditure/GDP. This result of the second cointegration equation was similar to the finding of the final cointegrating equation.

Our main interests are the VECM results in (column 2) of table 7, which found the one year lag of expenditure as a proportion of GDP positively related to the solvency indicator. This implies that a percentage change in expenditure/GDP was increasing the solvency indicator and moving towards unsustainability. This result differs from the expectations that total expenditure will lead to growth and consequently improve external debt sustainability. This result could imply that total expenditure/GDP was not used on high return projects in the country. Expenditure cannot just lead to growth, unless it is properly allocated to promote growth. In developing countries including Zambia, one of the common challenges is the prudent use of public resources. There are many cases of public resources being used on expensive projects with minimal impact on economic growth.

The two year lagged Exports led to a decline in SI which is as expected and also similar with the results from OLS model 1. Interest rates also had a negative relationship with SI, similar to results from OLS. The other variables were not significant. The model had a goodness of fit of 71.5% and R adj of 53%. The F-test was significant implying the model is robust.

Results in column 3 of table 7 show that one year lagged expenditure/GDP is inversely related to revenues. Interest rates were also positively related to revenues. In the fifth column, exports at the second lag are negatively related to exchange rates. In final column, revenues at first and second lags are negatively related to interest rates. Expenditure/GDP is also positively linked to interest rates.

Table 7: VECM Model 1

Error Correction:	D(SI)	D(LNREV)	D(EXP_GDP)	D(LNEXR)	D(EXPORT)	D(INT)
CointEq1	-0.277286	0.207045	-2.204034	-0.083452	-116.4174	0.007859
	(0.06335)	(0.06343)	(13.7386)	(0.06735)	(161.165)	(0.00281)
	(-4.37682**)	(3.26398**)	(-0.16043)	(-1.23900)	(-0.72235)	(2.79636**)
CointEq2	0.693744	-1.131569	190.9062	0.387554	-1373.107	-0.008955
	(0.29049)	(0.29086)	(62.9944)	(0.30883)	(738.976)	(0.01289)
	(2.38819**)	(-3.89047**)	(3.03053**)	(1.25490)	(-1.85812)	(-0.69488)
CointEq3	-0.005751	0.004825	-1.901598	-0.004830	1.748370	-3.11E-06
	(0.00236)	(0.00236)	(0.51180)	(0.00251)	(6.00378)	(0.00010)
	(-2.43697**)	(2.04170**)	(-3.71555**)	(-1.92483)	(0.29121)	(-0.02971)
D(SI (-1))	0.003001	0.051001	101.4028	0.178686	-838.3702	-0.003887
	(0.21654)	(0.21681)	(46.9581)	(0.23021)	(550.857)	(0.00961)
	(0.01386)	(0.23523)	(2.15943)	(0.77617)	(-1.52194)	(-0.40463)
D(SI (-2))	0.252029	-0.230387	-4.324441	0.011629	-328.0074	-0.016399
	(0.23604)	(0.23634)	(51.1860)	(0.25094)	(600.454)	(0.01047)
	(1.06775)	(-0.97483)	(-0.08448)	(0.04634)	(-0.54627)	(-1.56608)
D(LNREV(-1))	-0.039894	0.302228	-77.22254	0.049096	7.012699	-0.008659
	(0.22935)	(0.22964)	(49.7350)	(0.24383)	(583.433)	(0.01017)
	(-0.17395)	(1.31612)	(-1.55268)	(0.20135)	(0.01202)	(-0.85104)
D(LNREV(-2))	-0.196246	-0.061341	-70.43058	0.021594	78.00397	-0.017124
	(0.17635)	(0.17658)	(38.2431)	(0.18749)	(448.623)	(0.00782)
	(-1.11281)	(-0.34739)	(-1.84165)	(0.11517)	(0.17387)	(-2.18877)
D(EXP_GDP(-1))	0.003760	-0.003451	0.509753	0.003068	0.105219	3.81E-05

	(0.00167)	(0.00167)	(0.36206)	(0.00178)	(4.24724)	(7.4E-05)
	(2.25223**)	(-2.06437**)	(1.40793)	(1.72856)	(0.02477)	(0.51412)
D(EXP_GDP(-2))	0.000537	-0.001901	0.356391	0.000964	-0.113328	9.40E-05
	(0.00096)	(0.00096)	(0.20718)	(0.00102)	(2.43038)	(4.2E-05)
	(0.56169)	(-1.98725)	(1.72021)	(0.94950)	(-0.04663)	(2.21723**)
D(LNEXR(-1))	0.204982	0.131043	-54.13929	0.250541	-32.37504	-0.008245
	(0.16938)	(0.16959)	(36.7304)	(0.18007)	(430.878)	(0.00751)
	(1.21021)	(0.77270)	(-1.47396)	(1.39133)	(-0.07514)	(-1.09724)
D(LNEXR(-2))	-0.125841	-0.227216	-44.58705	0.079956	69.91192	-0.012331
	(0.16243)	(0.16264)	(35.2250)	(0.17269)	(413.218)	(0.00721)
	(-0.77472)	(-1.39705)	(-1.26578)	(0.46300)	(0.16919)	(-1.71113)
D(EXPORT(-1))	2.45E-05	-1.32E-05	0.041198	-2.90E-05	-0.609328	-1.89E-06
	(0.00013)	(0.00013)	(0.02895)	(0.00014)	(0.33958)	(5.9E-06)
	(0.18327)	(-0.09899)	(1.42320)	(-0.20405)	(-1.79438)	(-0.31843)
D(EXPORT(-2))	-0.000233	-0.000138	0.013087	-0.000232	-0.102292	8.10E-06
	(0.00010)	(0.00010)	(0.02211)	(0.00011)	(0.25934)	(4.5E-06)
	(-2.28129**)	(-1.35133)	(0.59199)	(-2.13934**)	(-0.39443)	(1.79129)
D(INT(-1))	-17.45999	21.13224	3010.709	-10.31087	-34563.41	-0.087355
	(8.62496)	(8.63588)	(1870.38)	(9.16962)	(21941.1)	(0.38263)
	(-2.02436**)	(2.44703)	(1.60968)	(-1.12446)	(-1.57528)	(-0.22830)
D(INT(-2))	-2.432247	7.443995	1009.816	-4.751010	-15816.04	-0.271150
	(5.61447)	(5.62158)	(1217.53)	(5.96902)	(14282.7)	(0.24907)
	(-0.43321)	(1.32418)	(0.82939)	(-0.79594)	(-1.10736)	(-1.08863)
C	0.038721	0.106965	25.38245	0.201361	293.5641	0.003696

	(0.07545)	(0.07555)	(16.3625)	(0.08022)	(191.946)	(0.00335)
	(0.51318)	(1.41584)	(1.55126)	(2.51017)	(1.52941)	(1.10407)
R-squared	0.715239	0.759621	0.707586	0.538562	0.394467	0.794425
Adj. R-squared	0.537264	0.609384	0.524827	0.250164	0.016009	0.665941
Sum sq. resids	1.490757	1.494532	70105.35	1.684983	9647348.	0.002934
S.E. equation	0.249229	0.249544	54.04680	0.264967	634.0133	0.011057
F-statistic	4.018754	5.056151	3.871692	1.867423	1.042301	6.183045
Log likelihood	9.034362	8.983783	-206.1350	6.584939	-304.6238	133.6484
Akaike AIC	0.348282	0.350811	11.10675	0.470753	16.03119	-5.882418
Schwarz SC	1.023834	1.026363	11.78230	1.146305	16.70674	-5.206866
Mean dependent	-0.006675	0.097495	-2.752012	0.222066	213.5492	-0.001175
S.D. dependent	0.366380	0.399275	78.40506	0.305991	639.1500	0.019130

Determinant Residual Covariance	0.148110
Log Likelihood	-302.3493
Akaike Information Criteria	20.81746
Schwarz Criteria	25.63077

Source: Output from Eviews

4.4.2 Granger Causality Results Model 1

Granger causality test were also carried out to determine whether past values of a series in one variable were useful for predicting future values of another variable after past values have been accounted for. The results of the Granger causality are attached in Appendix 4. It revealed the following were significant; SI Granger causes revenues; interest Granger causes solvency indicator; there is a multi-directional Granger causality between revenues and expenditure/GDP; multi-directional Granger causality between exchange rates and revenues; exports Granger cause revenues; multi-directional causality between exchange rates and expenditure/GDP; interest Granger causes expenditure/GDP; and interest Granger cause exchange rates.

4.4.3 Impulse Response Functions – Model 1

Impulse response functions were conducted to show the proportion of movements due to its own shocks and shocks of other variables. The results of the impulse response functions given in appendix 5a for a ten year period reveal that a shock in the solvency indicator (PVD_GDP) due to a shock in itself is positive. It drops slightly after four years but continues to be positive. A shock in SI due to a shocks in revenues are slightly positive in the first two years, then drops and become negative for four years and only rises for a year and drops again then the cycle repeats itself. This could be due to persistent budget deficit. A shock in SI due to a shock in total expenditure/GDP is negative and is at the lowest in three years, it only becomes positive after the eighth year.

A shock in the solvency Indicator due to a shock in exchange rates is positive throughout the period and remains flat after the seventh year. A shock in SI due to an impulse in exports was negative all the way and reached its lowest in the third year. A shock in SI due to effects in interest rate was positive, slowly reducing in the fourth year and getting closer to zero in the eighth year.

Other interesting relations include; the shock in revenues from shocks in exports was positive throughout the period. The shocks in revenues due expenditure were negative. Shocks in exchange rates due to shocks in exports were negative. Impulse of Interest rates due to impulses in revenues was generally positive but negative in second year only. The impulses in interest rates due to impulses in expenditure/ GDP were generally positive but negative the fourth year only. The response to interest rates from exchange rates was negative.

