AN ANALYSIS OF THE IMPACT OF EXTERNAL DEBT ON ECONOMIC GROWTH: THE CASE OF ZIMBABWE: 1980 – 2012

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ABSTRACT

The thrust of this study was to analyse the impact of external debt on Zimbabwe's economic growth using a Vector Autoregressive approach (VAR). The study used annual time series data covering the period 1980 to 2012 on the following variables: Economic growth (proxied as Real Gross Domestic Product), capital (proxied as Gross Fixed Capital Formation), labour force and external debt represented as LNY, LNK, LNLAB and LNEXT respectively. Results from the analysis confirm a long-run negative relationship between external debt and economic growth. The Toda-Yamamoto Granger causality tests revealed the existence of unidirectional causality running from external debt to economic growth. This result indicates that for Zimbabwe, external borrowing has had an influence on the country's Gross Domestic Product (GDP). Thus, the results further confirm the presence of debt overhang in Zimbabwe. In this regard, effective debt management policies and strategies aimed at reducing the cost and risks associated with external debt are a must for ensuring a sustainable path of external debt to promote economic growth. There is need for government to put in place a public debt law to ratify any borrowings requirements. This will help in ensuring that all borrowings by government are targeted towards financing of projects that have a high return which would result in crowding in of private investments as well as ensuring fiscal sustainability. Expansion of the tax revenue base will help ease the budget deficit which compels huge borrowing by governments both externally and internally.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

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DEDICATION

This dissertation is dedicated to my parents: Mrs and the late Mr Mashingaidze; my wife, Yeukai for her moral support in my study.

DECLARATIONS

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Moses Mashingaidze

CHAPTER 1

INTRODUCTION AND BACKGROUND

1.0 Introduction

External debt is an important means of bridging government financing gap especially for developing countries like Zimbabwe. Notwithstanding this fact, external debt can however be viewed as a doubled-edged sword. For instance, effective and efficient utilization of external debt can increase economic growth and help a government to achieve its social and economic objectives. Theoretically, financing developmental related projects through debt can help a country to build its production capacity and facilitate economic growth (Cohen, 1993). A further argument is that borrowing from external sources enables a country to finance capital formation not only by mobilizing domestic savings but also by tapping into foreign capital surplus. Because of insufficient domestic economic resources and low tendency of saving, countries have difficulties to finance economic development especially in the less developed and developing countries. Hence, investments not provided by domestic sources sufficiently are necessary to accelerate economic growth in developing countries. The need of investment is quite increasing the need for external debts also (Bilginoglu & Aysu, 2008).

Based on this argument, an analysis carried out by Siddiqui (2002) found that foreign borrowing increased resource availability and contributed to economic growth in South Asia. On the other hand, excessive reliance on external debt and inappropriate debt management strategies can increase macroeconomic risks and hamper economic growth. Even with concessional flows of loans, high external debt calls for increased revenues to service debt and this certainly has social, economic and political implications in the absence of a broad tax revenue base. As a result, the government is left with no other alternative but to cut allocations for other public spending that can have positive externalities on economic growth (Isa, 2004).

Links between economic performance and external debt can be observed through the effect that a fiscal deficit can have on investments. And this can be explained through the 'debt overhang' and 'crowding out' effects. According to theoretical arguments, huge fiscal deficit results in increased borrowing by the government, which then constrains capital resources and pushes up the cost of capital through high interest rates. If there is some likelihood that in future, the debt will be larger than the country’s repayment ability, expected debt-service costs will discourage further domestic and foreign investment (Krugman, 2002). A high debt burden also encourages capital flight, through creating risks of devaluation in order to protect the 'real' value of financial assets. The outturn of this capital flight is a reduction in domestic savings and investment which ultimately results in reduced tax base, thereby affecting the government’s capacity to service debt (Alberto & Tabellini, 1989). Another argument against public debt is the drawdown of foreign reserves to service debt which results in limiting import capacity, competitiveness and investment, therefore growth of a country (Wijeweera, 2005).

Against these arguments, this study is principally motivated by the quest to understand whether external debt has had any influence on economic growth in Zimbabwe. Such an in-depth appreciation of the factors underpinning economic growth is pivotal in the formulation of macroeconomic policies, sustainable growth and achieving developmental goals. Furthermore, given the myriad of economic challenges that have been crippling the

Zimbabwean economy, the researcher found it imperative and opportune to investigate the relationship and direction of causality between external debt and economic growth. To that end, this researcher endeavours to explore the dynamics of external debt and economic growth in a Vector Autoregression analysis for Zimbabwe for the period 1980 – 2012.

1.1 Background of the study

Since attaining independence in 1980, Zimbabwe has been deficient in domestic financial resources and relied on external economic assistance, in the form of loans and grants to bridge this resource gap. However, lending to sovereign governments, even in its most concessional form is a debt creating flow, implying that all of it, with the exception of outrights grants, will need to be reimbursed at some future date, with interest. Thus, although the accumulation of foreign debt or borrowing by governments can be highly beneficial as it provides financial resources necessary to promote economic growth and development, it comes with costs.

The main cost associated with foreign borrowing and the accumulation of a large debt is the debt service, which represents the liquidation of principal and accumulated interest. Debt servicing represents a contractual fixed charge on a country's income, savings and foreign exchange reserves. As borrowing increases or as interest rates on accumulated borrowings rises, debt service, which must be paid in foreign exchange, also rises. This implies that debt service can only be met with export earnings, thus should exports decline or prices of exports fall, or interest rates rise significantly and exceed the country's export capacity, the country starts to experience debt service difficulties, low Foreign Direct Investment (FDI) inflows and poor economic performances. This has been the case for Zimbabwe and other developing countries.

Zimbabwe has been engulfed in an economic crisis manifesting through unprecedented levels of hyperinflation, sustained period of negative Gross Domestic Product (GDP) growth rates, massive devaluation of the currency, low productive capacity, and loss of jobs, food shortages, poverty, massive de-industrialisation and general despondency. This has been exacerbated by a growing external debt burden coupled with plummeting FDI inflows. The poor investment and growth performance of highly indebted countries like Zimbabwe has frequently been attributed to some extent to the debt burden of their foreign debt, a phenomenon which has been defined as debt overhang (Krugman, 2002). However, Todaro (2000) argues that accumulation of foreign debt is a common phenomenon among many developing countries in the early stages of economic development where domestic savings are low, current account deficits are high and capital imports are necessary to augment domestic resources.

Despite the costs associated with external borrowing, external debt has played a key role in accelerating Zimbabwe's economic growth over the years. By 2000, Zimbabwe was classified among African middle income countries (MICs), a classification attained by countries with per capita income greater than US$885 (World Bank, 2005). However, persistent inadequacy of domestic capital perpetuated dependence on external borrowing, which saw an upward trajectory of Zimbabwe's total external debt to US$4.246 billion at the end of 2006, from the US$82.5 million contracted in 1980 (Reserve of Zimbabwe Weekly Economic Report, 2006).

The rising external debt burden has assumed great importance in the Zimbabwean economy and requires urgent and bold measures from the authorities as it has not only resulted in the country being placed on lending sanctions by international creditors but also litigations by some creditors. Litigations against the country tarnish the country’s image in the face of foreign investors, hence reduced FDI inflows. In addition, Zimbabwe needed a last minute payment of US$120 million in February 2006, to clear its arrears under the General Resources Account (GRA) of the International Monetary Fund (IMF). The GRA had been in protracted arrears since 2000. Settlement of these arrears removed the basis of the IMF’s complaint with respect to Zimbabwe’s compulsory withdrawal from the IMF. Despite this payment, Zimbabwe remained in arrears of US$130 million to the Poverty Reduction and Growth Facility – Trust Fund (PRGFTF) of the IMF (IMF Press Release, 2006). The accumulated arrears resulted in lending sanctions being imposed on the country resulting in the suspension of Zimbabwe’s voting and related rights in the IMF, ineligibility to use IMF resources, declaration of non-cooperation and suspension of technical assistance. These measures by the IMF resulted in withdrawal of financial support and FDI to Zimbabwe by many other creditors and institutions who take cue from the IMF. The IMF (2009) reports that Zimbabwe’s arrears to other creditors including multilaterals are large and increasing. The IMF (2009) noted that as of December 2008, Zimbabwe’s arrears to the World Bank Group amounted to US$642 million, whilst arrears to the African Development Bank Group (ADB) totalled US$434 million. This shows the severity of the matter under investigation on the country’s economic performance.

In examining the relationship between external debt and economic growth, it is critical to understand the major changes and outcomes in the economy through time as they have important implications for the interactions between these variables. The Zimbabwean economy has evolved from international isolation of the 1970s, to a system of centralised state control of the 1980s to economic liberalisation and reforms of the 1990s. Zimbabwe’s economic development experienced during its first 26 years as an independent state closely reflects the pattern in many Sub-Saharan African countries. After independence in 1980, Zimbabwe witnessed rapid growth, with total GDP increasing by an average 6% per year, while GDP per capita grew by about 51.23% from US$529.10 in 1980 to US$800.20 in 1989 before peaking to US$966.30 in 1999, as shown in Table 1 below. This trend seem to suggest the positive linkage between GDP growth and external borrowings, which were also increasing from US$82.5 million the country obtained in 1980 to US$2.4 billion in 1989 to US$4.1 billion in 1999. However, the trend reversed as per capita income declined to US$549.20 by the end of 2006 as the external debt burden continued on an upward trajectory as tabulated below:

Table 1: Selected Indicators for Zimbabwe (1980 – 2006)

year	Economic growth: the rate of change of real GDP	GDP, millions of U.S. dollars	External debt, millions of U.S. dollars	Debt/GDP ratio	Debt/Export ratio	GDP per capita
1980	14.42	5354.8	82.5	1.5	5.7	529.1
1983	1.59	6052.7	1996	33	173	591.1
1986	2.1	6216.8	2340	37.6	176.9	607.3
1989	5.2	8263.1	2428	29.4	144	800.2
1993	1.05	6446.3	3988	61.9	243.7	619.3
1996	10.36	8706.3	4691	53.9	186.5	831.6
1999	-0.82	5963.6	4062	68.1	210	966.3
2000	-3.06	5872.9	3525	60	160	556.6
2001	1.44	6104.6	3422	56.1	161.9	577.4
2002	-8.89	6716.7	3510	52.3	194.8	577.5
2003	-17	6241.1	3812	61	228.3	532.3
2004	-5.81	4489	4071	90.7	241.7	377.6
2005	-5.71	2757.3	3978	144.3	248.3	230.2
2006	-3.46	6645	4246	146	248.7	549.2

Source: RBZ Weekly Economic Reports 2006

The IMF (2005), states that the external debt of any country is sustainable when it can be serviced without resorting to exceptional financing such as debt relief or a major correction of the fiscal balance. Debtor countries usually undertake annual Debt Sustainability Analysis (DSA) aimed at early detection of debt related vulnerabilities and is the cornerstone for elaboration of medium term external debt strategies, fiscal frameworks and public expenditure planning in support of sustainable progress towards the country's development goals and attracting FDI. In carrying out DSAs, countries make use of debt ratios such as debt/GDP, debt/export ratios among others. These ratios have been developed mostly as indicators of potential debt related risks and to support sound debt management. Figure 1 below shows the trend in the debt to GDP ratio over the period 2004 to 2012.

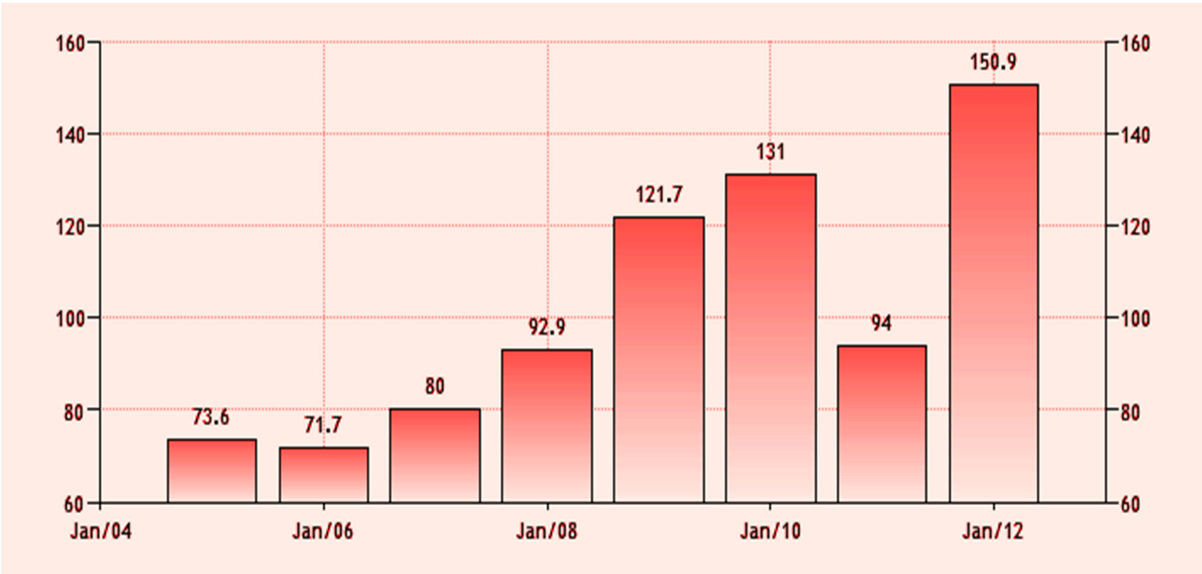


Figure 1: Debt/GDP Ratio (%)

Source: Reserve Bank of Zimbabwe 2012

The external debt/GDP ratio remained above sustainable levels of 75% as shown in the figure above. It continued on an upward trajectory from 2004 to 2010 before falling a bit at the beginning of 2011 before picking up in 2012 to 150.9%. At the end-2011, total external debt stood at $10.7 billion or 113½% of GDP, while total external debt increased by $1.7 billion compared to end-2010, the debt-to-GDP ratio declined on account of higher GDP growth. The debt to GDP ratio is defined as the ratio of the total external debt at the end of the year to annual GDP. By using GDP as a denominator, the ratio may provide some indication of the potential to service external debt by switching resources from production of domestic goods to the production of exports. However, a debt/GDP ratio of above 100% is undesirable because it indicates that the country’s total production will go towards debt service. This can discourage FDI inflows as investors fear that the government may increase taxes as a way of raising resources for debt service.

Zimbabwe contracted loans from both multilateral and bilateral lenders. The composition of Zimbabwe’s total external debt by creditor from 2010 to 2011 is tabulated in table 2 below:

Table 2: Zimbabwe Total External Debt Stock by Creditor, 2010-2011

	2010		**2011**	
	in millions of USD	**in percentage of GDP**	**in millions of USD**	**in percentage of GDP**
Total	**9018**	**121.3**	**10726**	**113.4**
MLT Debt	**6927**	**93.2**	**8207**	**86.8**
Bilateral Creditors	3107	41.8	3311	35
Paris Club	2680	36.1	2758	29.2
Non-Paris Club	427	5.7	533	5.8
Multilateral institutions	2687	36.1	2828	29.9
IMF	133	1.8	138	1.5
AfDB	582	7.8	645	6.8
World Bank	1279	17.2	1336	14.1
EIB	305	4.1	305	3.2
Others	388	5.2	404	4.3
Private Creditors	1133	15.2	2068	21.9
Suppliers credits	**313**	**4.2**	**273**	**2.9**
Short Term Debt	**1673**	**22.5**	**1921**	**20.3**
Unidentified financing gap (public sector)	**105**	**1.4**	**325**	**3.4**

Sources: WB, AfDB, Zimbabwean authorities, and staff estimates 2011.

Due to lack of historical data on the breakdown of Zimbabwe's total debt by creditor, the study is restricted to consider the structure and composition of Zimbabwe's total external debt for 2010 and 2011. The table above shows that Zimbabwe's external debt increased over the two periods from about 9 billion in 2010 to about 10.7 billion in 2011. Total external debt increased by $1.7 billion compared to end-2010, the debt-to-GDP ratio declined by 8 percentage points on account of higher GDP growth. Total public and publicly guaranteed (PPG) external debt at end-2011 stood at 84 % of GDP, of which 65 % of GDP were in arrears. Most PPG external debt is medium- to long-term and owed to official creditors. Zimbabwe's overdue financial obligations to IFIs include the World Bank ($911 million), African Development Bank ($587 million), EIB ($244 million) and the IMF ($138 million) as shown in Table 3 below.

Table 3: Zimbabwe 2011 External Debt Stock by Servicing Status (in millions US dollars)

	Remaining Principal Due	Total Arrears	Principal Arrears	Total Debt
Total	**4383**	**6344**	**3671**	**10727**
MLT Debt	2848	5360	2847	**8208**
Bilateral Creditors	881	2430	1341	**3311**
Paris Club	487	2271	1242	**2758**
Non-Paris Club	394	159	99	**553**
Multilateral institutions	600	2228	1371	**2829**
IMF	0	138	112	**138**
AfDB	58	587	314	**645**
World Bank	425	911	556	**1336**
EIB	62	244	149	**306**
Others	55	349	240	**404**
Private Creditors	1366	702	135	**2068**
Suppliers credits	0	273	228	**273**
Short Term Debt	1210	711	595	**1921**
Unidentified financing gap (public sector)	325	0	0	**325**

Sources: WB, AfDB, Zimbabwean authorities, and staff estimates 2011.