4.4.4 VECM Results Model 2

In VECM model 2 using the same variables as OLS equation given as:

Equation 5

$$\Delta SI = C + \Delta REV + \Delta GDPG + \Delta INT + \Delta EXR + \Delta CUREXP + \varepsilon \quad (2)$$

Using the results given in table 8, it was found that there were long term equilibriums in three cointegrating equations. The first CEq revealed that there were long term equilibriums in the solvency indicator and GDP growth. The second equation revealed there were long term equilibriums in solvency indicator and revenues. The final showed that there were long term relationships in SI, GDP growth and interest.

The second column of VECM results revealed that revenues were positively related to solvency indictor. This is different from expectation that increasing revenues will lead to better capacity for servicing debt thereby improving external debt sustainability. This could be explained by poor revenue utilization within the country. While one would expect that increased revenues will raise the capacity of the country to service the loan, one should also understand the complex decisions that government has to make in allocating resources under conditions of perpetual inadequacies of public resources. In a situation of tremendous social and political pressures, any increase in revenue may not translate into any increase in resources allocated to debt servicing which may have low priority in the overall ranking of expenditure items.

The results also revealed that GDP growth was positively related to SI, which could imply that the economy was not growing enough to foster external debt sustainability. During the study period (1970 -2012), the average annual growth rate was a modest 2.52%. Indeed it is only after 2000 that the growth rate had risen steadily from 3.51% to 7.31% in 2012 as shown in figure 10. Before 2000 the growth rate was very volatile with a number of years showing negative growth. In this kind of situation, combined with social political pressures on the budget, it is not easy for economic growth benefits to be invested in debt service. It is anticipated that any economic growth will lead to increased revenue but these increases in revenue may not easily translate into increases in debt service and overall debt sustainability.

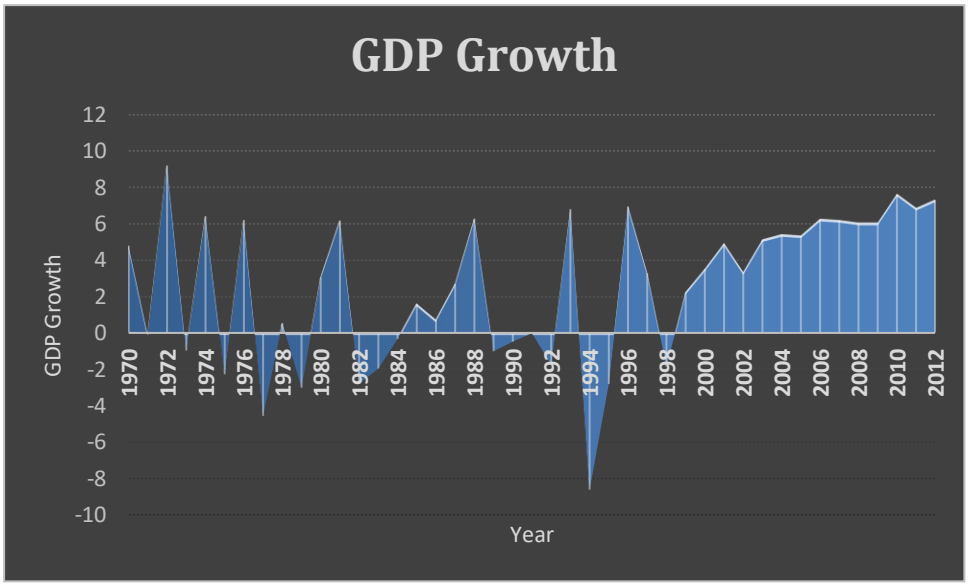

Figure 10: GDP Growth

Source: Author's graph using WorldBank Data

Exchange rate at one year lag was also positively related to SI and this is expected given the volatility of the Zambian kwacha as well as depreciation of the currency which could be resulting in higher payment outflows. The model had 66.73% of variation in SI being explained by variation in the explanatory variables. The remaining 33.27% of variation in SI remains unexplained. The F test was significant with F-stat of 3.2 implying the model was robust.

In column 3, results reveal that an increase in current expenditure will lead to a decrease in revenues; this could mean there is unproductive expenditure. If current expenditure is concentrated on low return projects or factors that do not stimulate private productivity, there may not be any increase in revenues. The extreme result is one of negative impact on revenues. In the fourth column, the results reveal that revenues at one lag are negatively related to GDP growth, which could be the result of inefficient utilization of revenue in the promotion of GDP growth.

Interest rates at both lags are negatively related to GDP growth rate. This suggests that the higher the interest payment outflows, the lower the GDP growth. Exchange rate is also negatively related to GDP growth, this would again be explained by depreciating kwacha increasing external payment and thereby reducing resources for GDP growth. On the other hand in column 5, GDP growth will also negatively impact interest rate slightly. This could imply

that as the country is growing, perhaps the country is improving its credit worthiness which could lower interest rate at which it accesses international finance.

Table 8:VECM Model 2

Error Correction:	D(SI)	D(LNREV)	D(GDPGR)	D(INT)	D(LNEXR)	D(CUREXP)
CointEq1	-0.549400	0.355462	8.064111	0.014797	0.249737	-479814.8
	(0.25548)	(0.33270)	(3.56359)	(0.01006)	(0.27420)	(295786.)
	(-2.15044)	(1.06841)	(2.26292)	(1.47071)	(0.91077)	(-1.62217)
CointEq2	-0.025370	-0.592551	-0.664193	-0.000951	-0.166732	-139825.5
	(0.14468)	(0.18841)	(2.01805)	(0.00570)	(0.15528)	(167503.)
	(-0.17535)	(-3.14503)	(-0.32913)	(-0.16689)	(-1.07375)	(-0.83476)
CointEq3	-0.053739	0.032089	-1.437869	0.003187	-0.023013	56815.28
	(0.02589)	(0.03372)	(0.36113)	(0.00102)	(0.02779)	(29974.5)
	(-2.07566)	(0.95174)	(-3.98160)	(3.12587)	(-0.82817)	(1.89545)
D(SI (-1))	-0.107097	0.018724	-4.724689	0.007800	-0.133067	169493.7
	(0.24941)	(0.32479)	(3.47888)	(0.00982)	(0.26769)	(288755.)
	(-0.42940)	(0.05765)	(-1.35811)	(0.79421)	(-0.49710)	(0.58698)
D(SI (-2))	0.073988	-0.403174	-1.555594	-0.012283	-0.318707	-121660.5
	(0.23136)	(0.30129)	(3.22713)	(0.00911)	(0.24831)	(267859.)
	(0.31979)	(-1.33816)	(-0.48204)	(-1.34821)	(-1.28348)	(-0.45420)
D(LNREV(-1))	0.288036	0.099053	-4.524379	-0.003912	0.250240	58500.82
	(0.13806)	(0.17979)	(1.92572)	(0.00544)	(0.14818)	(159840.)
	(2.08632**)	(0.55094)	(-2.34945**)	(-0.71953)	(1.68880)	(0.36600)
D(LNREV(-2))	0.061900	-0.090360	-1.182145	-0.014463	0.108069	231974.3
	(0.19877)	(0.25885)	(2.77253)	(0.00783)	(0.21333)	(230127.)
	(0.31141)	(-0.34908)	(-0.42638)	(-1.84778)	(0.50657)	(1.00803)

D(GDPGR(-1))	0.045066	-0.005932	0.291630	-0.002725	0.009203	-15007.47
	(0.02071)	(0.02697)	(0.28886)	(0.00082)	(0.02223)	(23975.7)
	(2.17619**)	(-0.21998)	(1.00961)	(-3.34141**)	(0.41408)	(-0.62595)
D(GDPGR(-2))	0.023641	-0.008693	0.086982	-0.001995	-0.003531	-309.9339
	(0.01285)	(0.01674)	(0.17926)	(0.00051)	(0.01379)	(14878.8)
	(1.83958)	(-0.51942)	(0.48523)	(-3.94236**)	(-0.25601)	(-0.02083)
D(INT(-1))	-11.72438	10.56596	-390.1929	0.269185	-12.04478	12443068
	(9.46805)	(12.3298)	(132.065)	(0.37285)	(10.1618)	(1.1E+07)
	(-1.23831)	(0.85695)	(-2.95456**)	(0.72197)	(-1.18530)	(1.13514)
D(INT(-2))	-3.557265	0.253073	-198.5793	-0.044827	-9.268733	937977.8
	(5.99018)	(7.80072)	(83.5538)	(0.23589)	(6.42912)	(6935169)
	(-0.59385)	(0.03244)	(-2.37666**)	(-0.19003)	(-1.44168)	(0.13525)
D(LNEXR(-1))	0.306650	0.089518	-4.816011	-0.004088	0.223825	100767.1
	(0.13760)	(0.17919)	(1.91927)	(0.00542)	(0.14768)	(159304.)
	(2.22860**)	(0.49958)	(-2.50929)	(-0.75441)	(1.51561)	(0.63255)
D(LNEXR(-2))	0.084447	-0.252370	-2.012409	-0.014375	0.067135	227200.9
	(0.20308)	(0.26446)	(2.83264)	(0.00800)	(0.21796)	(235116.)
	(0.41583)	(-0.95429)	(-0.71044)	(-1.79750)	(0.30802)	(0.96634)
D(CUREXP(-1))	-1.46E-07	-8.93E-08	2.24E-06	-6.92E-10	-3.27E-07	-0.210612
	(2.1E-07)	(2.8E-07)	(3.0E-06)	(8.5E-09)	(2.3E-07)	(0.24862)
	(-0.68080)	(-0.31930)	(0.74670)	(-0.08184)	(-1.42029)	(-0.84712)
D(CUREXP(-2))	-3.05E-07	-5.61E-07	4.68E-06	6.15E-09	-3.73E-07	-0.137975
	(2.0E-07)	(2.5E-07)	(2.7E-06)	(7.7E-09)	(2.1E-07)	(0.22577)
	(-1.56259)	(-2.21038**)	(1.72046)	(0.80039)	(-1.78152)	(-0.61114)

C	-0.097639	0.156085	0.699883	0.004142	0.160647	37812.62
	(0.07514)	(0.09785)	(1.04805)	(0.00296)	(0.08064)	(86990.7)
	(-1.29947)	(1.59519)	(0.66780)	(1.39996)	(1.99207)	(0.43467)
R-squared	0.667348	0.524995	0.712748	0.810775	0.450639	0.354771
Adj. R-squared	0.459441	0.228116	0.533216	0.692509	0.107288	-0.048498
Sum sq. resids	1.741474	2.953297	338.8206	0.002701	2.006044	2.33E+12
S.E. equation	0.269372	0.350791	3.757329	0.010608	0.289111	311867.6
F-statistic	3.209833	1.768382	3.970029	6.855520	1.312474	0.879739
Log likelihood	5.925409	-4.638392	-99.48936	135.3058	3.096760	-552.5544
Akaike AIC	0.503730	1.031920	5.774468	-5.965290	0.645162	28.42772
Schwarz SC	1.179281	1.707471	6.450020	-5.289738	1.320714	29.10327
Mean dependent	-0.006675	0.097495	-0.047299	-0.001175	0.222066	75433.22
S.D. dependent	0.366380	0.399275	5.499476	0.019130	0.305991	304569.6
Determinant Residual Covariance		187.4315				
Log Likelihood		-445.2135				
Akaike Information Criteria		27.96068				
Schwarz Criteria		32.77398				

Source: Output from Eviews

4. 4.5 Granger Causality Results Model 2

The Granger causality for model 2 was also estimated as shown in Appendix 4B. The results reveal that; SI Granger causes revenues; interest rates Granger causes SI; GDP growth Granger causes revenues; current expenditure Granger causes revenues; exchange rates Granger causes GDP growth; GDP growth Granger causes current expenditure and multi-directional causality between exchange and interest rates.

4.4.6 Impulse Response Functions – Model 2

The results of the impulse response functions for model 2 are given in appendix 5b for a 10 year period. The results reveal a shock in solvency indicator due to a shock in itself is positive. A shock in solvency indicator due to a shock in revenue becomes negative after two years and continues decreasing. A shock in SI due to shocks in GDP is negative after two years and becomes positive in the seventh year, after which it stays positive but modest. Impulses in SI due to impulses in interest and exchange rate are positive throughout the period while the impulse from current expenditure fluctuates around zero.

Other interesting responses were impulses in GDP growth due to impulses in revenue were negative for the first two years, after which they rose exponentially and remained positive for the period. It was also found that impulses in GDP growth due to interest rate, exchange rate and current expenditure were fluctuating around zero.

4.4.7 VECM Model 3

The final model used variables from equation (3)

Equation 6

$$\Delta SI = C + \Delta REV + \Delta GDPG + \Delta INT + \Delta CAP + \Delta EXR + \varepsilon \quad (3)$$

The results from table 9 showed that there were four cointegrating equations. The second CEq shows that there are long term relationships with GDP growth and capital expenditure. The third CEq shows relationships between GDP growth and interest rates. The final equation reveals long term equilibrium between solvency indicator and interest rate.

The VECM results showed that GDP growth at lag one was positively related to SI, similar to the previous model. This again would imply the economy was not growing to impact positively on external debt sustainability. Interest rate at lag one, is still negatively related to SI as was shown in previous models implying that the interest rates could have been correctly priced or maybe under-priced. Exchange rate is also positively related to SI, reflecting the kwacha

depreciation impact on external debt burden. The model had a good fit, with R^2 of 71.04% and R Adj of 50.09%.

Table 9:VECM Model 3

Error Correction:	D(SI)	D(LNREV)	D(GDPGR)	D(INT)	D(LNCAPEX)	D(LNEXR)
CointEq1	-0.349970	-0.398950	-0.770431	0.005506	0.330934	-0.000613
	(0.20573)	(0.33571)	(2.91435)	(0.00719)	(0.29128)	(0.23206)
	(-1.70109)	(-1.18838)	(-0.26436)	(0.76560)	(1.13615)	(-0.00264)
CointEq2	-0.156429	0.003961	3.508804	0.005554	0.461651	0.032548
	(0.11896)	(0.19411)	(1.68511)	(0.00416)	(0.16842)	(0.13418)
	(-1.31500)	(0.02041)	(2.08224)	(1.33581)	(2.74107)	(0.24258)
CointEq3	-0.045829	0.023892	-1.477688	0.002003	0.029025	-0.002600
	(0.02536)	(0.04138)	(0.35924)	(0.00089)	(0.03590)	(0.02860)
	(-1.80718)	(0.57737)	(-4.11343)	(2.25932)	(0.80839)	(-0.09090)
CointEq4	38.92965	-25.24981	125.6216	-1.980274	-18.51073	20.23169
	(10.7946)	(17.6142)	(152.912)	(0.37731)	(15.2830)	(12.1756)
	(3.60641)	(-1.43349)	(0.82153)	(-5.24844)	(-1.21120)	(1.66165)
D(SI (-1))	-0.221472	0.501023	0.366680	0.015546	-0.063709	0.020426
	(0.20678)	(0.33742)	(2.92922)	(0.00723)	(0.29276)	(0.23324)
	(-1.07103)	(1.48486)	(0.12518)	(2.15093)	(-0.21761)	(0.08757)
D(SI (-2))	-0.003508	0.142136	2.442268	-0.005914	-0.526212	-0.212698
	(0.20990)	(0.34251)	(2.97340)	(0.00734)	(0.29718)	(0.23676)
	(-0.01671)	(0.41498)	(0.82137)	(-0.80602)	(-1.77069)	(-0.89838)
D(LNREV(-1))	0.204751	-0.156717	-4.897218	-0.006308	0.027127	0.003969
	(0.14950)	(0.24395)	(2.11775)	(0.00523)	(0.21166)	(0.16863)
	(1.36958)	(-0.64242)	(-2.31246)	(-1.20724)	(0.12816)	(0.02354)
D(LNREV(-2))	-0.159534	-0.154306	-0.237426	-0.012348	-0.052029	-0.099321
	(0.20086)	(0.32775)	(2.84525)	(0.00702)	(0.28437)	(0.22655)
	(-0.79427)	(-0.47081)	(-0.08345)	(-1.75876)	(-0.18296)	(-0.43840)
D(GDPGR(-1))	0.046381	0.000147	0.316522	-0.002066	-0.011421	-0.000727
	(0.01988)	(0.03243)	(0.28156)	(0.00069)	(0.02814)	(0.02242)
	(2.33347**)	(0.00455)	(1.12415)	(-2.97381**)	(-0.40584)	(-0.03244)
D(GDPGR(-2))	0.014693	0.016485	0.217254	-0.001392	-0.003391	-0.005791
	(0.01327)	(0.02165)	(0.18794)	(0.00046)	(0.01878)	(0.01496)
	(1.10749)	(0.76147)	(1.15597)	(-3.00263)	(-0.18052)	(-0.38699)
D(INT(-1))	-25.27954	28.55261	-98.61064	0.814225	29.52116	-18.86348
	(9.39661)	(15.3331)	(133.109)	(0.32844)	(13.3037)	(10.5988)
	(-2.69028**)	(1.86216)	(-0.74083)	(2.47904**)	(2.21901**)	(-1.77977)

D(INT(-2))	-10.13851	12.85108	-62.73121	0.198148	9.421165	-11.60077
	(5.61054)	(9.15508)	(79.4770)	(0.19611)	(7.94341)	(6.32837)
	(-1.80705)	(1.40371)	(-0.78930)	(1.01040)	(1.18604)	(-1.83314)
D(LNCAPEX(-1))	0.232413	0.112814	1.265847	-0.003160	-0.316942	0.305507
	(0.12432)	(0.20286)	(1.76105)	(0.00435)	(0.17601)	(0.14022)
	(1.86950)	(0.55612)	(0.71880)	(-0.72716)	(-1.80071)	(2.17872**)
D(LNCAPEX(-2))	-0.020059	0.191422	1.922016	0.004438	0.110711	0.142700
	(0.10434)	(0.17026)	(1.47810)	(0.00365)	(0.14773)	(0.11769)
	(-0.19224)	(1.12426)	(1.30033)	(1.21686)	(0.74941)	(1.21247)
D(LNEXR(-1))	0.459596	-0.008609	-3.975177	-0.009853	-0.387179	0.328347
	(0.16189)	(0.26416)	(2.29327)	(0.00566)	(0.22920)	(0.18260)
	(2.83896**)	(-0.03259)	(-1.73341)	(-1.74124)	(-1.68924)	(1.79816)
D(LNEXR(-2))	-0.128153	-0.035677	0.618377	-0.009224	0.007213	0.060401
	(0.21728)	(0.35455)	(3.07788)	(0.00759)	(0.30762)	(0.24508)
	(-0.58981)	(-0.10063)	(0.20091)	(-1.21450)	(0.02345)	(0.24646)
C	-0.119926	0.143823	0.706888	0.005006	0.143366	0.114465
	(0.08204)	(0.13387)	(1.16212)	(0.00287)	(0.11615)	(0.09253)
	(-1.46184)	(1.07437)	(0.60827)	(1.74583)	(1.23432)	(1.23700)
R-squared	0.710484	0.350908	0.742151	0.870252	0.772256	0.471931
Adj. R-squared	0.509082	-0.100634	0.562778	0.779992	0.613826	0.104578
Sum sq. resids	1.515651	4.035660	304.1396	0.001852	3.038115	1.928294
S.E. equation	0.256706	0.418884	3.636408	0.008973	0.363445	0.289549
F-statistic	3.527687	0.777133	4.137465	9.641639	4.874416	1.284681
Log likelihood	8.703145	-10.88335	-97.32969	142.8526	-5.204695	3.887332
Akaike AIC	0.414843	1.394167	5.716484	-6.292632	1.110235	0.655633
Schwarz SC	1.132617	2.111941	6.434258	-5.574859	1.828009	1.373407
Mean dependent	-0.006675	0.097495	-0.047299	-0.001175	0.057138	0.222066
S.D. dependent	0.366380	0.399275	5.499476	0.019130	0.584853	0.305991
Determinant Residual Covariance		9.04E-10				
Log Likelihood		75.94756				
Akaike Information Criteria		2.502622				
Schwarz Criteria		7.822592				

Source: Output from Eviews

4.4.8 Granger Causality Results Model 3

The Granger causality tests were also done in model 3 as shown in Appendix 4C. The tests revealed that solvency indicator Granger causes revenues; interest rate Granger causes solvency indicator; GDP growth Granger causes revenues; GDP growth Granger causes capital expenditure; exchange rates Granger causes GDP growth; interest rates Granger cause capital expenditure and multi directional causality between interest and exchange rates.