While domestic public debt remains a comparatively small component of total debt, it is, nevertheless, another source of vulnerability. Total domestic government debt stood at $507 million at the end of 2011. The domestic debt incurred by the Reserve Bank of Zimbabwe (RBZ) accounts for the largest part of this ($342 million), but also some other expenditure arrears of $160 million accumulated. Unidentified domestic contingent liabilities within the parastatal sector or related to RBZ restructuring are another source of potential debt.

The debt crisis has evolved from a complex combination of factors, some of which are external while others are the direct result of economic policies pursued by the debtor countries. However, Ajayi (1991) has argued that the division of the factors into external and domestic is not correct because external factors impinge crucially on what happens domestically and vice versa. That notwithstanding, Zimbabwe’s external debt can be attributed to both internal and external factors.

Like many developing nations, which export raw materials, Zimbabwe has been affected by the declining terms of trade with negative consequences on the country’s export earnings, hence undermining the country’s capacity to service its debts. The chaotic land reform program also exacerbated exporting earning for Zimbabwe given its reliance on the agricultural sector for economic prosperity. In addition, increases in oil prices of the 1985 and the 1990s affected Zimbabwe’s repayment capacity. On the other hand, Zimbabwe’s external indebtedness can be partly attributed to internal factors. These mainly refer to the overly expansionary fiscal policies coupled with an under developed domestic debt market, which meant that the country relied on external borrowing to finance fiscal deficits. Moreover, imprudent external debt management policies and the investment of borrowed funds into unproductive projects that did not yield returns capable of repaying the loans also contributed to the growing external debt burden and low economic growth in Zimbabwe.

1.2 Statement of the problem

Growing public debt is a worldwide phenomenon and it has become a common feature of the fiscal sectors of most economies. The inadequate debt management and a permanent growth of debt to Gross Domestic Product ratio may result in negative macroeconomic performance, like crowding out of investment, financial system instability, inflationary pressures, exchange rate fluctuations and more importantly adverse effects on economic growth, (Cohen, 1993). There are also certain social and political implications of unsustainable debt burden. Persistent and high public debt calls for a large piece of budgetary resources for debt servicing and consequently, the government is forced to cut allocations for other public services. Moreover external debt may have indirect effects through private and public investment through the debt overhang and crowding out effects.

A number of empirical studies undertaken in this area show that in the long run and beyond a certain threshold, external debt would exert negatively on economic growth and such conclusions are consistent with the debt overhang theories advanced by the neoclassical economists. Although there is substantial literature on the impact of external debt on economic growth, most of these have employed cross country studies, which have been criticised for ignoring the heterogeneity among economies (Savvides, 2002). Developing countries differ significantly in terms of their economic and political environment, organisation and institutions, hence the need for specific country study to ascertain the association between these variables. In the case of Zimbabwe, external debt over the period of analysis depicts a rising trend and therefore, the country is not precluded from the implication of a rising debt stock and this has necessitated the need for an empirical analysis of the above phenomenon in Zimbabwe.

1.3 Objectives of the study

The general objective of this study is to examine the relationship between external debt and economic growth in Zimbabwe. The specific objectives are to:

- Investigate the impact of external debt burden on economic growth in Zimbabwe
- Determine the direction of causality between external debt and GDP in Zimbabwe.
- Provide a basic foundation for policy formulation geared towards a successful debt management strategy that contributes to a sustainable economic growth in the country.

1.4 Significance of the study

The study is inspired by the fact that a lot of literature on the matter has focused mainly on cross sectional analysis on a number of countries. Furthermore, a number of recent studies on external debt have concentrated on those countries included in the HIPC initiative. If the intention is to analyse the overall relationship between external debt and growth then such concentration would lead to bias, hence the need to also assess the external debt implications on economic growth for non HIPC countries like Zimbabwe. On the other hand, adequate knowledge and understanding of the effects of heavy external debt burden on an economy will inform macroeconomic policy formulation geared towards minimising macroeconomic imbalances and elimination of economic distortions caused by heavy external debt obligations.

1.5 Organisation of the study

This chapter gave a brief overview and background of the area of the study in the context of the Zimbabwean economy. The remainder of this study is as follows: Chapter 2 discusses the existing theoretical and empirical literature on the subject of the study. Chapter 3 documents the methodology and empirical motivation as well as the variables used, while Chapter 4 presents the results and their interpretations. Chapter 5 summarises the findings of the study, policy implications and recommendations for effective debt management.

CHAPTER 2

LITERATURE REVIEW

2.0 Introduction

The motivation of this chapter is to explore the theoretical and empirical explanations of the underlying relationship between external debt and economic growth. The first section dwells on the theory of external debt build up and explains the two hypotheses of debt overhang as well as the credit rationing/crowding out effect. In explaining the relationship between external debt and economic growth, reference will also be made to the debt Laffer curve. The empirical literature section explores studies, methodologies, applications and observations that have been made by different authors and researchers in different countries and regions on the subject.

2.1 Theoretical Literature Review

2.1.1 The Basic Transfer Concept

The debt-creating feature of external borrowing and its transition to indebtedness can be theoretically illustrated with the highly simplified concept known as the basic transfer. The concept of basic transfer explains the mechanics of resource inflow and outflow from borrowing country. Todaro and Smith (2006) defined basic transfer of a country as the net foreign exchange inflow or outflow related to its international borrowing. This concept is measured as the difference between the net capital inflow (capital inflow minus capital outflow) and interest payments on the existing accumulated external debt. The net capital inflow is simply the difference between the gross inflow and the amortization on past debt.

The significance of this concept is that it indicates the amount of foreign exchange a debtor country is receiving or losing every year as a result of international capital movement. Todaro and Smith (2006) have noted that for most indebted countries, the basic transfer has been negative, resulting in the loss of large foreign exchange during the onset of the debt crisis in the 1980s.

Using the formulation of Todaro and Smith (2006), the basic transfer concept can be illustrated in an equation form as follows:

$BT = dD - rD = (d - r)D$... (1)

Where: ***BT*** is the basic transfer, ***r*** is the interest rate on accumulated debt and ***rD*** is the total annual interest payments, while ***d*** is the rate of increase in the level of external debt ***dD*** is the total debt outstanding. The basic balance will be positive when ***d*** > ***r*** and the country is gaining foreign exchange from borrowing hence enhanced economic performance. The basic transfer turns negative if ***r*** > ***d*** and the country begins to lose foreign exchange. A meaningful analysis of the evolution of the indebtedness of the less developed countries requires examination of the various factors that cause ***d*** and ***r*** to rise or fall. At the outset of the accumulation of external borrowing when a country has a relatively small amount of debt, ***D***, the rate of increase ***d***, will be high. This is also because most early stage borrowing comes from official sources such as bilateral donors and Multilateral Development Banks (MDB), and as such debt is incurred at a lower cost with longer repayment periods, as opposed to the case if the borrowing was on commercial terms. At this stage ***r*** is low and in all cases smaller than ***d***. As long as the foreign debt accumulated is used in productive investments, whose rates of return exceed ***r***, the rise in borrowing does not pose a problem or threat for the recipient country. In fact it is a worthwhile strategy for countries to borrow for productive investments in the early stages of their development.

The problem however, arises when firstly, accumulated debt becomes very large such that its rate of increase, ***d***, naturally begins to decline as repayments increase relative to new inflows or as the net inflows decline; secondly, when the terms of borrowing become increasingly commercial resulting in increases in ***r***; thirdly, when the country’s balance of payments deteriorate as a result of falling export prices; fourthly, when an external shock such as global recession or rising oil prices, or a rise in the value of the United States Dollar in which most external loans are denominated, occurs; and fifthly, when there is a loss of confidence in the borrowing country resulting in the cutting off of private capital inflows and foreign investments.

The factors identified above could jointly influence the levels of ***d*** and ***r*** in the basic transfer equation, with lower ***d*** and higher levels of ***r*** causing the basic transfer to become highly negative as capital starts to flow from the less developed, borrowing country. At this point the external debt problem becomes a self-reinforcing phenomenon and highly indebted poor countries are forced into rapidly, falling, net transfers, collapsing foreign reserves and weakening economic development prospects. The foregoing discussion presented a review of the transition from the accumulation of external borrowing to finance development activities, to debt crisis.

2.1.2 Debt Overhang Hypothesis

The adverse effect of public debt stock on economic growth has largely been explained by the debt overhang hypothesis**.** Krugman (2002) states that the debt overhang arises in a situation in which the debtor country benefits very little from the return to any additional investment because of debt service obligations. High debt ratio can be understood as a tax on created revenue in the domestic economy that is issued by foreigners. When foreign obligations cannot be fully meet with existing resources and actual debt payments are determined by some negotiation process between the debtor country and its creditors. The amount of payments can become linked to the economic performance of the debtor country, with the consequence that at least part of the return to any increase in production would be devoted to debt servicing. Implying that, the expected future public debt service of a country is likely to be an increasing function of the country’s output level. Therefore, huge accumulation of public debt stock creates uncertainty behaviour among investors on the actions and policies that the government will adopt to meet its debt service obligations.

In this regard, Krugman (2002) contends that most potential investors will assume that government will finance its debt service obligations through distortionary tax measures, thus they will adopt a wait and see attitude which will affect private investments and therefore economic growth. This creates a disincentive to foreign investment from the point of view of the global interests of the debtor country. For the same reason, the debt overhang is also likely to discourage government efforts to undertake adjustment policies and through actual or expected economic policies, it is likely spread to the private sector, affecting its incentives to invest or accumulate domestic assets.

Basically, the debt overhang hypothesis indicates that the accumulated debt act as a tax on future output, discouraging productive investment plans of foreign investors and adjustment efforts on the part of governments. In a sense, foreign debt acts like a tax when the debt situation is such that an improvement in the economic performance of the indebted country has the side effect of higher debt repayments; whereas creditors receive part of the fruits of increased production or exports by the debtor country. The overall result of the debt overhang is reduction in FDI inflows and a down turn in GDP growth.

2.1.3 Crowding In Hypothesis

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

2.1.4 Credit Rationing Effect/ Crowding out Hypothesis

In the same study as above, Krugman (2002) suggests that the second channel is more indirect and arises from the higher domestic interest rates that prevail in a debtor economy as a consequence of its unfavourable standing in international financial markets. The credit rationing effect arises from the fact that a highly indebted and non-performing debtor is unlikely to obtain any foreign borrowing beyond the involuntary rollover of interest and amortization payments that are not met. As such, the debtor country will have to rely on domestic borrowing to cover the financial gap, hence crowding out private investors. Relying on the domestic market may result in a rise in domestic interests hence undermining the capacity of the economy to produce goods and services as the cost of borrowing will be high.

According to Elmendorf and Mankiw (2009), public debt contracted to finance the budget deficit is a primary source of crowding out private investments. The implication of huge borrowings by the government is an increase in interest rates. The increase in interest rates may reduce or crowd out private-sector investments in plants and equipment. This decline in investment means that the overall economy has a smaller capital stock with which to work, which then decreases future growth rates.

A further argument advanced by Elmendorf and Mankiw (2009) is the effect of a budget deficit on savings accumulation. An increased stock of government borrowing can result in distortionary tax measures which can incite dissaving behaviour among consumers and consequently raise interest rates. By implication, this reduces investible funds and raises the cost of capital through high interest rates. The result is a decline in private sector investments. Aschauer (1989) provides empirical evidence pointing out to budget deficit as the primary source for crowding-out private investments as advanced above by the two scholars.

It is interesting to note that the two effects, although usually associated with each other, may not necessarily be present together. Even though a country from a debt overhang situation would normally be credit-constrained as well, it is conceivable that it may not be credit-constrained despite the past debt overhang. For example, a country can obtain new loans that are (explicitly or implicitly) senior to the previous outstanding debt, and it uses these resources for economically sound investments, which translates into economic growth.

Theory predicts that current debt flows will tend to stimulate growth, as the resource flows help to finance imports of capital and technical assistance, which are critical inputs. On the other hand, accumulated debt, works against investment (foreign and private) and GDP growth due to need for future repayment. These two effects interact to generate a debt laffer curve, which shows that there is a limit at which the accumulation of debt stimulates FDI and GDP growth, in line with resource gap models, (Elbadawi, 2009). Normally the debt Laffer curve is used with reference to a borrower’s prospects for repaying loans after a critical limit of debt accumulation is reached. Elbadawi (2009) used the concept of the debt Laffer curve to refer to the possible negative effects of debt on growth when there is over borrowing.

The debt Laffer curve in Figure 2 below illustrates the relationship between FDI, economic growth and debt accumulation. At all points to the left of ***A*** “*the good side*”, increasing levels of debt generate new investments and GDP growth. This is referred to as the good side because external borrowing impacts positively on both FDI and GDP growth. More so, there is zero probability of default. At ***A***, at the point of departure from the 45^0 line, both FDI and GDP growth begin to increase at a declining rate, until the peak point ***E*** at **D*** (level of debt), where both FDI and GDP begins to fall with additional levels of debt, “*the wrong side*”. D* is therefore the limit at which further debt accumulation starts to impact negatively on FDI and economic growth. The theory therefore predicts growth inducement effects from external debt at low levels and thereafter FDI and economic growth are retarded at high levels of indebtedness.

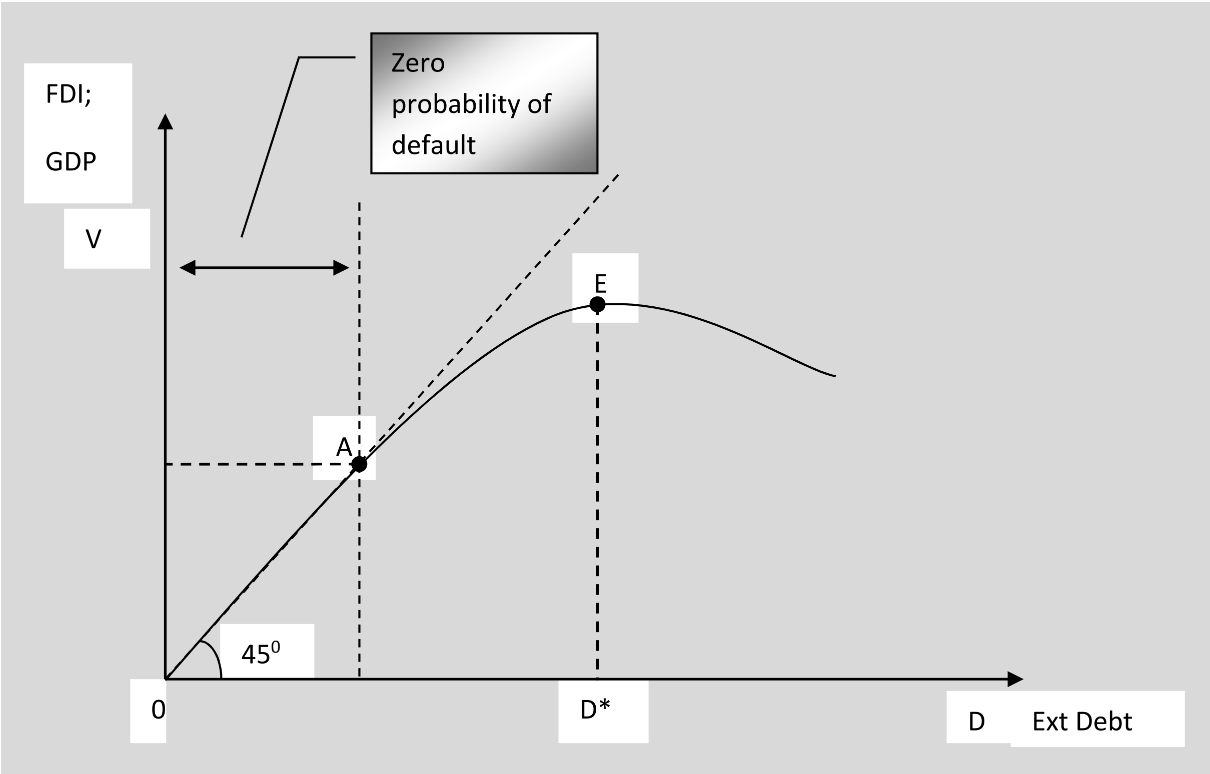


Figure 2: Debt Laffer curve

Source: Krugman (2002)

The channels, through which external debt would impact on FDI and GDP growth, include through a liquidity constraint, caused by debt service payments reducing export earnings. There is also an indirect channel that works through government expenditure and the financing of these expenditures or the fiscal balance. How accumulated debt might affect FDI depends on how the government is expected to raise revenues to finance the debt service. If debt service were financed by excessive government deficits, the concomitant expansionary policies would tend to discourage FDI – the debt overhang effect as alluded to earlier. The external debt effects on FDI and growth can also be compounded by the crowding out effects and lack of access to capital markets, resulting in a serious financial resource constraint which negatively impact on FDI and GDP growth.

2.2 Empirical Literature

There are a lot of empirical studies on growth effects of public debt, though most of the studies in this area generally deal exclusively with either public external debt or public domestic debt. Inferring to empirical literature, most of the studies on public external debt have been a reaction to the two waves of (external) debt crisis, the first affecting several Latin-American Countries in the 1980s (Green, 1993; Savvides, 2002), and the second concerning the debt relief policies which targeted a number of heavily indebted and poor countries (HIPCs). These studies include among others “Debt Relief Initiatives, Policy Design and Outcomes” by Arnone and Presbitero (2010) and “Debt Overhang or Debt Irrelevance” by Cordella, Ricci and Ruiz-Arranz (2005). Studies focusing on either domestic debt or total public debt investigating the effects of public debt on economic growth have also been undertaken. Studies investigating growth effects of debt would focus either on cross section analysis or country specific.