4.4.9 Impulse Response Functions – Model 3

The results of the impulse response functions for model 3 are given in appendix 5c for a ten year period. The results revealed that shocks in SI due shocks to itself, interest rate and exchange rate were positive as found in models 1 and 2. Shocks in SI from shocks in revenues were negative for the whole period. Impulse in SI due to GDP growth was very low and was actually negative from year two to year four. Impulses in Si due to impulses in capital expenditure were negative till year eight after which it started fluctuating around zero. Shocks in GDP growth due to shocks in capital expenditure and exchange rate fluctuated around zero. Shocks in GDP growth due to shocks in revenues were positive after two years.

Having reviewed the VAR models, the most robust model on the basis of the lowest AIC and SIC was model 3 which had AIC value of 2.50 and SIC value of 7.82. This was followed by model 1 which had AIC 20.82 and SIC 25.63. The least robust was model 3 with AIC 27.96 and SIC 32.77.

5 RESEARCH CONCLUSIONS

Given the high dependency on external funding in Zambia, the study assessed the dynamics of macroeconomic factors notably GDP growth, revenues, exports, expenditure pattern, interest and exchange rates that impinge on external debt sustainability. By managing these macroeconomic factors well, the country would indirectly improve external debt sustainability. Even factors that may not be within the control of the Government will need to be approached with a clear understanding of what they mean for debt sustainability for Zambia. The study used OLS and VECM estimating techniques using secondary data from 1970 to 2012.

The impulse response of the solvency indicator to revenue, GDP growth and total expenditure/GDP were generally negative over a ten year period. The impulse responses from exchange and interest rates to shocks on the solvency indicator were positive. The impulse response of SI from impulses in exports was negative.

The econometric results of the study found that interest rate was significant across all the OLS and VECM models. Although the expectation was that high interest would increase the solvency indicator making external debt unstainable, the result was that interest rates led to declining solvency indictor. This would imply that interest rates were fairly charged or under-priced given the debt levels.

The OLS model 2 showed that current expenditure was significantly related to sustainability, the expectation was that expenditure on capital would lead to this effect and not current expenditure. However, given the high level of expenditure on recurrent activities in Zambia, the results showed that current expenditure is also positively related to debt sustainability. This result may please the advocates of high spending on social services such as the World Bank which advocates a minimum of 35% of national budget going to social services in Zambia.

Capital expenditure was not a significant factor relating to the solvency indicator. This is different from expectations as infrastructure is assumed to have high returns through impact on productive capacity of both public and private sectors. This outcome may reflect the poor attention paid to infrastructure development in Zambia where capital expenditure as a share of total expenditure has consistently been the lowest in Africa.

The models also showed that total expenditure to GDP was inversely related to sustainability. We had anticipated that total expenditure would mean more resources for servicing the debt and should therefore be positively related to sustainability. This result indicates that even as expenditure was rising, the provisions for debt service were not rising at the same pace. This could reflect the complexity of expenditure decisions in which social and political pressures could relegate debt servicing to a low priority level.

Exports were also positively related to sustainability as the increase in exports was leading to a decrease in the solvency indictor. This result was expected and this also reflects that Zambia's exports are doing well. This should support Zambia's policy emphasis on increasing non-traditional exports to stabilize the export base.

Revenues were inversely related to the solvency indicator. This is contrary to expectations as increased revenues would normally be expected to lead to increased resources for debt servicing. This again reflects the challenges in budgetary allocations that arise from strong social and political pressures that give low priority to debt service in budgetary allocations.

GDP growth was inversely related to debt sustainability, which could have reflected that the country was not growing high enough in relation to the accumulation of debt. Otherwise, GDP growth should mean greater capacity to service the debt.

Exchange rates were also found to be inversely related to debt sustainability which could be explained by the impact of the depreciating kwacha on the debt burden. This result collaborates Chongo's (2013) findings on the inverse relationship of the kwacha depreciation and the foreign public debt stock, as well as public debt service.

5.1 Policy Implications

There are a number of policy implications that can be drawn from this study. In recognition of the inevitability of foreign debt and the need to avoid a debt trap, the Government through the

Ministry of Finance should strengthen its capability for debt management. This requires clear identification and assessment of the factors that have a bearing on debt sustainability. Since everything will revolve around GDP growth, it is important to implement policies in a holistic framework that can mitigate the bottlenecks that promote malfunctioning of the economy. The Government should also develop capabilities and instruments for dealing with factors that are not within its control such as international interest rates and exchange rates.

Although interest rates were positively related to external debt sustainability in this study, the Government should still watch out for interest rate risk. Given the opportunity that the country can now borrow from international capital markets with B+ rating, the Government should focus on diversifying its interest rate exposure and make investments in high return projects such as infrastructure. It will also be important to maintain Zambia's high credit worthiness so that it can mobilize external funds at competitive interest rates. Maintaining a high credit rating may require serious control on the appetite for foreign debt. This should entail vigilance in the area of fiscal discipline and overall management of the deficit.

Countries usually opt for the Euro bond due to the limitation of their own capital markets. Due to increasing demand for deficit financing, Government should explore the alternative of domestic funding to reduce the high dependency on external funds. This may entail growing the domestic capital market. The Lusaka Stock Exchange (LuSE) remains small and weak but has plenty of room for growth. The recently developed bond and derivatives market when fully developed can provide good opportunities to the Government for domestic borrowing.

Public finance data is very limited. The Bank of Zambia (BOZ), Ministry of Finance (MOF) , Zambia Revenue Authority (ZRA) and Central Statistics Office (CSO) do not have a credible harmonized system for managing data. Most of these institutions may have access to recent data but all have difficulties in storing and retrieving historical data. This makes it difficult for debt management staff to plan and implement credible debt management programs. Moreover, access of public finance data by researchers is not easy as the data centres feel it is highly political and might be used against them. It is therefore necessary to improve and harmonize data management systems and create a common data management platform for all key institutions. There is also need to promote transparency in the management and utilization of public finance data.

With regard to revenue mobilization, Zambia cannot gain much by raising taxes which are already considered to be exorbitant and inequitable. However, there is opportunity space for increasing tax revenue through broadening the tax base and improving tax administration. One area generally mentioned as a target for broadening the tax base is the large informal sector which accounts for around 80% of the labour force in the country. The exclusion of this sector from the tax pool mainly reflects the high tax administration costs entailed in collecting taxes from scattered small scale informal sector operators who have no credible operational or financial records. The first task for Zambia in this area is to facilitate registration of small companies through simplified registration procedures. The registered small businesses can be enticed into tax brackets through concessionary tax rates that promote tax compliance rather than tax avoidance by small enterprises.

Exports are important for both solvency and liquidity in the servicing of external debt. The current policy emphasis on non-traditional exports i.e agricultural and other non-mining products should be encouraged. There is a lot of scope especially in the agricultural sector for expanding agricultural exports. It is generally accepted that Zambia's agricultural potential has historically been under-utilized. Current Government programs on expansion of roads will resolve one of the major constraints on agricultural production. However, in order to fully realize the agricultural potential, Government should systematically harmonize infrastructure development with other agricultural promotion policies.

The exchange rate is not entirely under the full control of the Zambian government. However, policies that promote exports especially non-traditional exports will tend to help stabilize the exchange rate. The national export policies may be the principal avenue for Zambia to influence and achieve the desired exchange rates. It is of course assumed that in the day to day management of financial instruments, the use of financial derivatives can help to mitigate exchange rate risks especially for private sector. However the export promotion remains the major avenue for achieving significant impact on the exchange rate.

GDP growth is fundamental to debt sustainability. The economy should be growing to generate adequate tax revenue to service the debt. Government should therefore stay focused on policies that enhance economic growth. Current policies of massive expansion of infrastructure especially roads, energy, water and communications should be encouraged as they will provide significant support not only to the private sector which is recognised as the engine of economic

growth, but also the public sector. The recent expenditure decisions that have encouraged steady increase in capital expenditure are likely to have greater impact on economic growth and should therefore be encouraged.

6 RECOMMENDATIONS FOR FUTURE RESEARCH

As Roubini (2001) has put it, assessing solvency "is an "art" that requires considering a very broad range of indicators, factors, forecasts about likely future policy events and shocks in a country." This paper has touched on a number of variables which were considered to have a high likelihood of impacting on debt sustainability. Future research can explore other factors that contribute to debt sustainability.

The paper's focus was confined to external debt whose overall sustainability could be influenced by levels of domestic debt. Therefore future research may also examine drivers of domestic debt sustainability separately or as part of the overall total debt of the country. It will also be interesting to see how the various macro-economic factors influence debt sustainability in different countries. For instance the quantum of revenue may not be the critical factor per say but how the revenue is distributed among competing needs of the economy. The ranking of debt service on the expenditure priority list may vary from country to country. Therefore the results of this study may not be generalised for other countries. It will also be good in another 10 years to look at how significant and dramatic improvements in infrastructure and capital markets impinge on debt sustainability.

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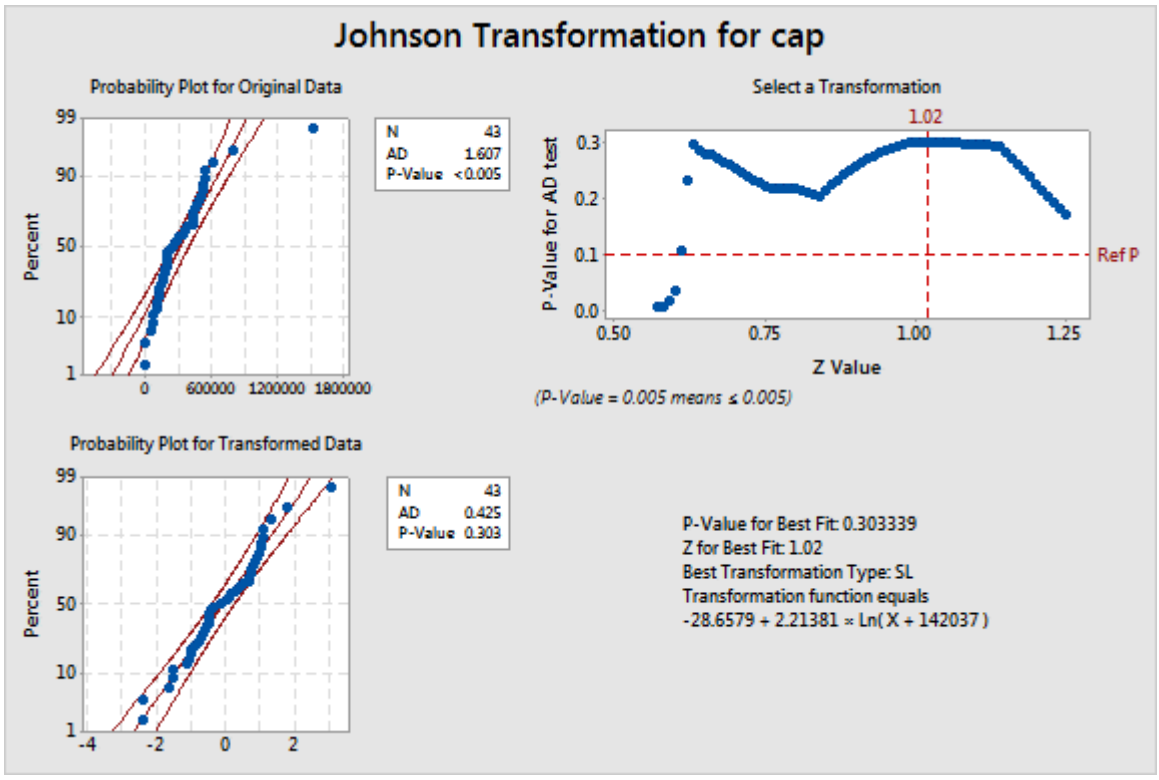
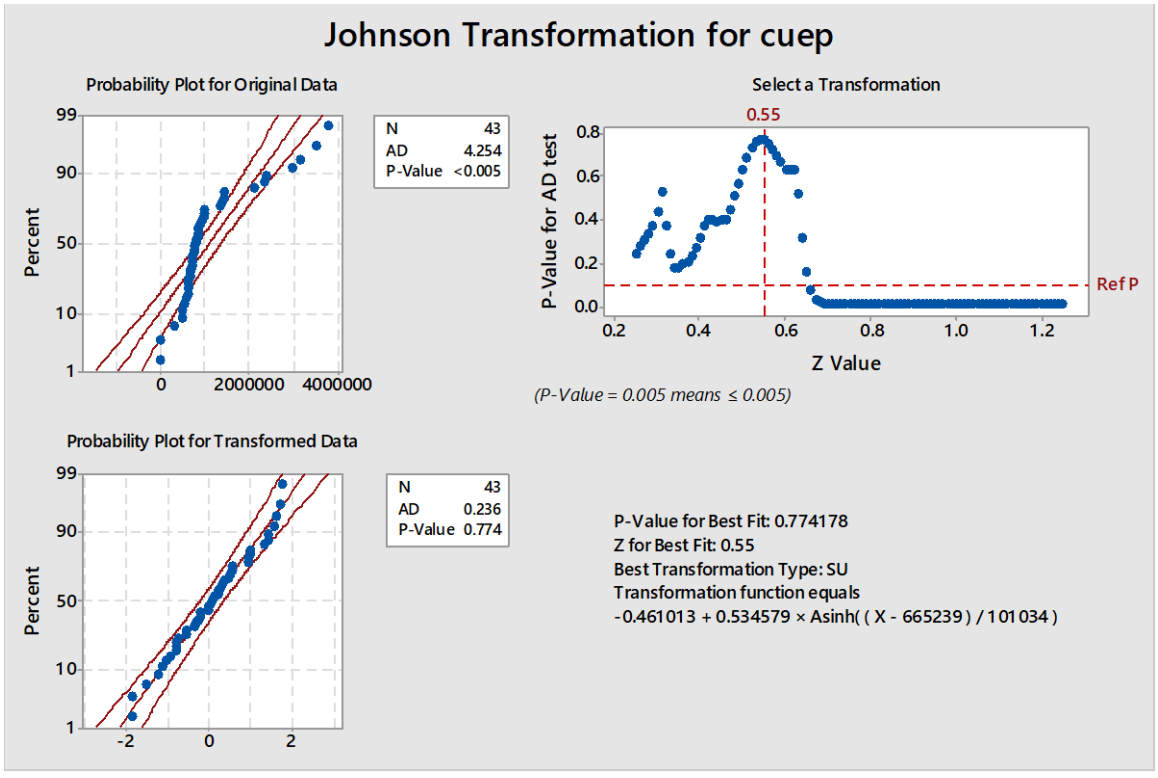
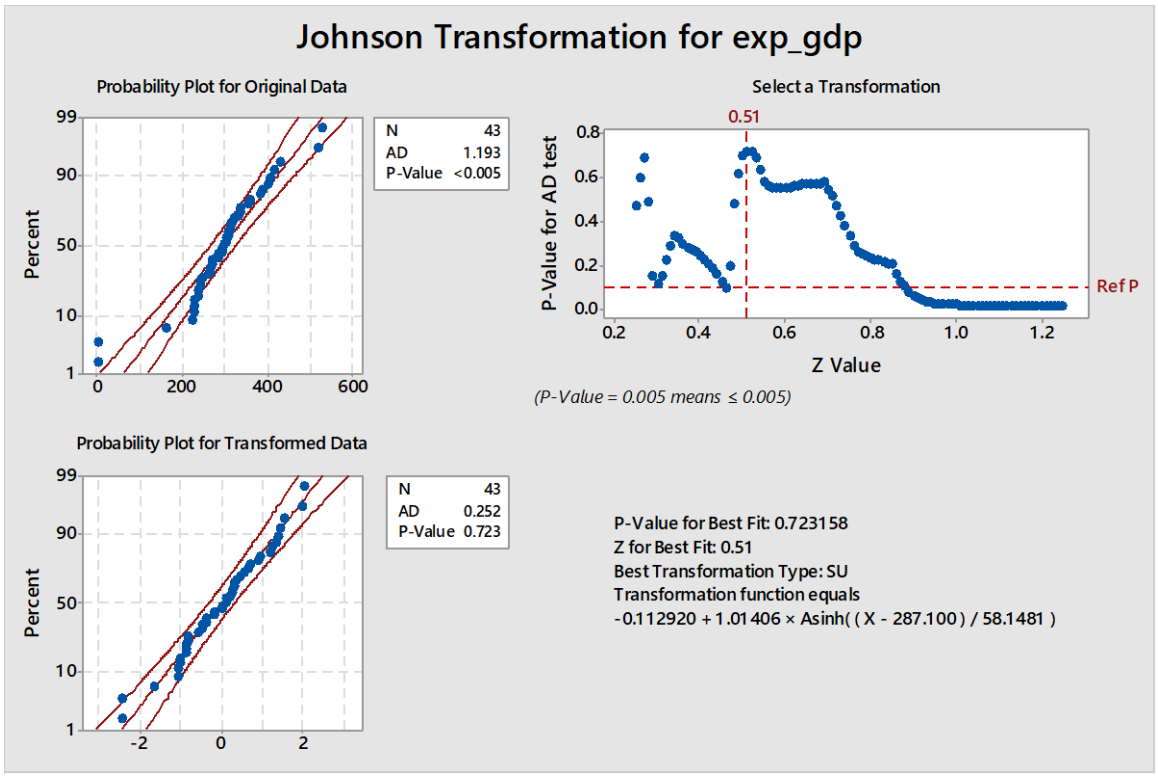
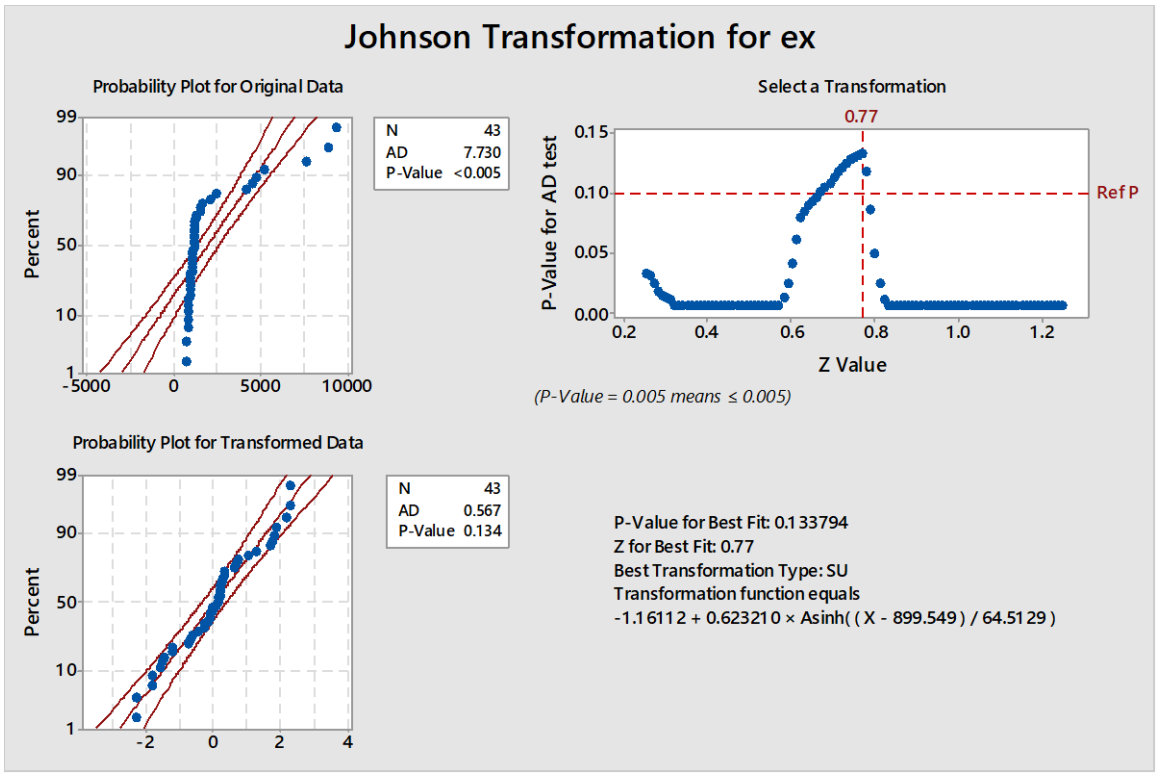
APPENDICES