Most studies undertaken at cross country level have mainly applied the Generalised Method of Moment (GMM) technique utilising panel data. Most results under GMM techniques analysing the impact of public debt (domestic or external debt) on economic growth have been consistent with theory.

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

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

Abbas and Christensen (2010) also complement the vast literature in this area but focusing on public domestic debt growth effects using a panel of low-income countries and emerging markets. Applying the GMM technique, the study shows that moderate levels of domestic debt have a positive contribution to GDP growth. They argued that the presence of developed financial markets, increased private savings, better institutions and political accountability and improved monetary policy mainly accounted for this outturn. They however concluded that in the long-run and when the stock of domestic debt becomes too large (above the 35 %

of bank deposits), its contribution to economic growth would be negative, because of inflationary pressures and crowding out of the private sector.

The application of Instrumental Variables (IV) in this methodology was able to minimise the endogeneity effect between public debt and economic growth. Engle and Granger (1987) assert that most endogenous variables have feedback effects implying causality. However, the above studies and many that have applied GMM like Chrietensen, (2005); Schclarek, (2004); Maana and Isaya, (2008); Checherita and Rother, (2012) did not detect the direction of causality which, according to EL-Mahdy and Torayeh (2009) is important for policy guidance.

The IMF (1989), in a panel study of the impact of external debt burden on economic growth in debtor countries reveals that debt overhang existed in these countries in the 1980s. The study was based on a period spanning from 1975 – 1985 and regressed debt servicing on GDP, savings ratio and investment (proxied by the level of foreign direct investment inflows). There are two pieces of evidence supporting the debt overhang proposition. First, the saving ration decreases when external finance dried up. Secondly, in a comparison of a group of countries with debt problem with a group of other heavily indebted counties, which did not experience a debt servicing problem, saving ratios decreased in the former group. There was an important drop in saving ratios and investment ratios in problem debtor countries during the 1980s.

A follow up study by Sachs and Kenen (1996) in cross section analysis of HIPCs in Africa and Asia, concluded that external debt burden plays an important role in the heavily indebted countries. The study examined the relationship between debt service, private investment and economic growth over the period 1977 – 1987. The authors argue that debt overhang is the main reason for slowing economic growth in indebted countries. Results from the study show that large debt burden discourages private investments and the payments of the debt service of some countries are so large that the prospects for a return to growth paths are dim, even if the governments were to apply hard adjustment programmes. It is argued that a debt overhang creates adverse incentives effects on the economic growth in the long run. According to Sachs and Kenen (1996), the scope of debt overhang is much wider in that the effects of debt do not only affect investment in physical capital but any activity that involves incurring costs upfront for the sake of increased output in the future. Such activities include investment in human capital and in technology acquisition whose effects on growth may be even stronger over time. How debt overhang discourages private investment depends on how the government is expected to raise the resources needed to finance external debt service whether private or public investment are complementary. For example, if a government resorts to inflation tax or to a capital levy, private investment is likely to be discouraged.

Consistent with the above findings, Geiger (1990) examined the relationship between GDP growth rate and debt burden. The ratio of net transfers to GDP, debt service to GDP, and debt service to exports were regressed on real GDP growth rate using Ordinary List Squares (OLS) regression analysis. The analysis was based on a 13 year period, from 1974 to 1986, on 9 highly indebted South American countries namely Argentina, Chile, Brazil, Peru, Colombia, Ecuador, Paraguay, Bolivia and Venezuela. The debt burden represents debt service ratio (the sum of interest payments and repayments of principal on external debt to exports of goods and services), the ratio of debt service to GDP and the ratio of net transfers to GDP in highly indebted countries in South America where the problem of debt was serious. The study focused on the specific countries to determine the impact of debt burden and capital inflows on economic growth. The results of the study confirm that there is a statistically significant inverse relationship between External Debt and economic growth.

In addition, intra-country analysis shows that the marginal effects of the debt burden on the economy decrease when the debt burden increases. Even though there is an important variation in the model from country to country, many different factors affect economic development in each of the countries and there are also different reactions to the debt burden. For all countries examined, the lagged model is the most highly correlated. On the other hand, the burden of the principal and interest payments has a greater impact on the economy in the following year rather than in the current year. It is also not surprising that the lagged equation model results have more statistical significance than the linear equations because the debt financed projects are likely to yield incomes in the following years rather than in that same year debt is contracted.

The results from the above studies were also confirmed by Savvides (2002), who examined the effects of huge external debt on investment and economic growth in a sample of 43 less developed countries over the period of 1980 – 1986. The study applied a Two Stage Limited Dependent Variable model (2SLDV) procedure by cross section-time series data. The study found evidence in support of the debt overhang hypothesis. Savvides, (2002) concluded that if a debtor country is unable to pay its external debt, debt payments become linked to the country’s economic performance, such that the country partially benefits from an increase in output or exports. This is because a fraction of the increase is used to service the debt and accrues to the creditors.

Thus, from the perspective of the debtor country, the debt burden acts like a high marginal tax on the country, thus lowering the return to the investment and providing a disincentive to domestic capital formation. He further noted that debt overhang and decreasing foreign capital inflows have a significant negative effect in investment rates. In the study, it is also argued that the disincentive effect of the debt overhang may have repercussions on private savings and investment, even when all external debt is held by the government. The government has little incentive to institute policies to promote domestic capital formation or to reduce current consumption in exchange for higher future economic growth when the benefits from such policies go to creditors in the form of higher debt payments.

Furthermore, Sawada’s (2004) findings in his investigation on whether the highly indebted Sub-Saharan countries (HICs), concerned with their external debt repayments, stay solvent, found evidence in support of the debt overhang hypothesis. A direct test of the solvency condition derived from the usual inter-temporal budget constraints shed light on the sustainability of their current policies. This study employed annual time series data for a sample period from 1955 – 1990 and estimated the cointegration regression. The findings of this study show that HICs have debt overhang problems, since their current external debts are above the expected present value of the future gains.

Syed and Anwar (2010) employed OLS to analyse public debt and economic growth in Pakistan for a period 1972 to 2010. The study did allude to poor social economic conditions arising mainly due to huge public debt which stands to be over the GDP figure in Pakistan. The results in this study were in support of the neoclassical theoretical arguments on debt accumulation.

Isa (2004) also applied the OLS technique using time series data to examine the impact of external debt on economic growth and public investment in Nigeria from 1970-2002. The debt service burden was said to impede the Country's rapid economic development and worsened the social problems. Service delivery by key institutions designed to mitigate the living condition of vulnerable groups were hampered by decaying infrastructure due to inadequate funding. By cutting down expenditure on social and economic infrastructure, the Government appears to have also constrained private sector investment and growth. He concluded that debt overhang was the major factor that contributed largely to the poor performance of Nigeria's economy during the period under review.

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

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

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

Using OLS methodology, Fosu (1996) tested the relationship between economic growth and external debt for a sample of Sub-Saharan African countries over the period 1970 – 1986. The study examined the degree to which external debt had a negative impact on economic growth of Sub-Saharan African countries, estimating the direct and indirect debt hypothesis. The results show that by using a debt-burden measure, direct effect of debt hypothesis reveals that GDP growth is negatively influenced via a diminishing marginal productivity of capital. The findings of this study also show that on average a highly indebted country faces about 1 % reductions in GDP growth rate annually. This explains one-third of all reduction of growth rate in the sample countries. On the other hand, the results do not support the adverse indirect effect of debt hypothesis, which states that the relationship between debt and economic growth is indirect, via reduced FDI.

In a further study, Fosu (1999) employed an augmented production function to investigate the impact of external debt on economic growth in a panel study of Sub-Saharan Africa for the period 1980 - 1990. The author based his study on the hypothesis that external debt negatively affects economic growth even if it has little or no effect on the level of FDI. The findings show that as debt variable is included in the equation, debt exhibits a negative coefficient. Moreover, Fosu, (1999) questioned the negative association between external debt and economic growth in his earlier work, and argued that the negative relationship between economic growth and debt might be due to a poor performer receiving large external debt. Hence, he re-estimated the growth equation for only the first half of the decade from 1980 to 1985. However, the results are reassuring in the coefficient of debt is still negative and significant.

The debt overhang hypothesis was also confirmed by Deshpande (1997) through an empirical examination of the investment of 13 severely indebted countries including Algeria, Argentina, Ivory Coast, Egypt, Honduras, Kenya, Mexico, Morocco, Peru, Philippines, Sierra Leone, Venezuela and Zambia, using OLS estimation for the period 1971 to 1991. Deshpande (1997) found external debt to exercise a negative effect on foreign investment. Firstly, for the period from 1971 to 1991, the FDI ratio for the sample countries shows rising and then a declining trend at the end of the eighties. The relationship between external debt and FDI is negative. He concluded that any increase in production and exports are used for debt payment to creditors. As a consequence, this gives a disincentive to foreign investors as investors are not willing to invest a large amount of money. Notwithstanding the above, the application of OLS to analyse time series data and in particular public debt and economic growth variables which are highly endogenous could render the result bias even though consistent to theory, (Engle & Granger, 1987).

Further to the IMF (1989) study, the IMF (2003) examined the channels through which external debt affects growth in 55 low income countries that are classified as eligible for the

IMFs Poverty Reduction and Growth Facility (PRGF) covering the period 1970 to 1999. The study was based on reduced form growth equation of per capita GDP, debt service, human capital, terms of trade, gross domestic investment and central government fiscal balances. The results suggest that a substantial reduction in the stock of external debt projected for highly indebted poor countries (HIPCs) would directly increase per capita income growth by about 1 % point per annum. The IMF (2003) concluded that reductions in external debt service could also provide an indirect boost to economic growth through their effects on public investment. It is further argued that if half of all debt service relief were channelled for such purposes without increasing the budget deficit, then growth could accelerate in some HIPCs by an additional 0.5 percentage point per annum.

All the above empirical literature in support of the debt overhang hypothesis are based on cross country studies. However, Karagol (2002) investigated the long-run and short-run relationship between economic growth, external debt service, labour force and capital (gross fixed capital formation) for Turkey during the period 1956 to 1996 using multivariate co-integration techniques and employed a standard production function model. The estimation results suggest that there is a one co-integration relationship in the long-run. Debt service is negatively related to economic growth in the long-run, whilst Granger causality test results showed a unidirectional causality running from debt service to economic growth. Karagol (2002) results are therefore in conformity with the debt overhang hypothesis.

On the contrary, Hofman (2001) queried the debt overhang hypothesis in explaining FDI behaviour. He argued that there are some shortcomings in the IMF (1989) study, which claims that debt overhang exists on two pieces of evidence in debtor countries. First, debtor countries financed their investment by foreign savings in 1978 to 1981. Secondly, the IMF (1989) paper picks a group of middle income debtor countries. These countries are arbitrary and classified as indebted countries but have not faced a serious debt servicing problem. In his study of the effects of external debt burden on economic growth and FDI, over the period 1971 to 1987, Hofman (2001) split the period of study into two sub periods 1971 – 1981 and 1982 – 1987, and applied pooled time series cross section data for debtor countries with the OLS method. For the two periods, it was concluded that there is no debt overhang in debtor countries. In this context, the negative correlation between debt and FDI is rejected by this study. It is also found that the transfers of financial resources from debtor countries to the other countries are a more important explanation for the FDI reduction rather than the levels of debt outstanding.

The debt overhang hypothesis was also disputed by Warner (1992), who measured the effect of debt crisis on investment using the Least Squares Estimation (LSE) for 13 less developed countries over the period of 1982 – 1989. He regressed external debt service on GDP, export prices, foreign investment inflows and interest rates on borrowing. Warner's (1992) results show that the reason behind the decline of FDI in many heavily indebted countries are declining export prices, high world interest rates and sluggish growth in developing countries. He argued that to measure debt effects, a better way to forecast FDI over the debt crisis period (1982 – 1989), is to use equations that incorporate the declining export prices for the indebted countries, high world interest rates and recession in developed countries, but which do not incorporate debt crisis effects.

The main idea is that these forecasts should not track FDI during the debt crisis period if the postulated debt crisis effects are crucial, but should track FDI if they are not. Clearly, if debt crisis effects are important, then this FDI forecast, which ignores debt crisis effects, should be higher than actual FDI. Warner (1992) claims that FDI decline in many of the countries on the heavily indebted list can be forecast out of the sample by simple terms of trade and world real interest rate equations. Out of 13 countries, 11 of this group were examined. Forecast FDI in the final year of forecasting period was lower than actual investment. He then introduced a debt crisis dummy in a panel regression. The data is pooled on all of the highly indebted countries. The result is that the debt crisis dummy variable failed to have a negative coefficient as the debt theories predict. The effect of dummy debt variable was positive and highly significant.

2.3 Conclusion

Given the above empirical findings, it is difficult to say whether external debt service has a negative or positive effect on investment and economic growth. The above studies showed that the effect of external debt service differs among countries. Based on these mixed results, it is improper to make any type of generalisations of the potential relationship between economic growth and external debt.

Most of the literature reviewed herein employed cross country analysis and applied OLS techniques and panel data analysis. However, cross-country analysis is not easy and has some difficulties. Developing countries in aggregate differ significantly in their economic and political environment, organisations and institutions. Thus, in designing a recovery policy aimed at maintaining sustainable external debt and promoting economic growth, it is necessary to consider the case of each developing country separately. Such a recovery policy should be based on the country's interrelationships between its GNP and external debt. To shed some light on such an important and controversial issue, as well as contribute to the existing literature on Zimbabwe, this study investigates the effect of foreign indebtedness on economic growth in a VAR analysis for the Zimbabwean economy.

CHAPTER 3

METHODOLOGY

3.0 Introduction

The analytical framework discussed in chapter 2 provides theoretical motivation for the existence of growth, capital, labour force and external debt linkage, which has some testable implications worth investigating on empirical grounds. The methodology adopted in this study closely follows the work by El-Mahdy and Torayeh (2009), Karagol (2002) and Cunningham (2003). Granger causality tests and variance decomposition will be carried out in a multivariate model involving external debt, capital, labour force and real GDP.

3.1 Model Specification

3.1.1 Extension of Export-Growth Model

This study focuses on the relationship between the external debt and real GDP in Zimbabwe and employs the standard neoclassical production function, which expresses output as a function of labour (L) and capital (K), represented as $Y = f(L,\ K)$. Cunningham (2003) provided an extension of the neoclassical production function when she investigated the association between economic growth and debt burden in heavily indebted countries during the period 1971-1996 with the following model:

$Y = (K, LF, EXT)$.. (2)

Where Y, K, LF and EXT are the measures of GDP growth, capital stock, labour force and external debt service respectively. Cunningham (2003) argued that the debt burden can be considered as debate in the production function due to its effects on the productivity of labour and capital in a manner similar to the inclusion of exports in the production function. In as much as a nation has significant debt burden, the need to service its debt will affect how labour and capital will be employed in the production function. More specifically, if the gains of the productivity increase are to foreign creditors and not domestic agents, there is little motivation to increase the productivity of capital or labour.

Following the studies by Cunningham, (2003) and Karagol (2002), the following function can be formulated and expressed in logarithmic form, by letting Y = real GDP, as follows:

$LNY_t = \rho_0 + \rho_1 LNK_t + \rho_2 LNLAB_t + \rho_3 LNEXT_t + \varepsilon_t$.. (3)

Where, LNK, LNLAB and LNEXT are measures of capital, labour force and external debt respectively and ε_t is the error term.

3.2 Definition and Justification of Variables

Economic Growth Rate (LNY)

Economic growth rate will be proxied by real GDP using 2005 as the base year. GDP is a measure of total production of goods and services within the national boundaries of a country at a given time, regardless of who owns the factors of production. This is a good measure of a country's level of domestic production and welfare, when compared to Gross National Product (GNP) which measures the level of output produced by that country's factors of production regardless of their location. Ali and Mustafa (2010) used GNP in their analysis of the effects of external debt on economic growth in Egypt. GNP has not been considered in this study because outside production may not be affected by the level of external borrowings in the domestic economy; hence consistent with studies by Syed and Anwar (2010), Jayaraman and Choong (2006) and Fosu (1996), real GDP is the preferred proxy for economic growth.

External Debt (LNEXT)

External debt is the total amount of a country’s foreign borrowing which carries a future repayment obligation. Total external debt is the sum of public, publicly guaranteed, and private nonguaranteed long term, use of IMF credit, and short term debt. This study used data of total debt outstanding and disbursed (DOD) including arrears. The external debt is expected to have a negative effect on economic growth, (Geiger 1990; Rockerbie, 1996; and IMF, 2003). Other studies such as Pattillo, Poirson and Ricci (2002) used the debt/exports ratio and Chowdhury (2004) used debt/GDP ratio.

Capital (LNK)

The capital stock is defined as the value of the existing supply of physical goods that are used in the production process at a given point in time and includes buildings, machinery, equipment and inventory, among others. Capital stock is of critical importance, not only as a component of aggregate demand, but also in terms of its impact on the economy’s growth and employment opportunities (Ghali, 1998). Following Ali and Mustafa (2010) and Karagol (2002), the study uses gross fixed capital formation (GFCF) as a proxy for capital. It is expected that capital stock positively relates to GDP hence it should have a positive coefficient.