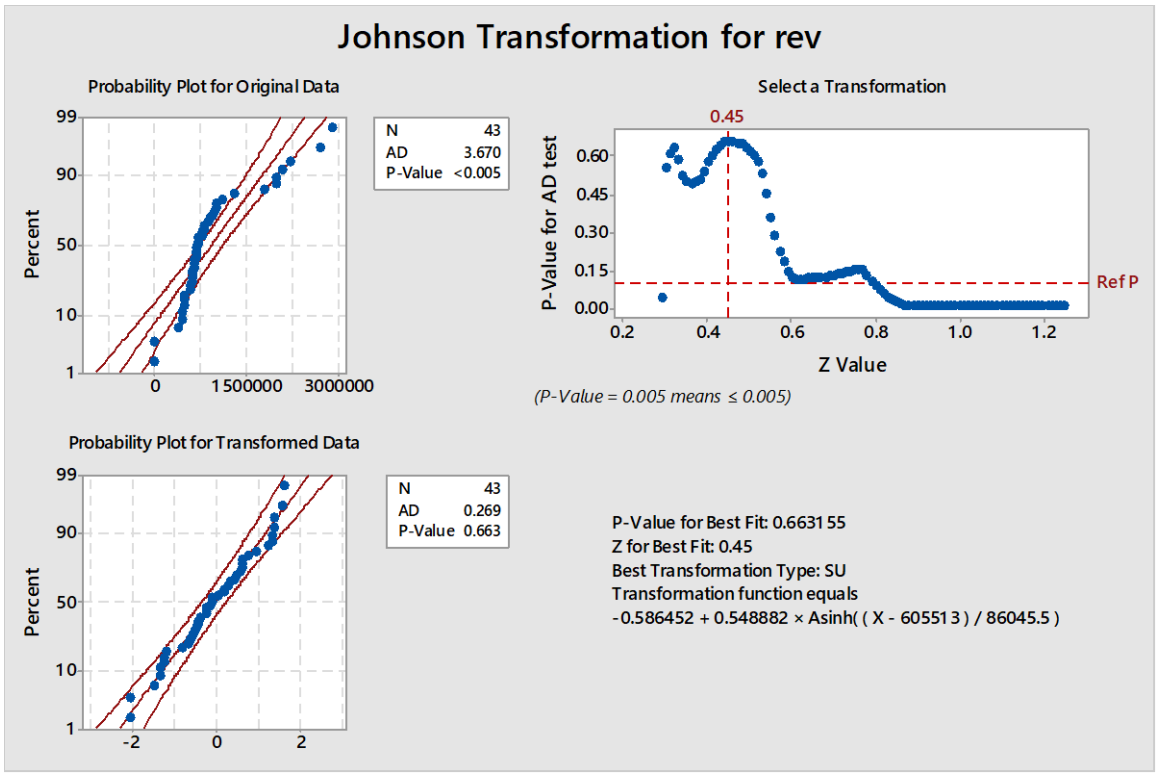
Appendix 1: Normality Transformation






Johnson Transformation for exp_gdp
Probability Plot for Original Data
Percent
N 43
AD 1.193
P-Value <0.005
Select a Transformation
0.51
P-Value for AD test
Ref P
Z Value
(P-Value = 0.005 means ≤ 0.005)
Probability Plot for Transformed Data
N 43
AD 0.252
P-Value 0.723
P-Value for Best Fit: 0.723158
Z for Best Fit: 0.51
Best Transformation Type: SU
Transformation function equals
-0.112920 + 1.01406 × Asinh((X - 287.100) / 58.1481)


Johnson Transformation for ex
Probability Plot for Original Data
Percent
N 43
AD 7.730
P-Value <0.005
Select a Transformation
0.77
P-Value for AD test
Ref P
Z Value
(P-Value = 0.005 means ≤ 0.005)
Probability Plot for Transformed Data
N 43
AD 0.567
P-Value 0.134
P-Value for Best Fit: 0.133794
Z for Best Fit: 0.77
Best Transformation Type: SU
Transformation function equals
-1.16112 + 0.623210 × Asinh((X - 899.549) / 64.5129)


Johnson Transformation for rev
Probability Plot for Original Data
Percent
99
90
50
10
1
0
1500000
3000000
N 43
AD 3.670
P-Value <0.005
Select a Transformation
0.45
P-Value for AD test
0.60
0.45
0.30
0.15
0.00
0.2
0.4
0.6
0.8
1.0
1.2
Z Value
Ref P
(P-Value = 0.005 means ≤ 0.005)
Probability Plot for Transformed Data
Percent
99
90
50
10
1
-2
0
2
N 43
AD 0.269
P-Value 0.663
P-Value for Best Fit: 0.663155
Z for Best Fit: 0.45
Best Transformation Type: SU
Transformation function equals
-0.586452 + 0.548882 × Asinh((X - 605513) / 86045.5)

Appendix 2: Heteroskedasticity Test

White Heteroskedasticity Test - Model 1

White Heteroskedasticity Test:

F-statistic	0.579219	Probability	0.818111
Obs*R-squared	6.612057	Probability	0.761491

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 11/30/14 Time: 12:01

Sample: 1971 2012

Included observations: 42

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.049723	0.021454	2.317675	0.0272
D(REV)	-0.022295	0.069010	-0.323074	0.7488
(D(REV))^2	-0.008471	0.038164	-0.221971	0.8258
D(EXP_GDP)	0.000147	0.000173	0.848876	0.4025
(D(EXP_GDP))^2	-5.38E-07	1.12E-06	-0.479509	0.6349
D(EXR)	-0.023706	0.048870	-0.485078	0.6310
(D(EXR))^2	0.007427	0.029751	0.249646	0.8045
D(EX)	0.104484	0.081178	1.287097	0.2076
(D(EX))^2	-0.038377	0.188733	-0.203340	0.8402
D(INT)	0.335820	0.668061	0.502679	0.6187
(D(INT))^2	8.327483	19.28463	0.431820	0.6689

R-squared	0.157430	Mean dependent var	0.043720
Adjusted R-squared	-0.114367	S.D. dependent var	0.067858
S.E. of regression	0.071634	Akaike info criterion	-2.214377

Sum squared resid	0.159073	Schwarz criterion	-1.759273
Log likelihood	57.50191	F-statistic	0.579219
Durbin-Watson stat	2.123015	Prob(F-statistic)	0.818111

White Heteroskedasticity Test - Model 2

White Heteroskedasticity Test:

F-statistic	0.593668	Probability	0.806597
Obs*R-squared	6.750483	Probability	0.748772

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 11/30/14 Time: 12:08

Sample: 1971 2012

Included observations: 42

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.056526	0.023008	2.456818	0.0198
D(REV)	-0.039251	0.069236	-0.566911	0.5749
(D(REV))^2	-0.004552	0.038659	-0.117737	0.9070
D(GDPG)	0.000404	0.002709	0.148954	0.8826
(D(GDPG))^2	-0.000284	0.000334	-0.850643	0.4015
D(INT)	0.529814	0.710592	0.745596	0.4615
(D(INT))^2	10.12294	22.63574	0.447210	0.6578
D(EXR)	0.005950	0.052937	0.112402	0.9112
(D(EXR))^2	0.009841	0.030459	0.323090	0.7488
D(CUEP)	1.15E-07	7.19E-08	1.598950	0.1200

(D(CUEP))^2	-1.04E-13	1.13E-13	-0.919436	0.3650

R-squared	0.160726	Mean dependent var	0.047531
Adjusted R-squared	-0.110008	S.D. dependent var	0.077547
S.E. of regression	0.081701	Akaike info criterion	-1.951366
Sum squared resid	0.206928	Schwarz criterion	-1.496262
Log likelihood	51.97868	F-statistic	0.593668
Durbin-Watson stat	2.310179	Prob(F-statistic)	0.806597

White Heteroskedasticity Test - Model 3

White Heteroskedasticity Test:

F-statistic	0.826623	Probability	0.606627
Obs*R-squared	8.841737	Probability	0.547186

Test Equation:

Dependent Variable: RESID^2

Method: Least Squares

Date: 11/30/14 Time: 12:10

Sample: 1971 2012

Included observations: 42

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.053713	0.023396	2.295839	0.0286
D(REV)	0.046834	0.065313	0.717077	0.4787
(D(REV))^2	-0.051388	0.041700	-1.232335	0.2271
D(GDPG)	0.003381	0.003379	1.000557	0.3248
(D(GDPG))^2	-0.000519	0.000393	-1.319000	0.1968

D(INT)	0.145480	0.850887	0.170974	0.8654
(D(INT))^2	-0.092719	25.76830	-0.003598	0.9972
D(CAP)	0.070841	0.032674	2.168119	0.0379
(D(CAP))^2	0.037040	0.031557	1.173741	0.2494
D(EXR)	0.011132	0.060057	0.185353	0.8542
(D(EXR))^2	0.004528	0.042112	0.107526	0.9151

R-squared	0.210518	Mean dependent var	0.052423
Adjusted R-squared	-0.044154	S.D. dependent var	0.091559
S.E. of regression	0.093558	Akaike info criterion	-1.680341
Sum squared resid	0.271347	Schwarz criterion	-1.225237
Log likelihood	46.28715	F-statistic	0.826623
Durbin-Watson stat	2.009396	Prob(F-statistic)	0.606627

Appendix 3: Optimal lags

Varsoc Model 1 – Optimal Lag

Selection-order criteria
Sample: 1974 - 2012 Number of obs = 39

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-243.647				.014629	12.8024	12.8942	13.0584
1	-50.3569	386.58	36	0.000	4.7e-06	4.73625	5.37903	6.52778*
2	-18.1729	64.368	36	0.003	6.5e-06	4.93194	6.12569	8.25907
3	24.2587	84.863	36	0.000	6.9e-06	4.60212	6.34682	9.46484
4	92.4683	136.42*	36	0.000	3.2e-06*	2.95034*	5.246*	9.34866

Endogenous: pvd_gdp lnrev exp_gdp lnexr lnexp inte
Exogenous: _cons

Varsoc Model 2 –Optimal Lag

Selection-Order criteria

Sample: 1970 – 2012 Number of obs = 39

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-558.908				329326	29.732	29.824	29.9906*
1	-508.448	100.92	36	0.000	157823	28.971	29.6149*	30.7809
2	-477.376	62.145	36	0.004	236922	29.2303	30.4263	32.5917
3	-425.215	104.32	36	0.000	153917	28.3798	30.1277	33.2925
4	-369.947	110.54*	36	0.000	149157*	27.3656*	29.6655	33.8298

Endogenous: PVD_GDP REV GDPG INT EXR CUEP

Exogenous: _Cons

Varsoc Model 3 –Optimal Lag

Selection-Order criteria

Sample: 1970 – 2012 Number of obs = 39

lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	-162.675				.00023	8.65002	8.74185	8.90595
1	17.5777	360.51	36	0.000	1.4e-07*	1.25242	1.89521*	3.04395*
2	46.1668	57.178	36	0.014	2.4e-07	1.63247	2.82621	4.95959
3	86.0988	79.864	36	0.000	2.9e-07	1.43083	3.17553	6.29355
4	128.944	85.69*	36	0.000	4.9e-07	1.07981*	3.37547	7.47813

Endogenous: PVD_GDP REV GDPG INT CAP EXR

Exogenous: _Cons

Appendix 4 Granger Causality Test

4a. Granger - Model 1

Pairwise Granger Causality Tests

Date: 12/01/14 Time: 21:51

Sample: 1970 2012

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
D(REV) does not Granger Cause D(SI)	41	0.13049	0.87808
D(SI) does not Granger Cause D(REV)		6.48417	0.00394
D(EXP_GDP) does not Granger Cause D(SI)	41	0.66164	0.52217
D(SI) does not Granger Cause D(EXP_GDP)		1.16936	0.32208
D(EXR) does not Granger Cause D(SI)	41	1.88194	0.16697
D(SI) does not Granger Cause D(EXR)		1.09398	0.34575
D(EX) does not Granger Cause D(SI)	41	1.41935	0.25508
D(SI)does not Granger Cause D(EX)		0.25841	0.77370
D(INT) does not Granger Cause D(SI)	41	3.87595	0.02989
D(SI) does not Granger Cause D(INT)		0.46226	0.63354
D(EXP_GDP)does not Granger Cause D(REV)	41	9.53329	0.00048
D(REV) does not Granger Cause D(EXP_GDP)		7.28699	0.00220
D(EXR) does not Granger Cause D(REV)	41	5.44573	0.00859
D(REV) does not Granger Cause D(EXR)		41.1580	5.0E-10
D(EXP) does not Granger Cause D(REV)	41	57.1609	6.7E-12
D(REV) does not Granger Cause D(EX)		0.88166	0.42285
D(INT) does not Granger Cause D(REV)	41	1.46626	0.24424
D(REV) does not Granger Cause D(INT)		1.78145	0.18292

D(EXR) does not Granger Cause D(EXP_GDP)	41	9.84026	0.00039
D(EXP_GDP) does not Granger Cause D(EXR)		10.1154	0.00033
D(EX) does not Granger Cause D(EXP_GDP)	41	2.20490	0.12493
D(EXP_GDP) does not Granger Cause D(EX)		2.45566	0.10006
D(INT) does not Granger Cause D(EXP_GDP)	41	7.63394	0.00172
D(EXP_GDP) does not Granger Cause D(INT)		0.25691	0.77484
D(EX) does not Granger Cause D(EXR)	41	1.10449	0.34235
D(EXR) does not Granger Cause D(EX)		3.07323	0.05858
D(INT) does not Granger Cause D(EXR)	41	7.90003	0.00143
D(EXR) does not Granger Cause D(INT)		3.63103	0.03660
D(INT) does not Granger Cause D(EX)	41	1.16220	0.32426
D(EX) does not Granger Cause D(INT)		0.88197	0.42272

4b. Granger - Model 2

Pairwise Granger Causality Tests

Date: 12/03/14 Time: 13:23

Sample: 1970 2012

Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
D(REV) does not Granger Cause D(SI)	41	0.13049	0.87808
D(SI) does not Granger Cause D(REV)		6.48417	0.00394
D(GDPG) does not Granger Cause D(SI)	41	2.19271	0.12630
PVD_GDP does not Granger Cause GDPGR		0.47684	0.62460
D(INT) does not Granger Cause D(SI)	41	3.87595	0.02989
D(SI) does not Granger Cause INT		0.46226	0.63354

D(EXR) does not Granger Cause D(SI)	41	1.88194	0.16697
D(SI) does not Granger Cause D(EXR)		1.09398	0.34575
D(CUEP) does not Granger Cause D(SI)	41	0.93935	0.40025
D(SI) does not Granger Cause D(CUEP)		0.75400	0.47777
D(GDPG) does not Granger Cause D(REV)	41	9.33991	0.00054
LNREV does not Granger Cause GDPGR		0.51889	0.59956
D(INT) does not Granger Cause D(REV)	41	1.46626	0.24424
D(REV) does not Granger Cause D(INT)		1.78145	0.18292
D(EXR) does not Granger Cause D(REV)	41	5.44573	0.00859
D(REV) does not Granger Cause D(EXR)		41.1580	5.0E-10
D(CUEP) does not Granger Cause D(REV)	41	46.1801	1.2E-10
D(REV) does not Granger Cause D(CUEP)		1.23825	0.30194
D(INT) does not Granger Cause D(GDPG)	41	1.60899	0.21415
D(GDPG) does not Granger Cause D(INT)		0.03566	0.96500
D(EXR) does not Granger Cause D(GDPG)	41	3.56979	0.03852
GDPGR does not Granger Cause LNEXR		0.43031	0.65361
D(CUEP) does not Granger Cause D(GDPG)	41	1.05573	0.35846
D(GDPG) does not Granger Cause D(CUEP)		4.52722	0.01763
D(EXR) does not Granger Cause D(INT)	41	3.63103	0.03660
D(INT) does not Granger Cause D(EXR)		7.90003	0.00143
D(CUEP) does not Granger Cause D(INT)	41	0.11980	0.88745
D(INT) does not Granger Cause D(CUEP)		1.13830	0.33162
D(CUEP) does not Granger Cause D(EXR)	41	0.88890	0.41994
D(EXR) does not Granger Cause D(CUEP)		1.86047	0.17025