Labour Force (LNLAB)

In this study, the labour force is defined as the employed labour, which is a summation of employees in all sectors of the economy. Since the rate of utilisation of the labour force is important in production, employed labour force is used rather than the total labour force. This proxy has been used in previous studies by Ali and Mustafa 2010 and Karagol 2002. A positive relationship between economic growth and labour force is expected.

3.3 Estimation Procedure

3.3.1 Stationarity Tests

Before modelling the relationship between the economic variables, their univariate time series properties are established. The test used to investigate the existence of unit roots is the Augmented Dickey Fuller (ADF) tests by Dickey and Fuller (1979). The actual procedure is to compute the tau statistics, τ. If the absolute value of the computed tau statistic is greater than the ADF critical values, the hypothesis that there is a unit root is rejected, thus the time series is stationary.

3.4 Cointegration Analysis

Cointegration analysis will be considered if results from unit root tests confirm that the variables are non-stationary in their levels. The Johansen Cointegration test will be used to test for the existence of cointegration. Cointegration refers to the existence of a long-run relationship amongst given non-stationary variables (Engle & Granger, 1987). Thus, two or more non-stationary time series are co-integrated if a linear combination of these variables converges to long-run equilibrium overtime. The existence of such long-run relationship typically takes place because of the relations of the stochastic trends of the variables. Cointegration implies that if in the long-run, two or more series move closer together, even though the series themselves are trended, the difference between them is constant. Furthermore, these variables might drift apart in the short run, but in the long run they are constrained.

The Johansen approach involves two tests namely the trace test (Trace) which is the likelihood ratio test for the hypothesis that there are at most “r” co-integrating vectors and the Maximum Eigen Value (Max-Eigen). The null hypothesis is that there is no cointegration and the alternative hypothesis is that there is cointegration. On the basis of the existence of cointegration relationship between variables, the Vector Error Correction (VEC) which according to Johansen (1990) avoids the arbitrary selection of endogenous and exogenous will be employed.

3.5 Granger Causality Tests

The study will use Granger non-causality tests using a modified Wald (MWALD) test proposed by Toda and Yamamoto (1995). The Toda-Yamamoto procedure has an advantage in that it does not require precise knowledge of the integration properties of the system. It can be applied even when there is no integration and or stability and rank conditions are not satisfied as long as the order of integration does not exceed the true lag length of the model, (Toda & Yamamoto, 1995). This procedure has been found to be superior to the traditional

Granger causality tests since it ignores any possible non-stationarity or cointegration between the series when testing for causality.

The procedure essentially suggests the determination of the d-max, that is maximal order of integration of the series in the system and intentionally over fit the causality test underlying model with additional d-max lags so that the VAR order is now p = k + d, where k is the optimal lag order. This ensures that the usual t-statistic for Granger causality have standard asymptotic distributions. The procedure utilises a modified Wald test statistic (MWWALD) for the restrictions on the parameters of a VAR (k), where k is the lag length in the system. The MWALD statistic has an asymptotic chi-square distribution when a VAR ($k + d_{max}$) is estimated. The external debt-economic growth model can be represented in the following VAR system:

$$LNY_t = \alpha_0 + \sum_{i=1}^{k} \alpha_{1i} LNY_{t-i} + \sum_{j=k+1}^{d\,max} \alpha_{2j} LNY_{t-j} + \sum_{i=1}^{k} \delta_{1i} LNEXT_{t-i} + \sum_{j=k+1}^{d\,max} \delta_{2j}\, LNEXT_{t-j} + \varepsilon_{1t} \tag{4}$$

$$LNEXT_t = \beta_0 + \sum_{i=1}^{k} \beta_{1i} LNEXT_{t-i} + \sum_{j=k+1}^{d\,max} \beta_{2j} LNEXT_{t-j} + \sum_{i=1}^{k} \Phi_{1i} LNY_{t-i} + \sum_{j=k+1}^{d\,max} \Phi_{2j}\, LNY_{t-j} + \varepsilon_{2t} \tag{5}$$

Where ε_{1t} and ε_{2t} are error terms that are assumed to be white noise. Frome equation (4), Granger causality from $LNEXT_t$ to LNY_t implies $\delta_{1i} \neq 0\ \forall i$; similarly in equation (5), LNY_t Granger causes $LNEXT_t$ if $\Phi_{1i} \neq 0\ \forall i$. The model will be estimated using seemingly unrelated regression technique. With optimal lag length determined, Granger causality tests based upon equations (4) and (5) can be formulated as follows:

LNY Granger causes external debt, LNEXT if

H_0: $\Phi_{11} = \Phi_{12} = \Phi_{13} = \ldots \ldots \ldots \ldots = \Phi_{1k} = 0$, is rejected against the alternative

H_1: not H_0

LNEXT Granger causes real GDP, LNY, if

H_0: $\delta_{11} = \delta_{12} = \delta_{13} = \ldots \ldots \ldots \ldots = \delta_{1k} = 0$, is rejected against an alternative

H_1: not H_0

The debt variable is argued to have a strong potential for endogeneity especially with respect to reverse causation where low or negative GDP growth rates are likely to induce issuance of more debt. While on the other hand, excessive debt hampers economic growth rate by impacting negatively on determinants of economic growth (Checherita & Rother, 2012). In this case, the Granger causality analysis can identify whether two variables move one after the other or contemporaneously. When they move contemporaneously, one provides no information for characterizing the other. If "X causes Y", then changes in X should precede changes in Y. In summary, the hypotheses for testing Granger non-causality for the model are specified below:

i. Real GDP does not Granger-cause other explanatory variables

ii. Other explanatory variables do not Granger-cause real GDP

The same analysis can be carried out to examine the relationship between external debt and capital as well as capital/economic growth nexus. Madalla (1998) indicates that if two variables are co-integrated, there must be at least one direction of causality between investigated variables. Our objective is to investigate whether observations of a variable like external debt service is potentially useful for anticipating future movements in economic growth. In the context of Granger causality, it is hypothesised that external debt causes economic growth with respect to a given information set that includes the relevant variables (i.e. LNEXT and LNY), if economic growth is better predicted by adding the past time series for debt service than by using the past LNY series alone.

3.6 The VAR Model Specification

The Vector Autoregression (VAR) modelling technique is used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables. A study by EL-Mahdy and Torayeh (2009) employed the econometric technique of cointegration and error correction modeling (ECM) in order to estimate the impact of public domestic debt on growth. The estimation was made using vector autoregressive (VAR) approach. The VAR approach sidesteps the need for structural modelling. It models every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system. It aims to come up with a parsimonious model that captures relevant variables without including too many variables.

The VAR model allows the incorporation of feedback in the multivariate model in which all the variables are allowed to affect each other. Hence, the interaction of all the four variables will be captured. According to Johansen (1988), the VAR framework has an advantage over other alternative estimators when modelling time series data especially macroeconomic variables. In this respect, El-Mahdy (2009) advanced that the appropriate approach to explaining the growth effects of external debt is by employing a VAR framework. This is because the framework is able to capture both the short-run and long-run effects of public debt on economic growth. And on the basis of the short-run and long-run trajectory, informed policy decision can be inferred. The multivariate VAR model specification is represented as follows:

$$V_t = \sum_{i=1}^{k} A_t V_{t-i} + \varepsilon_t \quad (6)$$

Where:

$$V_t = (LNY_t, LNLAB_t, LNEXT_t, LNK_t) \quad (7)$$

$A_1 - A_k$ are four by four matrices of coefficients and ε_t is a vector of error terms. LNY_t, $LNLAB_t$, $LNEXT_t$ and LNK_t are measures of real GDP, labour force, external debt and capital respectively. The variables are expressed in logarithm form to solve the problem of skewed data to normal form as some inferences depend on the assumption of normal distribution. Taking logs will make certain forms of relationships that look curved look linear.

3.7 The Residual Tests

The purpose of residual test is to detect whether autocorrelation and heteroscedasticity are a serious problem in the model. In this study, autocorrelation will be tested using Lagrange Multiplier (LM) test, and heteroscedasticity using White’s Heteroscedasticity test to be explained below.

3.7.1 Autocorrelation: The Lagrange Multiplier (LM) Test

Autocorrelation occurs when the residuals are correlated across time. The main problem of autocorrelation is that the t-test and F-test of significance will not be valid, and if they are used they provide misleading results about statistical significance of estimated regression coefficient.

In this study, the method used to test for autocorrelation is the autocorrelation LM test. The method reports the multivariate LM test statistics for residual serial correlation up to the specified lag order h. The LM test statistic is calculated by estimating an auxiliary regression of the error terms u_t on the original right- hand regressors and the lagged residualu_{t-h}, where the missing first h values of u_{t-h} are equated to zero. The LM test statistics is distributed as Chi-square χ^2 with k^2 degrees of freedom, where k is the number of endogenous variables. The null hypothesis is that there is no serial autocorrelation.

3.7.2 White's Heteroscedasticity Test

Heteroscedasticity occurs when the variance of the error terms are not constant over time. Estimation in the presence of heteroscedasticity results in wider confidence intervals, so that the t-test and F-test are more likely to give inaccurate results and this can lead to the acceptance of insignificant coefficients. The test is conducted as follows: The VAR equation is first estimated and estimating an auxiliary regression, that is the squared residuals from the original regression are regressed on the original regressors, their squared values and the cross products of the regressors. The system LM statistic is distributed as the χ^2 distribution with degrees of freedom equal to mn where m is the number of cross products of the residuals in the system and n is the number of common set of the right-hand side variables in the test regression. The null hypothesis is that there is no Heteroscedasticity.

3.8 Lag Length Selection

A key to the Granger causality estimations is the determination of the optimal lag length of the VAR model (Braun & Mittnik, 1993). Estimation of a VAR model with an improper lag length yields inconsistent results, so as the variance decompositions derived from that VAR, since the accuracy of forecasts from VAR models varies substantially for different lag lengths. To determine the appropriate lag-length for the VAR model, testing will be done up to an appropriate maximum number of lags that does not leave behind too few degrees of freedom. Lutkepohl (1993), indicated that over fitting (selecting a higher order lag length than the true lag length) causes an increase in the mean-square forecast errors of the VAR, while under fitting the lag length often generates auto-correlated errors. The optimal lag length is chosen using explicit information criterion such as the Akaike Information (AIC) or Schwarz Criterion.

3.9 Variance Decomposition

According to Enders (2003), variance decomposition tells how much a given variable changes under the impact of its own shock and the shock of other variables. Variance decomposition helps in identifying the degree to which one variable influences the other. This study is going to use variance decomposition to break down and ascertain the degree to which external debt influences other variables in the system and vice versa. Variables in a system will have a forecast error and the error in forecasting can be attributed to the present and past values of the variable in question and the past values of all other variables in the system. By breaking down this forecast error, it allows the determination of the degree to which the variable in question is being influenced by its past values and to the other variables in the system.

Variance decomposition indicates what part of the variance of the forecast error in one variable can be attributed to innovations in another variable after some periods. Accordingly, this decomposition can be used to approximate the contribution of each variable to the variability of the whole system. Variance decomposition exhibits the contribution of each source of innovation to the variance of the n^{th} year ahead forecast error for each of the variables included in the system.

Enders (2003) proposes that the forecast error variance decomposition permits inferences to be drained concerning the proportion of the movements in a particular time-series due to its own earlier shocks vis-à-vis shocks arising from other variables in a VAR model. The technique breaks down the variance of the forecast error for each variance following a shock to a particular variable and in this way it is possible to identify which variables are strongly affected and those that are not.

3.10 Generalised Impulse Response

Shin and Pesaran (2003) define the impulse response function as a function that measures the time profile of the effect of shocks at a given point in time on the (expected) future values of variables in a dynamic system. The generalised impulse response analysis is carried out to track the time path of external debt to real GDP. Impulse response traces out time paths of the effects of shocks of other variables contained in the VAR model on a particular variable. This approach is designed to determine how each variable responds over time to an earlier shock in that variable and to shocks in other variables (Enders, 2003). Furthermore, Sims (2005) states that the best descriptive device for understanding the inherent system dynamics, is the analysis of the system's response to random shocks. The random shocks are positive residuals of one standard deviation unit in each equation in the system. The idea is to calculate the response of the variables say real GDP, in the system to a shock of one standard deviation for example external debt.

3.11 Data Sources and Problems

Data employed in this research cover the period 1980 to 2012. The statistical data for most of the macro-economic variables were obtained from the World Bank. There was a preference for statistical data from the World Bank given the inconsistence of the data in Zimbabwe from the main data sources namely Zimstat under the Ministry of Finance and the Reserve Bank of Zimbabwe. The labour force statistical data was however obtained from the Zimstat. Furthermore, the process of obtaining data was cumbersome, as most of the data was not available on the official government of Zimbabwe websites, hence the strong reliance on archived data.

3.12 Conclusion

This chapter gave an outline of the methodology to be adopted in this study, as well as definition and justification of variables used. This chapter has laid the foundation for Chapter 4, which will deal with the actual model estimation outlined above and interpretation of results obtained by use of software known as E-Views (Econometric Views 7).

CHAPTER 4

PRESENTATION AND ANALYSIS OF RESULTS

4.0 Introduction

This chapter presents the results from unit root tests, criteria for optimal lag length selection, Granger causality tests, variance decomposition and impulse response analysis. Diagnostics tests will be carried out, which include autocorrelation, heteroscedasticity and model specification tests. Furthermore, the chapter gives an interpretation of the results obtained from the analysis.

4.1 Unit Root Tests

As already alluded in Chapter 3, the unit root tests were conducted using the Augmented Dickey-Fuller (ADF) test to determine the stationarity properties of the variables. The test uses a null hypothesis that the data are non-stationary and the alternative is that they are stationary. All variables were tested for stationarity. This is vital because econometric analysis of non-stationary variables affects the efficiency and consistency of estimation results (Granger, 1974). The results of the unit root test of the variables at levels are reported in Table 4 below:

Table 4: Unit Root Tests at Levels

Variable	ADF Statistic Test	Critical Value at 1%	Probability	Conclusion
LNY	-1.646315	-3.661661	0.4477	Non-stationary
LNEXT	-2.299280	-3.653730	0.1783	Non-stationary
LNLAB	-1.176710	-3.661661	0.6716	Non-stationary
LNK	-2.114693	-3.653730	0.2405	Non-stationary

The ADF unit root test above show that at levels, the researcher cannot reject the null hypothesis of unit root for all the variables implying that they are non-stationary at level. Thus the researcher will proceed to test the stationarity of the variables at first difference and the results are shown in Table 5 below:

Table 5: Unit Root Tests at First Difference

Variable	ADF Statistic Test	Critical Value at 1%	Probability	Conclusion
LNY	-3.804379	-3.661661	0.0070	Stationary
LNEXT	-3.963183	-3.661661	0.0047	Stationary
LNLAB	-12.49294	-3.661661	0.0000	Stationary
LNK	-6.47959	-3.661661	0.0000	Stationary

The null hypothesis of unit root test applied to the variables in their first differences is rejected for all the variables showing that they are stationary and integrated of order one-I(1). In each case presented in Table 5, the null hypothesis is that there is unit root, that is the time series is non-stationary. In each case, the ADF test statistics in absolute terms is greater than the critical values at 1%, hence the null hypothesis of unit root is rejected, and thus all-time series are stationary after first differencing. Inferring from the results in Table 5 above, it can be concluded that all the variables are stationary at first differencing and are integrated of the same order, giving rise to the possibility of the existence of a long-run relationship among the variables. To identify the long-run relationship among the variables included in both models, Johansen cointegration test will be employed.

4.2 Lag Length Selection

In estimating VAR, special attention needs to be given to ensuring an appropriate specification of the lag length so as to ensure no serial correlation from the residuals. Table 6 provides the lag length selection criteria. Based on the sequential modified Likelihood Ratio (LR) test statistic (each test at 5% level), Final Prediction Error (FPE), Schwartz information criterion (SC), Akaike Information Criterion (AIC) and Hannan-Quinn (HQ) criterion, the table suggests an appropriate lag length of 1.

Table 6: Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-18.38553	NA	4.98e-05	1.444228	1.629258	1.504543
1	136.0026	258.9736*	6.68e-09*	-7.484038*	-6.558885*	-7.182462*
2	147.3354	16.08525	9.56e-09	-7.182928	-5.517652	-6.640090

* indicates lag order selected by the criterion

4.3 Johansen Cointegration Tests

To test for the long-run cointegration relationship between the four time series, the researcher carried out the Johansen cointegration test. The test results, reported in Table 7, indicate that four series are cointegrated and there are two cointegrating vectors. Table 7 is divided into two parts. The first part reports the results from the trace test, while the second part reports the results of the maximum Eigenvalue.

Table 7: Johansen Cointegration Test

Hypothesized Number of Cointegrating Equations	Trace Test			Maximum Eigenvalue Test		
	Trace Statistic	Critical Value (0.05)	Probability	Maximum Eigenvalue Statistic	Critical Value (0.05)	Probability
ϒ = 0	88.60419	47.85613	0.0000	42.16333	27.58434	0.0004
ϒ ≤ 1	46.44086	29.79707	0.0003	31.72037	21.13162	0.0011
ϒ ≤ 2	14.72049	15.49471	0.0652	13.68370	14.26460	0.0616
ϒ≤ 3	1.036786	3.841466	0.3086	1.036786	3.841466	0.3086

The results of the test of cointegration in Table 7 above signify maximum and trace test statistics and their associated critical values. These test statistics help evaluate the null hypothesis of ϒ = 0 against the general alternatives of ϒ > 0, 1, 2, or 3. At 5% level for both the maximum and trace test statistics, the null hypothesis of ϒ ≤ 2 is not rejected, which shows that the model has at least 2 cointegrating equations. On the basis of the above results, a long-run relationship exists among LNGDP, LNLAB, LNK and LNEXT. Given this result, it follows that the VEC model is adopted for analytical purposes.