4c. Granger - Model 3

Pairwise Granger Causality Tests

Date: 12/03/14 Time: 13:32

Sample: 1970 2012

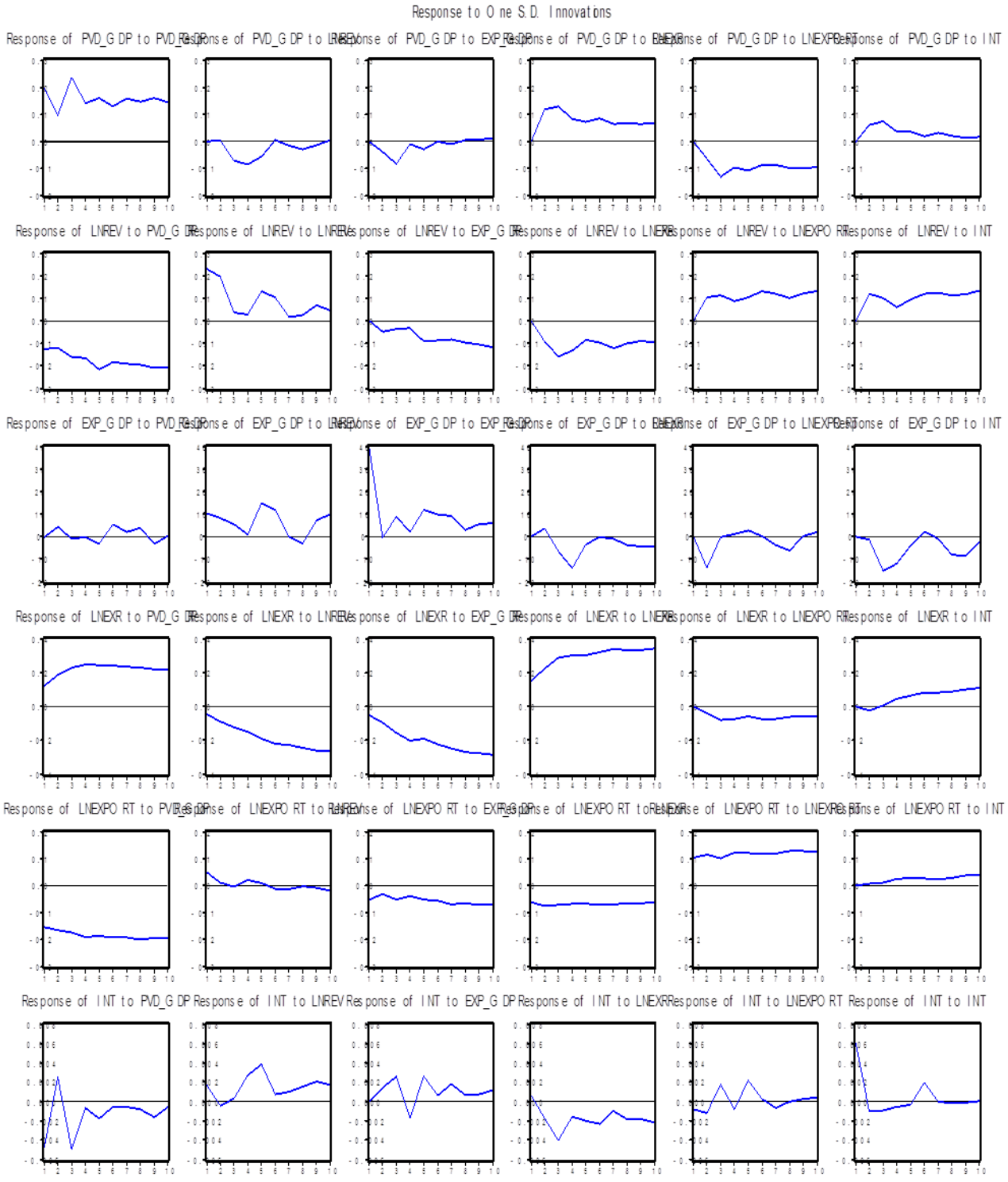
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Probability
D(REV) does not Granger Cause D(SI)	41	0.13049	0.87808
D(SI) does not Granger Cause D(REV)		6.48417	0.00394
D(GDPG) does not Granger Cause D(SI)	41	2.19271	0.12630
D(SI) does not Granger Cause D(GDPG)		0.47684	0.62460
D(INT) does not Granger Cause D(SI)	41	3.87595	0.02989
D(SI) does not Granger Cause D(INT)		0.46226	0.63354
D(CAP) does not Granger Cause D(SI)	41	0.01651	0.98363
D(SI) does not Granger Cause D(CAP)		2.55439	0.09175
D(EXR) does not Granger Cause D(SI)	41	1.88194	0.16697
D(SI) does not Granger Cause D(EXR)		1.09398	0.34575
D(GDPG) does not Granger Cause D(REV)	41	9.33991	0.00054
D(REV) does not Granger Cause D(GDPG)		0.51889	0.59956
D(INT) does not Granger Cause D(REV)	41	1.46626	0.24424
D(REV) does not Granger Cause D(INT)		1.78145	0.18292
D(CAP) does not Granger Cause D(REV)	41	1.23669	0.30238
D(REV) does not Granger Cause D(CAP)		2.76901	0.07611
D(EXR) does not Granger Cause D(REV)	41	5.44573	0.00859
D(REV) does not Granger Cause D(EXR)		41.1580	5.0E-10
D(INT) does not Granger Cause D(GDPG)	41	1.60899	0.21415
D(GDPG) does not Granger Cause D(INT)		0.03566	0.96500
D(CAP) does not Granger Cause D(GDPG)	41	0.10357	0.90188
D(GDPG) does not Granger Cause D(CAP)		8.98775	0.00068
D(EXR) does not Granger Cause D(GDPG)	41	3.56979	0.03852
D(GDPG) does not Granger Cause D(EXR)		0.43031	0.65361
D(CAP) does not Granger Cause D(INT)	41	1.89282	0.16534

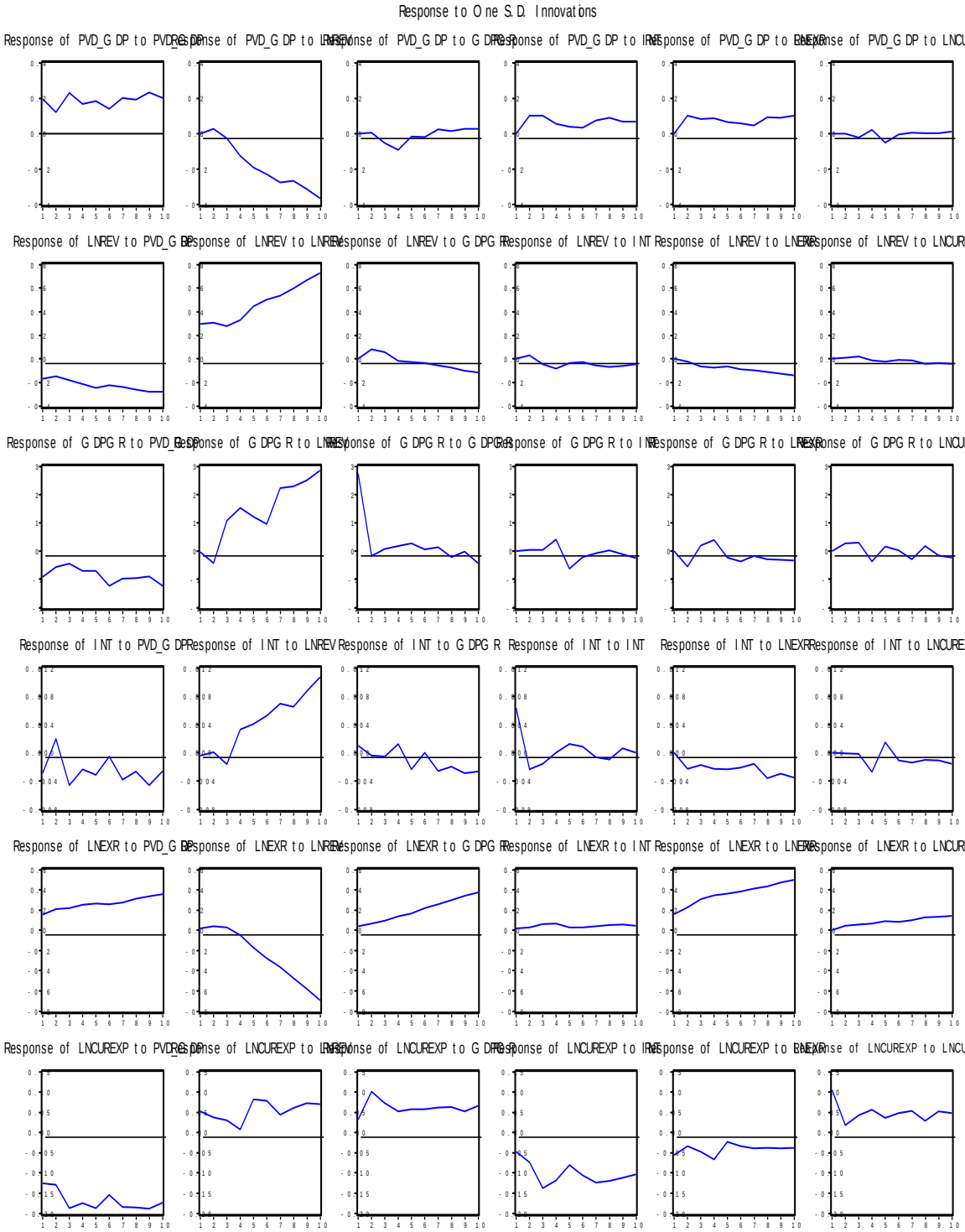
D(INT) does not Granger Cause D(CAP)		5.15360	0.01076
D(EXR) does not Granger Cause D(INT)	41	3.63103	0.03660
D(INT) does not Granger Cause D(EXR)		7.90003	0.00143
D(EXR) does not Granger Cause D(CAP)	41	18.8255	2.5E-06
D(CAP)does not Granger Cause D(EXR)		42.7269	3.1E-10

Appendix 5: Impulse Response Functions

5a. Impulse Functions – Model 1



5b. Impulse Functions – Model 2


Response to One S.D. Innovations
Response of PVD_GDP to PVD_GDP
Response of PVD_GDP to LNREV
Response of PVD_GDP to GDPGR
Response of PVD_GDP to INT
Response of PVD_GDP to LNEXR
Response of PVD_GDP to LNCUREXP
Response of LNREV to PVD_GDP
Response of LNREV to LNREV
Response of LNREV to GDPGR
Response of LNREV to INT
Response of LNREV to LNEXR
Response of LNREV to LNCUREXP
Response of GDPGR to PVD_GDP
Response of GDPGR to LNREV
Response of GDPGR to GDPGR
Response of GDPGR to INT
Response of GDPGR to LNEXR
Response of GDPGR to LNCUREXP
Response of INT to PVD_GDP
Response of INT to LNREV
Response of INT to GDPGR
Response of INT to INT
Response of INT to LNEXR
Response of INT to LNCUREXP
Response of LNEXR to PVD_GDP
Response of LNEXR to LNREV
Response of LNEXR to GDPGR
Response of LNEXR to INT
Response of LNEXR to LNEXR
Response of LNEXR to LNCUREXP
Response of LNCUREXP to PVD_GDP
Response of LNCUREXP to LNREV
Response of LNCUREXP to GDPGR
Response of LNCUREXP to INT
Response of LNCUREXP to LNEXR
Response of LNCUREXP to LNCUREXP

5c. Impulse Functions – Model 3