4.4 Diagnostic Tests

4.4.1 Autocorrelation: The Lagrange Multiplier (LM) Test

The LM test was used to test for autocorrelation in the VAR model. The LM tests the null hypothesis that there is no serial correlation at a given lag length. The results from the LM tests are shown below:

Table 8: Serial Correlation LM Test

Lags	LM Statistics	Probability
1	17.83364	0.3337
2	12.80139	0.6872
3	12.37229	0.7180
4	13.26389	0.6534

The results above show that the corresponding probability (0.6534) at lag length 4 from the LM statistic is greater than the α value of 0.05 hence the researcher failed to reject the null hypothesis of no serial correlation. The conclusion is that there is no problem of serial correlation at the selected lag length.

4.4.2 VEC Residual Normality Tests

The test for normality relies on the skewness and kurtosis of the residuals. With the data from Table 9 below, the hypothesis of normality properties cannot be rejected, since probability-values are 0.1959, 0.1801 and 0.1379 for skewness, kurtosis and the Jarque-Bera test. This provides some support for the hypothesis that residuals from the VEC model have a normal distribution. The results for VEC residual normality tests are shown below:

Table 9: VEC Residual Normality Test

Component	Skewness	Chi-sq	df	Prob.
1	-0.374158	0.699969	1	0.4028
2	0.265348	0.352048	1	0.5530
3	-0.955507	4.564970	1	0.0326
4	-0.291978	0.426254	1	0.5138
Joint		6.043242	4	0.1959

Component	Kurtosis	Chi-sq	df	Prob.
1	2.630099	0.171033	1	0.6792
2	3.677241	0.573319	1	0.4489
3	4.958267	4.793514	1	0.0286
4	3.763288	0.728260	1	0.3934
Joint		6.266126	4	0.1801

Component	Jarque-Bera	df	Prob.
1	0.871002	2	0.6469
2	0.925367	2	0.6296
3	9.358484	2	0.0093
4	1.154514	2	0.5614
Joint	12.30937	8	0.1379

4.4.3 White's Heteroskedasticity Test

The White test for heteroscedasticity was performed. The null hypothesis is that there is no heteroscedasticity. The test regression is run by regressing each cross product of the residuals on the cross products of the regressors and testing the joint significance of the regression. Under the null hypothesis of no heteroscedasticity, the non-constant regressors should not be jointly significant. The calculated *F*-statistic is 1.936518. If the calculated F-statistics is greater than the critical F-statistic from the tables of F-distribution, the null hypothesis of no heteroscedasticity is rejected. The critical *F*-statistics with 10 degrees of freedom for numerator and 20 degrees of freedom for denominator is greater than 1.936518. Since the critical value of *F*-statistics is greater than calculated *F*-statistics, the null hypothesis of no heteroscedasticity is not rejected. Table 10 shows a summary of the test of individual components.

Table 10: White Heteroscedasticity Test – Individual components.

Dependent	R-squared	F(10,20)	Probability	Chi-sq(16)	Probability
res1*res1	0.688780	1.936518	0.1104	21.35219	0.1654
res2*res2	0.553691	1.085524	0.4427	17.16441	0.3750
res3*res3	0.822379	4.051231	0.0059	25.49376	0.0616
res4*res4	0.229711	0.260937	0.9940	7.121033	0.9709
res2*res1	0.731082	2.378785	0.0552	22.66356	0.1230
res3*res1	0.491342	0.845212	0.6299	15.23160	0.5077
res3*res2	0.688906	1.937658	0.1102	21.35610	0.1652
res4*res1	0.487793	0.833294	0.6401	15.12159	0.5158
res4*res2	0.560356	1.115249	0.4226	17.37105	0.3620
res4*res3	0.498440	0.869558	0.6093	15.45165	0.4918

Table 11 shows the joint test for White's heteroscedasticity test. The null hypothesis is that there is no heteroscedasticity. The χ^2 test at 5% significance level with 180 degrees of freedom (df) is used. If the calculated Chi-squared of 204.5355 is greater than the critical χ^2 test at 5% with 180 df, the null hypothesis is rejected. The critical value of χ^2 at 5% with 180 df is found to be less. So the null hypothesis of no heteroscedasticity is not rejected.

Table 11: Joint Test for White's Heteroscedasticity Test

Chi-Squared	Degrees of freedom	probability
204.5355	180	0.1014

4.5 Stability tests

In order to determine whether the VEC model is suitable for analysis, a VEC stability test is conducted. The results of the stability test are shown below:

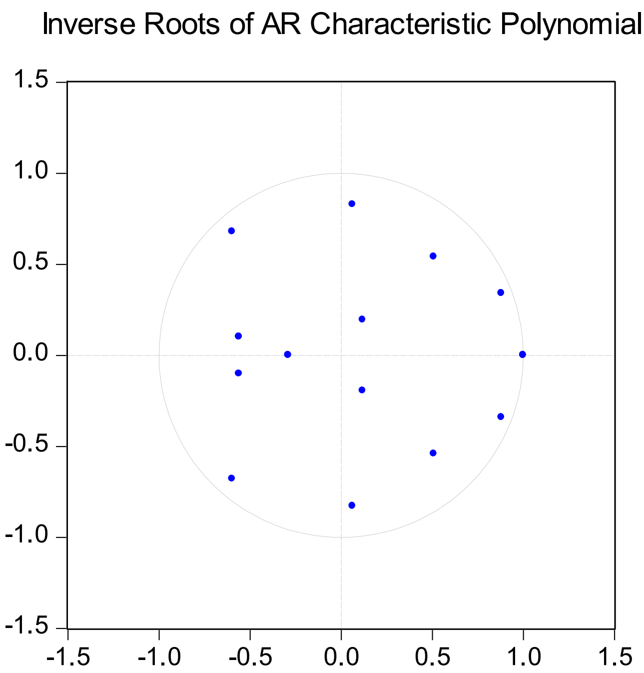


Figure 3: Inverse Roots of AR Characteristic Polynomial

For the VEC model to satisfy the stability conditions, all roots should lie inside the circle and the modulus has to be less than one. At the chosen lag length, the results showed that all the modulus were less than one. The figure above shows that no root lies outside the unit circle hence the VEC satisfies the stability condition. The stability check thus confirms that the VEC model is well specified.

4.6 Granger Causality Test Results

The Toda-Yamamoto causality tests were used to establish whether there is a causal relationship between the variables under study. Engel and Granger (1987) identify that if cointegration exists between two variables in the long-run then there must be either unidirectional or bi-directional granger causality between these two variables. The null hypothesis of no Granger causality is tested. The null hypothesis of no Granger causality between two variables is rejected if the probability is less than 5% (0.05) while the null hypothesis is not rejected in the event that the probability is greater than 0.05, signifying that there is no causal relationship between the variables. The Toda-Yamamoto Granger non-causality Wald test results are summarised in Table 12 below:

Table 12: Toda-Yamamoto Granger Causality Test Results

Null Hypothesis	Chi-square	Probability
LNLAB does not Granger cause LNY	2.94601	0.0861
LNY does not Granger cause LNLAB	0.00127	0.9715
LNK does not Granger cause LNY	5.48317	0.0071
LNY does not Granger cause LNK	0.12730	0.7212
LNEXT does not Granger cause LNY	4.01179	0.0108
LNY does not Granger cause LNEXT	1.71415	0.1291
LNK does not Granger cause LNLAB	0.19147	0.6617
LNLAB does not Granger cause LNK	1.92651	0.1651
LNEXT does not Granger cause LNLAB	0.00129	0.9713
LNLAB does not granger cause LNEXT	0.13535	0.7129
LNEXT does not Granger cause LNK	0.68922	0.4064
LNK does not Granger cause LNEXT	4.09716	0.02103

From to the results in the table above, the null hypothesis of no causality from labour force to economic growth is not rejected. The null hypothesis of no causality between capital and economic growth is rejected. On the other hand, the null hypothesis of no causality from economic growth to capital is not rejected. Thus, there is evidence of unidirectional causality from economic growth to capital. The results show that the null hypothesis that external debt does not cause economic growth can be rejected. However, the null hypothesis that economic growth does not cause external debt is not rejected. Thus, it can be concluded that there is a unidirectional direction of causality running from external debt to economic growth. This result suggests that for the period under consideration, Zimbabwe’s external debt influenced changes in the real GDP but real GDP did not impact on the level of the country’s external debt burden.

The null hypothesis that capital does not Granger cause labour force is not rejected as the probability value of 0.6617 is more than 0.05. Additionally, the null hypothesis that labour force does not Granger cause capital is not rejected as the probability value of 0.1651 is more than 0.05. Also, the null hypothesis of no Granger causality between labour force and external debt is not rejected. Capital and external debt have shown to granger cause GDP and by implication, this shows that external debt and capital have had an important effect on Zimbabwe’s economic growth. The extent that this will contribute to economic growth will largely depend on how government utilises the eternal debt component within the budget.

4.7 Variance Decomposition Analysis

According to Enders (2003), variance decomposition tells how much a given variable changes under the impact of its own shock and the shock of other variables. Therefore, the variance decomposition defines the relative importance of each random innovation in affecting the variables in the VEC. The forecast error variance decomposition provides information about the dynamic relationships among jointly analysed VEC system variables. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the endogenous variables. They measure the relative importance of shocks arising from one variable in explaining another variable. As expected, the largest importance is placed on each variable in explaining itself. It tells how much of a change in a variable is due to its own shock and how much due to shocks to other variables. In the short run most of the variation is due to own shock. But as the lagged variables’ effect starts kicking in, the percentage of the effect of other shocks increases over time.

Looking at Table 13, the fluctuations of economic growth are explained mainly by economic growth and external debt shocks. Economic growth shock accounts for 100% at first year. Its proportion in the variance of economic decreases over time and reaches 31.84% in the tenth year. External debt shock accounts for 0% in the first year. Its proportion increases over time and reaches 48.57% in the tenth year. External debt shock is the most important source of economic growth variability.

Capital shock account for 89.27% variance of capital in the first year and continuously dominates for the following years. Its proportion decreases over time but still accounts for 74.38% in the tenth year.

Labour force shock is the most important source of labour force variability. The role played by labour force shock increases over time and accounts for 72.1% in the tenth year. In addition, the fluctuation in labour force is also explained by capital shock. Capital shock accounts for 29% in the first year, falls to 15% in the fifth year and is not significant thereafter.

External debt variability is due to labour force, economic growth and capital. External debt shock accounts for 48.3% in the first year. Its proportion decreases over time and reaches 35.1% in the tenth year. Economic growth shock is an important source of the variability of external debt. It accounts for 32.9% in the first year and then decreases over time and reaches 9.4% in the tenth year. The impact of both labour and capital in the first year is 7.6% and 11.1% respectively and increases over time to 34.4% and 21.1% respectively in the tenth period. In summary, external debt shock is the most important source of effects on economic growth. Shocks to capital and labour are also an important source of their own variability.

Table 13a–13d: Variance Decomposition

13a: Variance Decomposition of LNY

Period	S.E.	LNY	LNLAB	LNK	LNEXT
1	0.064832	100.0000	0.000000	0.000000	0.000000
2	0.099746	99.07810	0.050354	0.039877	0.831671
3	0.125859	90.73590	2.411784	0.025368	6.826947
4	0.154097	75.85967	6.623489	0.310234	17.20660
5	0.185618	61.80335	10.15305	0.985809	27.05778
6	0.218271	51.32245	12.45344	1.728441	34.49567
7	0.250474	43.92212	13.90149	2.369148	39.80723
8	0.281519	38.63866	14.85052	2.883111	43.62770
9	0.311159	34.76306	15.50517	3.289852	46.44192
10	0.339351	31.84153	15.97661	3.613494	48.56837

13b: Variance Decomposition of LNK

Period	S.E.	LNY	LNK	LNLAB	LNEXT
1	0.640521	10.73000	89.27000	0.000000	0.000000
2	0.732803	12.16807	86.81419	0.074948	0.942793
3	0.781031	10.90019	84.66376	0.940524	3.495519
4	0.825214	9.779895	80.69723	2.444770	7.078103
5	0.859025	9.119615	78.07814	3.330050	9.472196
6	0.880736	8.925496	76.95171	3.595511	10.52728
7	0.893045	9.165584	76.41434	3.595444	10.82464
8	0.899407	9.728929	75.94902	3.544973	10.77708
9	0.903722	10.42808	75.30894	3.577963	10.68502
10	0.909562	11.05633	74.37850	3.774311	10.79085

13c: Variance Decomposition of LNLAB

Period	S.E.	LNY	LNK	LNLAB	LNEXT
1	0.031259	2.199164	29.12427	68.67656	0.000000
2	0.048972	3.118519	27.05408	69.29078	0.536626
3	0.062168	3.885115	22.45118	71.95185	1.711848
4	0.072738	4.513823	18.49677	73.92755	3.061849
5	0.081436	5.269035	15.53338	75.00046	4.197122
6	0.088752	6.272177	13.41261	75.31232	5.002893
7	0.094931	7.541935	11.94169	75.06807	5.448311
8	0.100110	9.050507	10.97672	74.41994	5.552829
9	0.104452	10.73514	10.44555	73.42411	5.395202
10	0.108176	12.49329	10.34258	72.06632	5.097814

13d: Variance Decomposition of LNEXT

Period	S.E.	LNY	LNK	LNLAB	LNEXT
1	0.094710	32.89856	11.12762	7.648115	48.32570
2	0.126301	21.86699	17.89429	6.245190	53.99353
3	0.138994	18.46675	27.09030	6.741479	47.70147
4	0.149699	16.76279	30.28445	11.79529	41.15747
5	0.158774	16.18152	28.38003	17.82534	37.61310
6	0.168586	15.33953	25.17296	23.63848	35.84902
7	0.180775	13.80993	22.59674	28.43876	35.15456
8	0.194746	12.01409	21.23594	31.70132	35.04866
9	0.208835	10.44770	20.91143	33.54034	35.10053
10	0.221462	9.393959	21.13771	34.40443	35.06390

4.8 Impulse Response

The impulse response analysis describes how innovations (shocks) to one variable affect another variable after a given period. Figure 4 exhibit the generalized asymptotic impulse response function. It includes 16 small figures which are denoted Figure 4.1, Figure 4.2 . . . Figure 4.16. Each small figure illustrates the dynamic response of each target variable (LNY, LNK, LNLAB and LNEXT) to a one-standard-deviation shock on itself and other variables. In each small figure, the horizontal axis presents the ten years following the shock. The vertical axis measures the yearly impact of the shock on each endogenous variable.

Figure 4.1 presents the long-run positive effect on LNY of a shock to LNY. Figure 4.2 show that in the long run a shock to economic growth has positive significant impact on capital. Looking at figures 4.3 and 4.4, a shock to economic growth has statistically insignificant effects on labour force and external debt. Figures 4.5 and 4.7 shows that in the long run labour force shocks have positive significant impacts on economic growth and labour force.

Under a shock to labour force, labour force increases considerably over the whole period. Figure 4.6 shows that labour force shock has a long run negative impact on capital. In the first period the impact is insignificant and thereafter it has a long run negative impact. There is no statistically significant impact of labour force on external debt in Figure 4.8. Figures 4.9 and 4.11 shows that in the long run, capital shocks have positive significant impact on economic growth and itself. Figure 4.10 show that shock to capital is positive and statistically significant in the short run and after period 3 becomes statistically insignificant. Figure 12 shows that capital shocks do not have effects on external debt.

Figures 4.13 show that in the long run a shock to external debt has a negative significant impact on economic growth. There is no impact of external debt shock on labour force in figure 4.14. Figure 4.15 show that external debt shock has a long run positive effect on external debt. Figure 4.16 show that a shock to external debt positive impact on capital in the first 6 years and thereafter it becomes negative and insignificant. It begins to increase slightly and reaches a maximum in the second year, then continues on a downward trend until year 6 when it becomes insignificant thereafter.

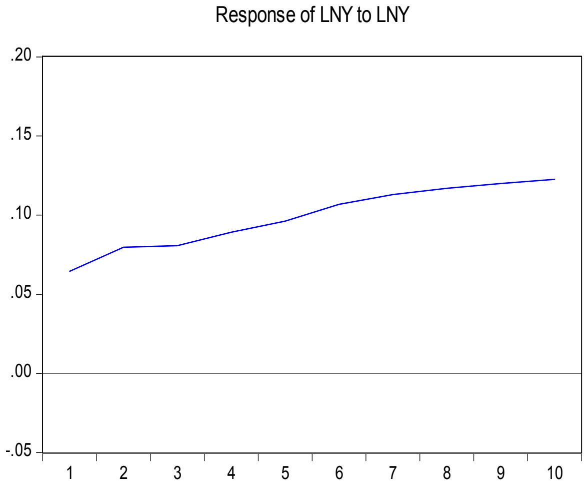


Figure 4.1

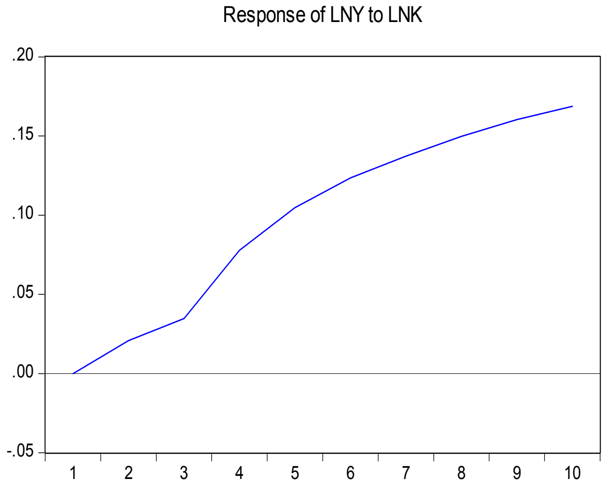


Figure 4.2

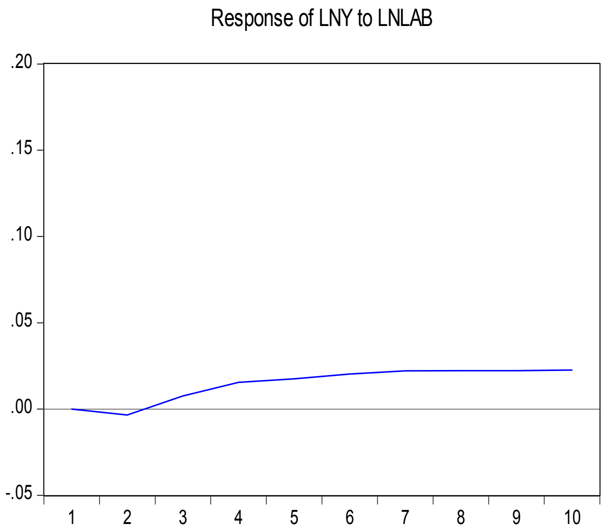


Figure 4.3

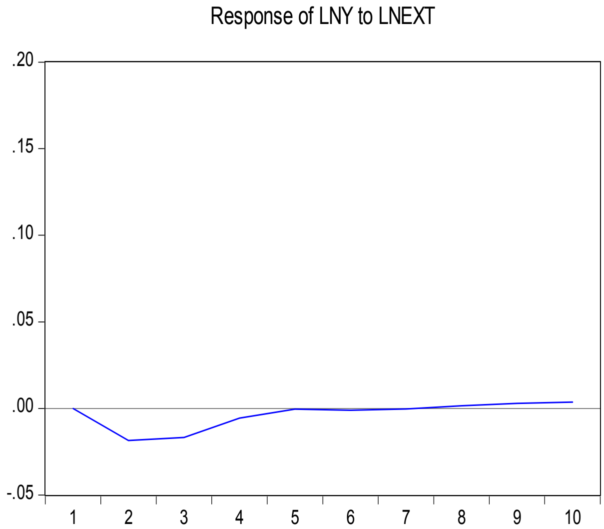


Figure 4.4

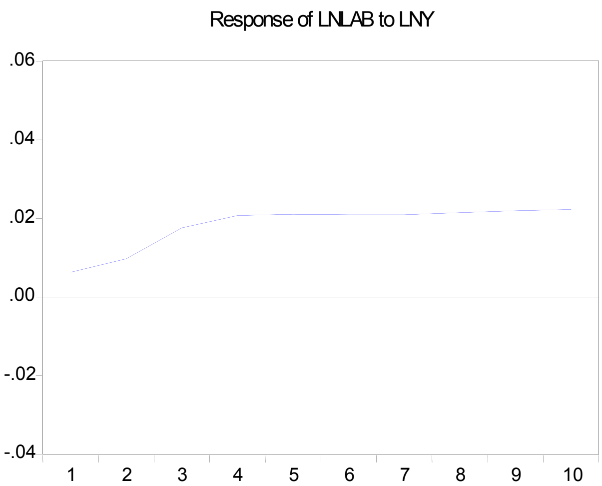


Figure 4.5

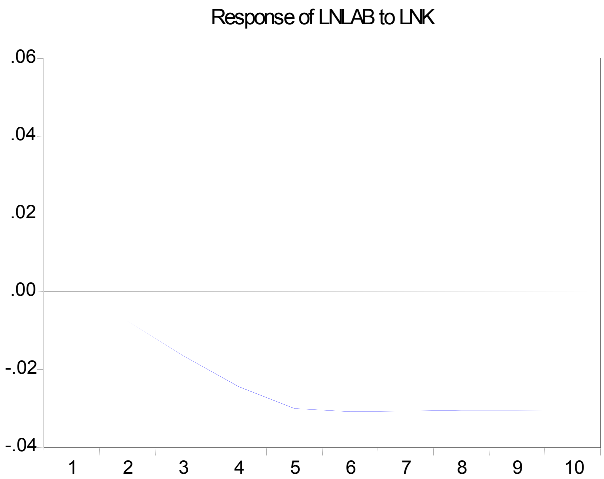
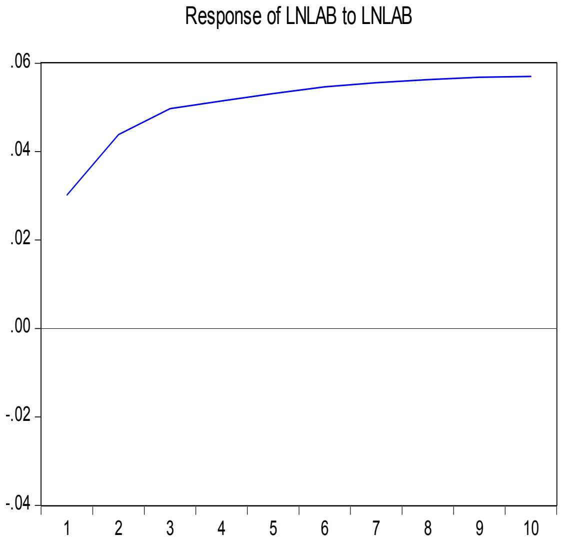


Figure 4.6



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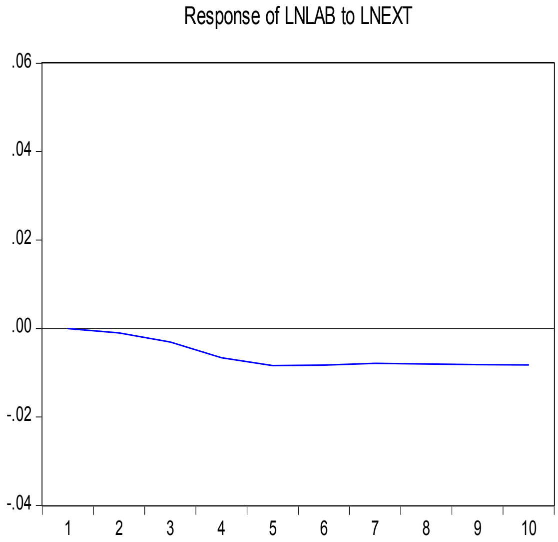


Figure 4.8

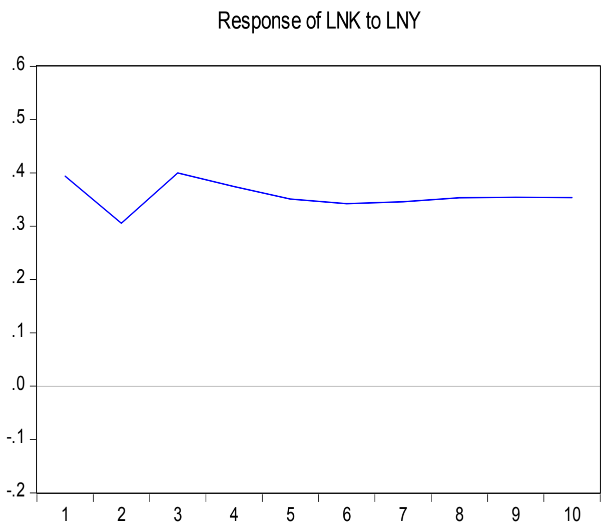


Figure 4.9

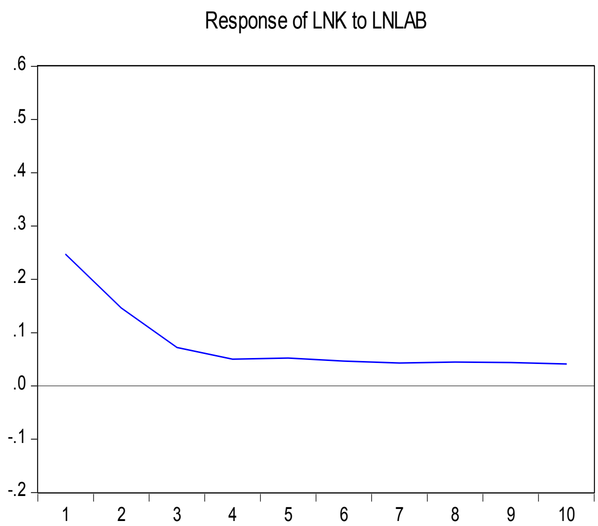


Figure 4.10

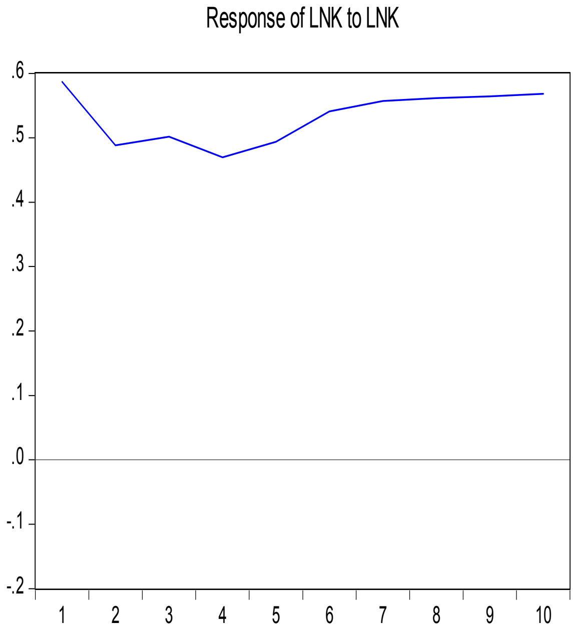


Figure 4.11

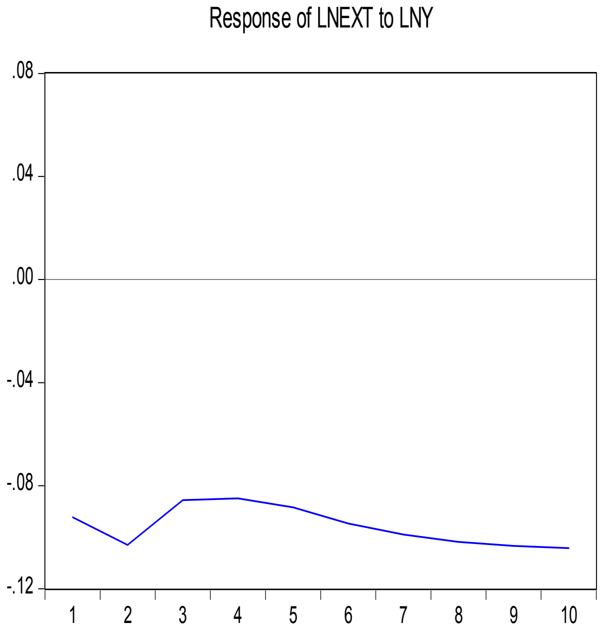


Figure 4.13

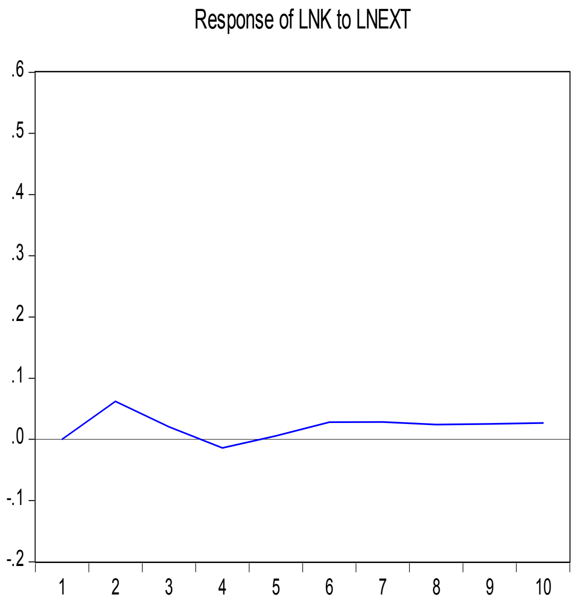


Figure 4.12

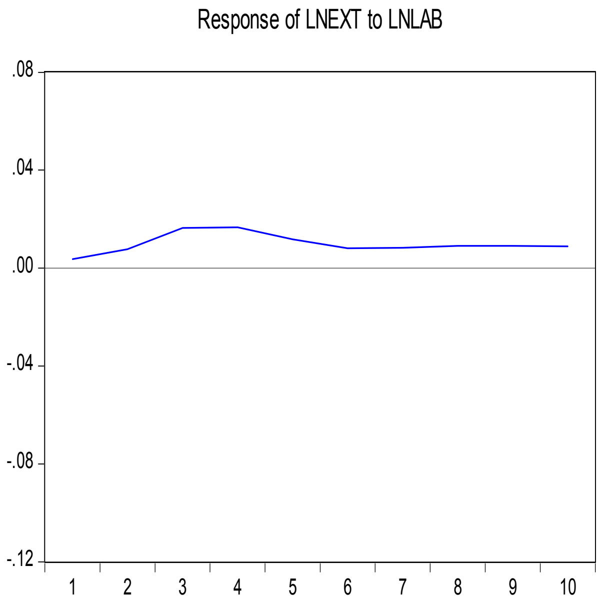


Figure 4.14

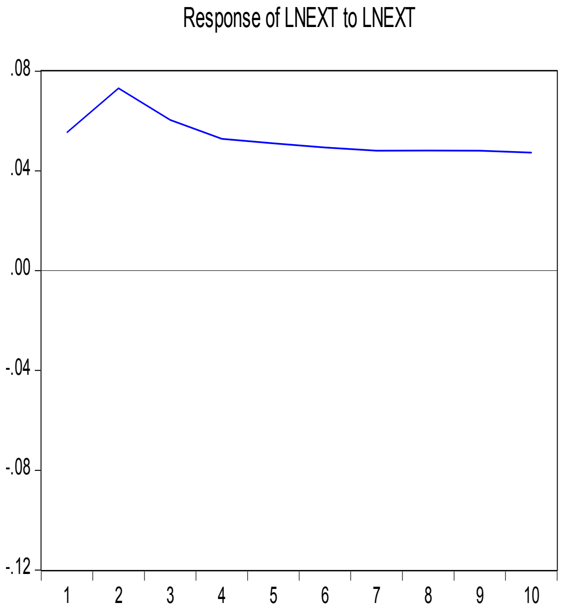


Figure 4.15

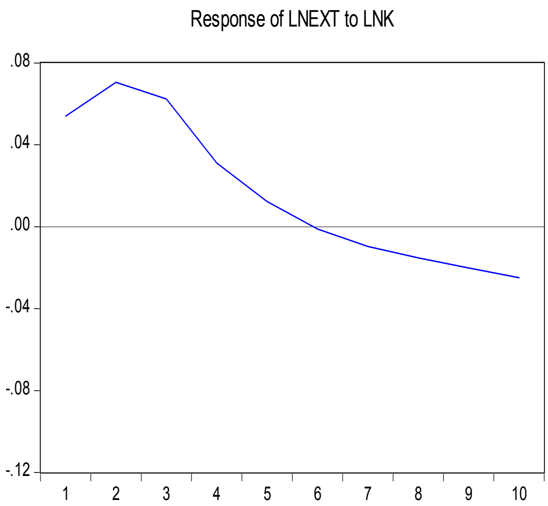


Figure 4.16

Figure 4.1-4.16: Impulse Response

4.9 Conclusion

This chapter focused on the results from the econometric analysis adopted in this study. The VEC estimates as shown by the impulse response and variance decomposition together with the Toda-Yamamoto Granger causality tests show that there is a strong unidirectional relationship between external debt and GDP as well as a unidirectional causal relationship running from external debt to GDP, as well as from capital to GDP and external debt. The chapter also provided economic interpretation of the results obtained from the research.

CHAPTER 5

CONCLUSIONS AND POLICY RECOMMENDATIONS

5.0 Introduction

The study investigated the relationship between external debt and economic growth over the period 1980 to 2012. The main objective of the study was to analyse the effects of external debt on economic growth in Zimbabwe. The huge external debt accumulation recorded in the last two decades coupled with low and sometimes negative growth rates prompted the need to undertake this study. In this chapter the study gives a recap of the findings, highlight areas of further investigation and policy recommendations in line with the results obtained herein.

5.1 Summary of Findings

This study set to investigate the relationship between external debt and economic growth for Zimbabwe over the period 1980 to 2012. Initially, stationarity properties of the variables were investigated using the ADF tests, to avoid the potential pitfalls associated with modelling non-stationary time series data. The Augmented Dickey-Fuller test results showed that all the variables were non-stationary at levels and only became stationary after first differencing. The main findings of the study obtained from Toda-Yamamoto Granger causality tests revealed the existence of unidirectional direction of causality running from external debt to economic growth. This result indicates that for Zimbabwe, external borrowing has had an influence on the country's GDP. This outcome indicates that a rising debt burden for Zimbabwe can consequently hamper growth.

The study analysed both the short-run and long-run impacts of external debt on economic growth using a VAR framework to take into account feedback effects between external debt and economic growth. On the basis of cointegration among variables which indicates a long-run relationship, a VEC was applied to analyse both the short-run and long-run dynamics of the model. To ensure that the model had a desired fit the LM, Jacque-Berra and VEC stability tests were applied.

Meanwhile, impulse response analysis provided a significant short run and long run dynamic interaction between GDP and independent variables of external debt and capital. In the short run and long run, the external debt transitory shock plays a role as a driving force of GDP in Zimbabwe. Furthermore, results from variance decomposition analysis established a significant relationship between external debt and real GDP. The external debt shock can significantly explain 6.8% of fluctuations in economic growth during the third period and 48.6% in period 10. Overall results of the model were statistically significant thus inference can be made to guide policy decision.

5.2 Policy Recommendations

The significance of the results in this study gives strong foundation to guide policy in the area of external debt management in Zimbabwe. The long-run inverse relationship between external debt and economic growth calls for policies that will promote conservative borrowing in order to reduce the negative growth effects of external debt on the economy. The results obtained herein show that, if unchecked, Zimbabwe’s external debt will continue to undermine the country's growth prospects hence leaving the country at risk of falling into a poverty trap.

The result calls for authorities to formulate and implement a holistic external debt management strategy which enables the government to effectively track debt service obligations through coordination of debt management with the country's fiscal and monetary policy objectives. Such a strategy would also ensure that loans are contracted at optimal costs and that the overall level of the country's external indebtedness remains within sustainable levels. This could be achieved through linking the country's borrowings to the country's current and prospective ability to service the contracted loans. The primary objective of such policy initiatives would be to ensure that contracted external debt remains within the "good side" of the debt Laffer curve, where there is zero probability of defaulting on the external payment obligations. As alluded to in Chapter 2, the "good side" of the debt Laffer curve is ideal as it postulates that the contracted debt yields positive GDP growth and does not deter foreign investors from investing in the country. There is also need to ensure that loans contracted are utilised for the intended purposes and invested in capital projects whose rate of return is higher than the principal and interest payments. There is also need for a public debt law to ratify any borrowings requirements. This will help to monitor all borrowings and ensure that all borrowings are directed towards the financing of capital projects that contributes to economic growth.

In light of the results obtained here, Zimbabwe should be discouraged from funding budget financing gaps by incurring non-concessional liabilities because this would further worsen the country's already precarious external debt situation. Any financing gaps should be funded by non-debt creating flows such as grants, foreign direct investments or more concessionary loans with longer grace and repayment periods as well as low interest rates.

Furthermore, these findings makes a relatively good case for debt relief for the highly indebted countries (HICs), including Zimbabwe, in line with the debt Laffer curve model discussed in this study. The results obtained add to calls by policy makers and public opinion around the world among other voices, regarding the need to have the debts of many developing countries cancelled. The study revealed that Zimbabwe faces challenges in repaying the outstanding debt obligations, which is severely constraining the country’s capacity to lure foreign direct investments and economic growth.

Insights from the Toda-Yamamoto Granger causality tests revealed causality running from capital to economic growth. Results from impulse responses revealed that capital shocks have positive significant impact on economic growth. This revelation helps to explain that external debt is not the only factor affecting the GDP level in Zimbabwe. To reverse the negative effects of a growing external debt stock, the government can enhance public investment in capital projects such as roads, rail and hydro plants and human development to attract private participation, and thus increase its revenue base.

Regarding external debt, the IMF called on Zimbabwe to engage in coordinated discussions with the World Bank and international financial institutions (IFIs) and to respect the preferred creditor status of IFIs, avoid selective debt service, and increase payments to the Fund’s Poverty Reduction and Growth Trust (PRGT) as capacity to repay improves. Strong macroeconomic policies and a comprehensive arrears clearance framework with the support of development partners are seen as essential to addressing Zimbabwe’s debt problems. The IMF Executive Board made a flurry of recommendations: 1) implement the SMP; 2) implement a revised fiscal plan; 3) reduce public expenditure on payrolls; 4) strengthen public financial management; 5) rebuild foreign reserves; 6) limit non-concessional lending; 7) enhance financial sector stability; 8) address structural bottlenecks to boost competitiveness; 9) reduce uncertainty regarding the indigenisation policy; and 10) implement measures to boost transparency in the diamond mining sector.

5.3 Recommendation for Future Studies

Due to data and time constraints, the study only focused on external debt, leaving out an important component of gap financing-domestic borrowing. Further studies could be carried out to investigate the debt overhang and credit rationing effects on FDI and GDP growth separately. In addition, future research could focus on the effects of total public debt encompassing both external and domestic debt on economic growth. On the other hand, to complement results of this study, it would be important also to fully understand the determinants of external debt in Zimbabwe, through a separate empirical investigation. Results from such a study would be read in conjunction with results obtained here and will form the basis for policy recommendations aimed at avoiding the accumulation of audacious debt in future.

5.4 Conclusion

The main thrust of the study was to analyse the impact of external debt on economic growth in Zimbabwe using a VAR model. This study highlights some important findings for policy. As regards the impact of external debt on economic growth, the results confirm the presence of debt overhang phenomenon in Zimbabwe. The results of the study confirm that there is a statistically significant inverse relationship between external debt and economic growth. The study found a unidirectional causality running from external debt to economic growth. In this regard, effective debt management policies and strategies aimed at reducing the cost and risks associated to external debt are a must for ensuring a sustainable path of external debt to promote economic growth. The study was successfully carried out.

APPENDICES

Appendix 1: Unit Root Tests

Null Hypothesis: LNY has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.646315	0.4477
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNY)
Method: Least Squares
Date: 09/04/14 Time: 18:36
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNY(-1)	-0.105557	0.064117	-1.646315	0.1109
D(LNY(-1))	0.388071	0.163081	2.379627	0.0244
C	2.386506	1.448058	1.648073	0.1105

R-squared	0.216455	Mean dependent var	0.005366
Adjusted R-squared	0.160487	S.D. dependent var	0.075558
S.E. of regression	0.069230	Akaike info criterion	-2.411000
Sum squared resid	0.134198	Schwarz criterion	-2.272227
Log likelihood	40.37050	Hannan-Quinn criter.	-2.365763
F-statistic	3.867507	Durbin-Watson stat	2.008871
Prob(F-statistic)	0.032877		

Null Hypothesis: D(LNY) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.804379	0.0070
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	

	10% level	-2.619160

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNY,2)
Method: Least Squares
Date: 09/04/14 Time: 18:37
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNY(-1))	-0.635903	0.167150	-3.804379	0.0007
C	0.002634	0.012857	0.204911	0.8391

R-squared	0.332924	Mean dependent var	-0.002136
Adjusted R-squared	0.309921	S.D. dependent var	0.085761
S.E. of regression	0.071242	Akaike info criterion	-2.383121
Sum squared resid	0.147188	Schwarz criterion	-2.290605
Log likelihood	38.93837	Hannan-Quinn criter.	-2.352963
F-statistic	14.47330	Durbin-Watson stat	1.980498
Prob(F-statistic)	0.000679		

Null Hypothesis: LNLAB has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.176710	0.6716
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNLAB)
Method: Least Squares
Date: 09/04/14 Time: 18:37
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNLAB(-1)	-0.020196	0.017163	-1.176710	0.2492
D(LNLAB(-1))	0.201860	0.068801	2.933956	0.0066

C	0.334647	0.261262	1.280887	0.2107

R-squared	0.381503	Mean dependent var	0.040664
Adjusted R-squared	0.337324	S.D. dependent var	0.036565
S.E. of regression	0.029766	Akaike info criterion	-4.099128
Sum squared resid	0.024809	Schwarz criterion	-3.960355
Log likelihood	66.53648	Hannan-Quinn criter.	-4.053891
F-statistic	8.635501	Durbin-Watson stat	1.406572
Prob(F-statistic)	0.001199		

Null Hypothesis: D(LNLAB) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-12.49294	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNLAB,2)
Method: Least Squares
Date: 09/04/14 Time: 18:38
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNLAB(-1))	-0.759332	0.060781	-12.49294	0.0000
C	0.027307	0.006351	4.299453	0.0002

R-squared	0.843306	Mean dependent var	-0.014834
Adjusted R-squared	0.837902	S.D. dependent var	0.074421
S.E. of regression	0.029963	Akaike info criterion	-4.115376
Sum squared resid	0.026035	Schwarz criterion	-4.022861
Log likelihood	65.78833	Hannan-Quinn criter.	-4.085218
F-statistic	156.0736	Durbin-Watson stat	1.451193
Prob(F-statistic)	0.000000		

Null Hypothesis: LNK has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.114693	0.2405
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNK)
Method: Least Squares
Date: 09/04/14 Time: 18:38
Sample (adjusted): 1981 2012
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNK(-1)	-0.279289	0.132071	-2.114693	0.0429
C	5.762094	2.714395	2.122791	0.0421

R-squared	0.129727	Mean dependent var	0.026526
Adjusted R-squared	0.100718	S.D. dependent var	0.644217
S.E. of regression	0.610914	Akaike info criterion	1.912741
Sum squared resid	11.19649	Schwarz criterion	2.004350
Log likelihood	-28.60386	Hannan-Quinn criter.	1.943107
F-statistic	4.471927	Durbin-Watson stat	2.028955
Prob(F-statistic)	0.042874		

Null Hypothesis: D(LNK) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-6.479590	0.0000
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNK,2)
Method: Least Squares
Date: 09/04/14 Time: 18:39
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNK(-1))	-1.177922	0.181790	-6.479590	0.0000
C	0.019599	0.117196	0.167234	0.8683

R-squared	0.591463	Mean dependent var	-0.010228
Adjusted R-squared	0.577376	S.D. dependent var	1.002954
S.E. of regression	0.652015	Akaike info criterion	2.044844
Sum squared resid	12.32860	Schwarz criterion	2.137359
Log likelihood	-29.69508	Hannan-Quinn criter.	2.075002
F-statistic	41.98508	Durbin-Watson stat	2.005124
Prob(F-statistic)	0.000000		

Null Hypothesis: LNEXT has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.299280	0.1783
Test critical values:	1% level	-3.653730	
	5% level	-2.957110	
	10% level	-2.617434	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEXT)
Method: Least Squares
Date: 09/04/14 Time: 18:39
Sample (adjusted): 1981 2012
Included observations: 32 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LNEXT(-1)	-0.120144	0.052253	-2.299280	0.0286
C	0.477986	0.182093	2.624958	0.0135

R-squared	0.149821	Mean dependent var	0.062494
Adjusted R-squared	0.121482	S.D. dependent var	0.135413
S.E. of regression	0.126921	Akaike info criterion	-1.230036
Sum squared resid	0.483271	Schwarz criterion	-1.138427
Log likelihood	21.68057	Hannan-Quinn criter.	-1.199670
F-statistic	5.286687	Durbin-Watson stat	1.112826
Prob(F-statistic)	0.028627		

Null Hypothesis: D(LNEXT) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=8)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-3.963183	0.0047
Test critical values:	1% level	-3.661661	
	5% level	-2.960411	
	10% level	-2.619160	

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

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(LNEXT,2)
Method: Least Squares
Date: 09/04/14 Time: 18:40
Sample (adjusted): 1982 2012
Included observations: 31 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LNEXT(-1))	-0.617646	0.155846	-3.963183	0.0004
C	0.029899	0.023064	1.296347	0.2051

R-squared	0.351329	Mean dependent var	-0.007550
Adjusted R-squared	0.328961	S.D. dependent var	0.143003
S.E. of regression	0.117143	Akaike info criterion	-1.388497
Sum squared resid	0.397954	Schwarz criterion	-1.295981
Log likelihood	23.52170	Hannan-Quinn criter.	-1.358339
F-statistic	15.70682	Durbin-Watson stat	1.965525
Prob(F-statistic)	0.000442		

Appendix 2: Lag Order Selection Criteria

VAR Lag Order Selection Criteria
Endogenous variables: LNY LNLAB LNK LNEXT
Exogenous variables: C
Date: 09/04/14 Time: 17:34
Sample: 1980 2012
Included observations: 31

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-18.38553	NA	4.98e-05	1.444228	1.629258	1.504543
1	136.0026	258.9736*	6.68e-09*	-7.484038*	-6.558885*	-7.182462*
2	147.3354	16.08525	9.56e-09	-7.182928	-5.517652	-6.640090

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

Appendix 3: Cointegration Tests

Date: 09/04/14 Time: 17:32
Sample (adjusted): 1984 2012
Included observations: 29 after adjustments
Trend assumption: Linear deterministic trend
Series: LNY LNLAB LNK LNEXT
Lags interval (in first differences): 1 to 3

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.892795	97.01272	47.85613	0.0000
At most 1 *	0.541076	32.25540	29.79707	0.0255
At most 2	0.243906	9.668136	15.49471	0.3071
At most 3	0.052373	1.560039	3.841466	0.2117

Trace test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.892795	64.75732	27.58434	0.0000
At most 1 *	0.541076	22.58726	21.13162	0.0310
At most 2	0.243906	8.108097	14.26460	0.3678
At most 3	0.052373	1.560039	3.841466	0.2117

Max-eigenvalue test indicates 2 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

LNY	LNLAB	LNK	LNEXT
-14.71267	3.208184	5.534386	1.352351
-11.23892	21.73826	2.424257	-23.12814
9.722554	-2.059977	-0.188112	4.464213
3.456338	-4.215892	0.181448	-2.850512

Unrestricted Adjustment Coefficients (alpha):

D(LNY)	0.034091	-0.028104	-0.007172	-0.000559
D(LNLAB)	-0.003738	-0.002532	-0.007311	0.004125
D(LNK)	-0.168464	-0.172506	-0.213203	-0.010587

D(LNEXT)	-0.030374	0.055492	-0.015138	-0.004419

1 Cointegrating Equation(s):		Log likelihood	170.0834

Normalized cointegrating coefficients (standard error in parentheses)

LNY	LNLAB	LNK	LNEXT
1.000000	-0.218056	-0.376165	-0.091917
	(0.09958)	(0.01894)	(0.12135)

Adjustment coefficients (standard error in parentheses)

D(LNY)	-0.501565
	(0.16189)
D(LNLAB)	0.054997
	(0.08970)
D(LNK)	2.478551
	(1.88763)
D(LNEXT)	0.446889
	(0.32042)

2 Cointegrating Equation(s):		Log likelihood	181.3770

Normalized cointegrating coefficients (standard error in parentheses)

LNY	LNLAB	LNK	LNEXT
1.000000	0.000000	-0.396553	-0.365072
		(0.02252)	(0.06124)
0.000000	1.000000	-0.093502	-1.252683
		(0.03923)	(0.10671)

Adjustment coefficients (standard error in parentheses)

D(LNY)	-0.185703	-0.501570
	(0.15314)	(0.18176)
D(LNLAB)	0.083455	-0.067035
	(0.11223)	(0.13320)
D(LNK)	4.417333	-4.290446
	(2.22763)	(2.64387)
D(LNEXT)	-0.176786	1.108862
	(0.30366)	(0.36040)

3 Cointegrating Equation(s):		Log likelihood	185.4311

Normalized cointegrating coefficients (standard error in parentheses)

LNY	LNLAB	LNK	LNEXT
1.000000	0.000000	0.000000	0.254975
			(0.41887)
0.000000	1.000000	0.000000	-1.106484

			(0.14081)
0.000000	0.000000	1.000000	1.563592
			(1.06390)

Adjustment coefficients (standard error in parentheses)

D(LNY)	-0.255430	-0.486796	0.121888
	(0.16859)	(0.17792)	(0.04873)
D(LNLAB)	0.012373	-0.051974	-0.025451
	(0.12046)	(0.12713)	(0.03482)
D(LNK)	2.344458	-3.851253	-1.310436
	(2.23732)	(2.36124)	(0.64674)
D(LNEXT)	-0.323962	1.140045	-0.030728
	(0.33310)	(0.35155)	(0.09629)

Appendix 4: Vector Error Correction Estimates

Vector Error Correction Estimates
Date: 08/06/14 Time: 14:06
Sample (adjusted): 1984 2012
Included observations: 29 after adjustments
Standard errors in ( ) & t-statistics in [ ]

Cointegrating Eq:	CointEq1			
LNY(-1)	1.000000			
LNLAB(-1)	-0.218056			
	(0.09958)			
	[-2.18977]			
LNK(-1)	-0.376165			
	(0.01894)			
	[-19.8578]			
LNEXT(-1)	-0.091917			
	(0.12135)			
	[-0.75747]			
C	-11.26015			
Error Correction:	**D(LNY)**	**D(LNLAB)**	**D(LNK)**	**D(LNEXT)**
CointEq1	-0.501565	0.054997	2.478551	0.446889
	(0.16189)	(0.08970)	(1.88763)	(0.32042)
	[-3.09815]	[0.61313]	[1.31305]	[1.39471]
D(LNY(-1))	-0.574939	0.045018	3.754180	0.665080
	(0.37358)	(0.20699)	(4.35589)	(0.73940)
	[-1.53899]	[0.21749]	[0.86186]	[0.89949]
D(LNY(-2))	-0.347884	0.089432	1.323815	0.302547
	(0.29755)	(0.16486)	(3.46939)	(0.58891)
	[-1.16915]	[0.54246]	[0.38157]	[0.51374]
D(LNY(-3))	0.147907	0.042181	0.666588	-0.411966
	(0.24175)	(0.13394)	(2.81870)	(0.47846)
	[0.61183]	[0.31492]	[0.23649]	[-0.86102]
D(LNLAB(-1))	-0.065639	0.630220	4.783330	-0.435678
	(0.49847)	(0.27619)	(5.81211)	(0.98658)
	[-0.13168]	[2.28184]	[0.82299]	[-0.44160]
D(LNLAB(-2))	-0.671457	-0.090578	-9.403268	1.646236
	(0.51635)	(0.28609)	(6.02054)	(1.02196)

	[-1.30039]	[-0.31660]	[-1.56187]	[1.61086]
D(LNLAB(-3))	0.147522	-0.073627	-2.274706	-0.165582
	(0.33062)	(0.18319)	(3.85499)	(0.65437)
	[0.44619]	[-0.40192]	[-0.59007]	[-0.25304]
D(LNK(-1))	-0.118597	0.002335	0.385503	0.155362
	(0.04867)	(0.02697)	(0.56749)	(0.09633)
	[-2.43669]	[0.08657]	[0.67931]	[1.61281]
D(LNK(-2))	-0.072706	0.007586	0.600057	0.077789
	(0.03380)	(0.01873)	(0.39408)	(0.06689)
	[-2.15119]	[0.40508]	[1.52270]	[1.16290]
D(LNK(-3))	-0.050970	0.009055	0.521566	0.073415
	(0.02873)	(0.01592)	(0.33494)	(0.05685)
	[-1.77436]	[0.56893]	[1.55719]	[1.29127]
D(LNEXT(-1))	-0.489150	-0.001332	3.087615	0.585001
	(0.23767)	(0.13168)	(2.77113)	(0.47039)
	[-2.05814]	[-0.01012]	[1.11421]	[1.24365]
D(LNEXT(-2))	-0.350824	0.043735	0.200011	0.081078
	(0.21384)	(0.11848)	(2.49328)	(0.42323)
	[-1.64062]	[0.36914]	[0.08022]	[0.19157]
D(LNEXT(-3))	0.006217	-0.021939	3.303137	0.089878
	(0.17845)	(0.09887)	(2.08070)	(0.35319)
	[0.03484]	[-0.22189]	[1.58751]	[0.25448]
C	0.065016	0.019216	-0.004010	-0.037702
	(0.02840)	(0.01573)	(0.33112)	(0.05621)
	[2.28941]	[1.22127]	[-0.01211]	[-0.67078]
R-squared	0.691459	0.455714	0.436464	0.437325
Adj. R-squared	0.424056	-0.016001	-0.051934	-0.050328
Sum sq. resids	0.052669	0.016169	7.160419	0.206318
S.E. equation	0.059256	0.032832	0.690913	0.117280
F-statistic	2.585837	0.966080	0.893665	0.896796
Log likelihood	50.36057	67.48407	-20.86767	30.56243
Akaike AIC	-2.507626	-3.688557	2.404667	-1.142237
Schwarz SC	-1.847552	-3.028483	3.064741	-0.482163
Mean dependent	0.004297	0.035942	0.015581	0.039092
S.D. dependent	0.078081	0.032572	0.673642	0.114436

Determinant resid covariance (dof adj.)	1.32E-09
Determinant resid covariance	9.46E-11
Log likelihood	170.0834
Akaike information criterion	-7.591959

Schwarz criterion	-4.763071

Appendix 5: Diagnostic Tests

VEC Residual Serial Correlation
LM Tests
Null Hypothesis: no serial
correlation at lag order h
Date: 09/04/14 Time: 17:26
Sample: 1980 2012
Included observations: 29

Lags	LM-Stat	Prob
1	17.83364	0.3337
2	12.80139	0.6872
3	12.37229	0.7180
4	13.26389	0.6534

Probs from chi-square with 16 df.

VEC Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: residuals are multivariate normal
Date: 09/04/14 Time: 17:26
Sample: 1980 2012
Included observations: 29

Component	Skewness	Chi-sq	df	Prob.
1	-0.374158	0.699969	1	0.4028
2	0.265348	0.352048	1	0.5530
3	-0.955507	4.564970	1	0.0326
4	-0.291978	0.426254	1	0.5138
Joint		6.043242	4	0.1959

Component	Kurtosis	Chi-sq	df	Prob.
1	2.630099	0.171033	1	0.6792
2	3.677241	0.573319	1	0.4489
3	4.958267	4.793514	1	0.0286
4	3.763288	0.728260	1	0.3934
Joint		6.266126	4	0.1801

Component	Jarque-Bera	df	Prob.
1	0.871002	2	0.6469

2	0.925367	2	0.6296
3	9.358484	2	0.0093
4	1.154514	2	0.5614
Joint	12.30937	8	0.1379

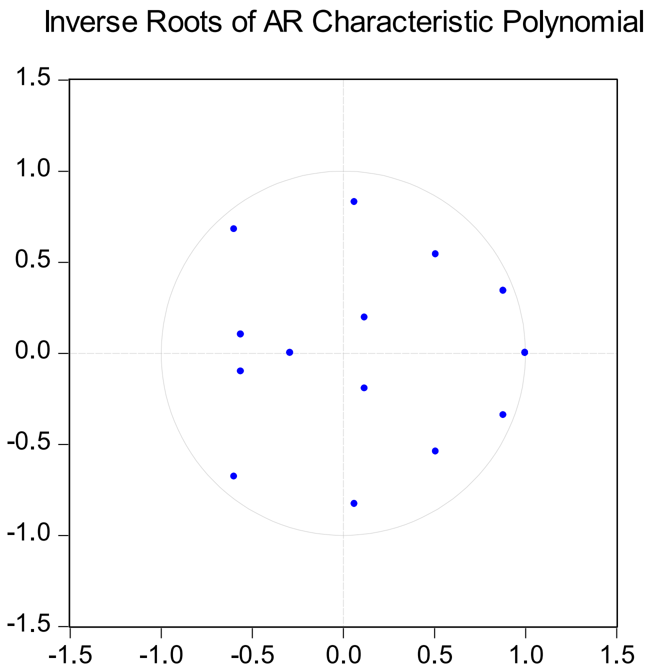
VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)
Date: 09/04/14 Time: 17:27
Sample: 1980 2012
Included observations: 29

Joint test:

Chi-sq	df	Prob.
204.5355	180	0.1014

Individual components:

Dependent	R-squared	F(26,2)	Prob.	Chi-sq(26)	Prob.
res1*res1	0.688780		1.936518		0.1104
res2*res2	0.553691		1.085524		0.4427
res3*res3	0.822379		4.051231		0.0059
res4*res4	0.229711		0.260937		0.9940
res2*res1	0.731082		2.378785		0.0552
res3*res1	0.491342		0.845212		0.6299
res3*res2	0.688906		1.937658		0.1102
res4*res1	0.487793		0.833294		0.6401
res4*res2	0.560356		1.115249		0.4226
res4*res3	0.498440		0.869558		0.6093


Inverse Roots of AR Characteristic Polynomial
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
-1.5
-1.0
-0.5
0.0
0.5
1.0
1.5

Appendix 6: Granger Causality Test Results

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	2.94601	2	0.0861

Null Hypothesis: C(5)=C(6)=C(7)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(5) - C(7)	-0.213161	0.659087
C(6) - C(7)	-0.818979	0.734125

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	5.48317	2	0.0071

Null Hypothesis: C(8)=C(9)=C(10)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(8) - C(10)	-0.067626	0.036431
C(9) - C(10)	-0.021735	0.025519

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	4.01179	2	0.0108

Null Hypothesis: C(11)=C(12)=C(13)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(11) - C(13)	-0.495367	0.194098
C(12) - C(13)	-0.357041	0.229993

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	0.00127	2	0.9710

Null Hypothesis: C(16)=C(17)=C(18)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(16) - C(18)	0.002837	0.216170
C(17) - C(18)	0.047250	0.214322

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	0.19147	2	0.6617

Null Hypothesis: C(22)=C(23)=C(24)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(22) - C(24)	-0.006721	0.020185
C(23) - C(24)	-0.001470	0.014140

Restrictions are linear in coefficients.

Wald Test:

System: Untitled

Test Statistic	Value	df	Probability
Chi-square	0.00129	2	0.9713

Null Hypothesis: C(25)=C(26)=C(27)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(25) - C(27)	0.020606	0.107544
C(26) - C(27)	0.065674	0.127432

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	0.12730	2	0.7212

Null Hypothesis: C(30)=C(31)=C(32)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(30) - C(32)	3.087593	4.549060
C(31) - C(32)	0.657228	4.510174

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	1.92651	3	0.1651

Null Hypothesis: C(33)=C(34)=C(35)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(33)	4.783330	5.812113
C(34)	-9.403268	6.020535
C(35)	-2.274706	3.854993

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	0.68922	3	0.4064

Null Hypothesis: C(39)=C(40)=C(41)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(39)	3.087615	2.771130
C(40)	0.200011	2.493284
C(41)	3.303137	2.080698

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	1.71415	3	0.1291

Null Hypothesis: C(44)=C(45)=C(46)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(44)	0.665080	0.739396
C(45)	0.302547	0.588915
C(46)	-0.411966	0.478463

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

Test Statistic	Value	df	Probability
Chi-square	0.13535	3	0.7129

Null Hypothesis: C(47)=C(48)=C(49)=0
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(47)	-0.435678	0.986583
C(48)	1.646236	1.021962
C(49)	-0.165582	0.654370

Restrictions are linear in coefficients.

Wald Test:
System: Untitled

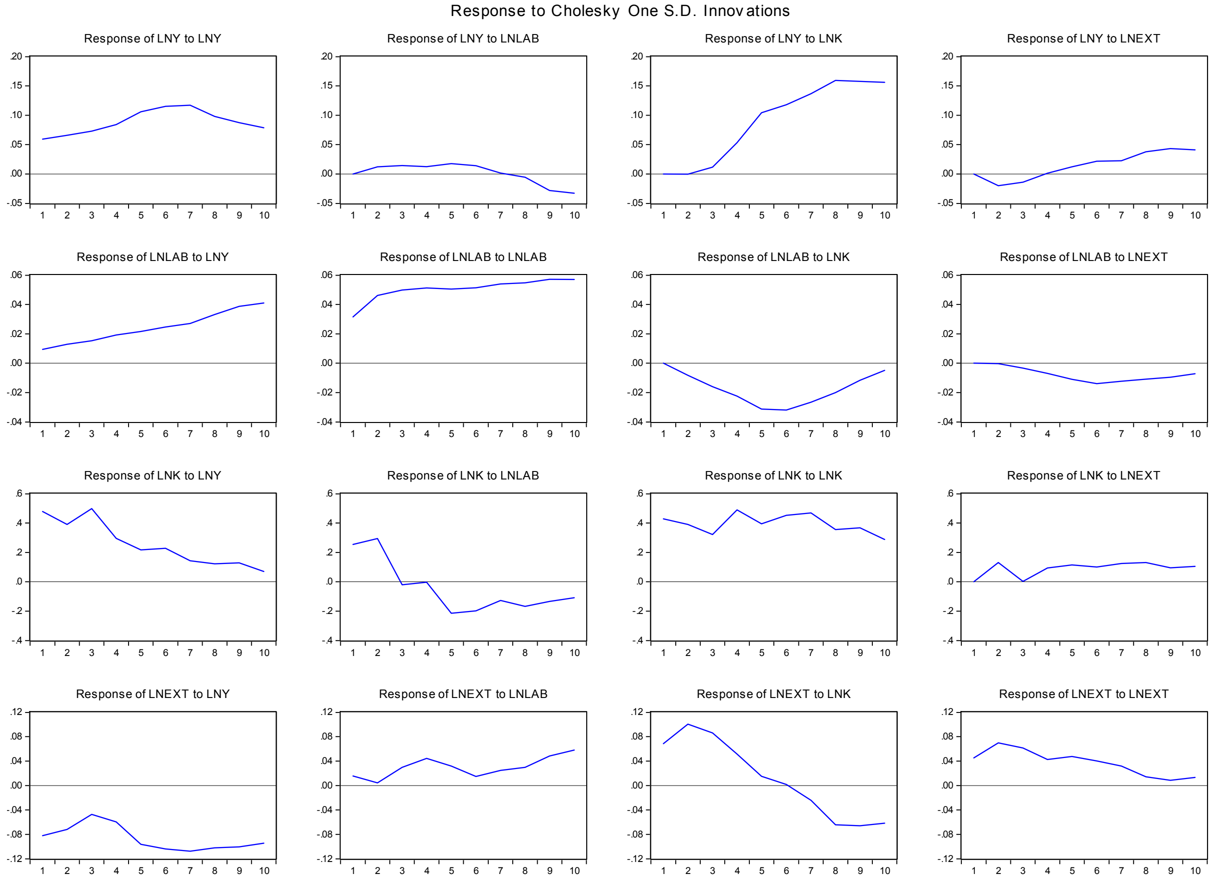
Test Statistic	Value	df	Probability
Chi-square	4.09716	2	0.02103

Null Hypothesis: C(53)=C(54)=C(55)
Null Hypothesis Summary:

Normalized Restriction (= 0)	Value	Std. Err.
C(53) - C(55)	0.495122	0.384159
C(54) - C(55)	-0.008800	0.455204

Restrictions are linear in coefficients.

Appendix 7: Impulse Response



Response to Cholesky One S.D. Innovations
Response of LNY to LNY
Response of LNY to LNLAB
Response of LNY to LNK
Response of LNY to LNEXT
Response of LNLAB to LNY
Response of LNLAB to LNLAB
Response of LNLAB to LNK
Response of LNLAB to LNEXT
Response of LNK to LNY
Response of LNK to LNLAB
Response of LNK to LNK
Response of LNK to LNEXT
Response of LNEXT to LNY
Response of LNEXT to LNLAB
Response of LNEXT to LNK
Response of LNEXT to LNEXT

Appendix 8: Variance Decomposition

Variance Decomposition of LNY: Period	S.E.	LNY	LNLAB	LNK	LNEXT
1	0.064832	100.0000	0.000000	0.000000	0.000000
2	0.099746	99.07810	0.050354	0.039877	0.831671
3	0.125859	90.73590	2.411784	0.025368	6.826947
4	0.154097	75.85967	6.623489	0.310234	17.20660
5	0.185618	61.80335	10.15305	0.985809	27.05778
6	0.218271	51.32245	12.45344	1.728441	34.49567
7	0.250474	43.92212	13.90149	2.369148	39.80723
8	0.281519	38.63866	14.85052	2.883111	43.62770
9	0.311159	34.76306	15.50517	3.289852	46.44192
10	0.339351	31.84153	15.97661	3.613494	48.56837

Variance Decomposition of LNK: Period	S.E.	LNY	LNLAB	LNK	LNEXT
1	0.640521	10.73000	89.27000	0.000000	0.000000
2	0.732803	12.16807	86.81419	0.074948	0.942793
3	0.781031	10.90019	84.66376	0.940524	3.495519
4	0.825214	9.779895	80.69723	2.444770	7.078103
5	0.859025	9.119615	78.07814	3.330050	9.472196
6	0.880736	8.925496	76.95171	3.595511	10.52728
7	0.893045	9.165584	76.41434	3.595444	10.82464
8	0.899407	9.728929	75.94902	3.544973	10.77708
9	0.903722	10.42808	75.30894	3.577963	10.68502
10	0.909562	11.05633	74.37850	3.774311	10.79085

Variance Decomposition of LNLA

B: Period	S.E.	LNY	LNLAB	LNK	LNEXT
1	0.031259	2.199164	29.12427	68.67656	0.000000
2	0.048972	3.118519	27.05408	69.29078	0.536626
3	0.062168	3.885115	22.45118	71.95185	1.711848
4	0.072738	4.513823	18.49677	73.92755	3.061849
5	0.081436	5.269035	15.53338	75.00046	4.197122
6	0.088752	6.272177	13.41261	75.31232	5.002893
7	0.094931	7.541935	11.94169	75.06807	5.448311
8	0.100110	9.050507	10.97672	74.41994	5.552829
9	0.104452	10.73514	10.44555	73.42411	5.395202
10	0.108176	12.49329	10.34258	72.06632	5.097814

Variance Decomposition of LNEXT: Period	S.E.	LNY	LNLAB	LNK	LNEXT
1	0.094710	32.89856	11.12762	7.648115	48.32570
2	0.126301	21.86699	17.89429	6.245190	53.99353
3	0.138994	18.46675	27.09030	6.741479	47.70147
4	0.149699	16.76279	30.28445	11.79529	41.15747
5	0.158774	16.18152	28.38003	17.82534	37.61310
6	0.168586	15.33953	25.17296	23.63848	35.84902
7	0.180775	13.80993	22.59674	28.43876	35.15456
8	0.194746	12.01409	21.23594	31.70132	35.04866
9	0.208835	10.44770	20.91143	33.54034	35.10053
10	0.221462	9.393959	21.13771	34.40443	35.06390

Cholesky Ordering: LNY LNLAB LNK LNEXT

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