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The nexus between value addition, liquidity, and imports in Zimbabwe (1980-2015): A co-integrated VAR approach

By

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DECLARATION

This Dissertation is entirely my own work and acknowledgements have been made where other sources are used. I do hereby declare that this Dissertation has not been previously submitted for the award of another degree at any University.

Signed_____ Date_____

DEDICATION

To my Daughter, Tinashe Rumbidzai Kenya Dube and son Takapiwanashe Rungano Dube, you are gifts from God.

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However, the views expressed in this dissertation, errors and omissions remain the author's and should not be attributed to any of the above-mentioned people and/or organizations

ABSTRACT

The study made an attempt to analyze empirically the nexuses between value addition, liquidity and imports in Zimbabwe. In order to make an intricate examine and understand the nexuses among the variables, imports are decomposed into two categories (Investment & raw material goods imports, and consumption & other goods import). Co-integrated VAR approach was employed to determine the relationship and data for the period 1980 to 2015 for Zimbabwe was used. The study found no evidence of granger causality between value addition and liquidity. However, empirical results derived from IRFs, and VDCs indicate that some of the variation in value addition in the long run is explained by variation in liquidity and liquidity respond to shocks in value addition in the long run as such it can be concluded that the two variables respond to the same shocks. Empirical results derived from IRFs, VDCs and granger causality show that while there is a bidirectional causality between value addition and consumption & other goods import, there is a unidirectional relationship between value addition and imports of Investment & raw material goods. There is also evidence of unidirectional causality between liquidity and the two categories of imports, running from liquidity to imports. The study also found that there is a long run relationship between the two categories of imports and liquidity, however imports of investment & raw material goods have a positive relationship with liquidity while imports of consumption &and other goods have a negative relationship with liquidity in the long run. The two categories of imports have similar relationships with value addition in the long run to those between them and liquidity. In short, an increase in liquidity will not have a significant impact on value addition in the Zimbabwean economy. Hence any polices aimed at solving the liquidity crises will not be enough to address the value addition challenges also. Therefore, the government has to address these challenges simultaneously by re-looking in to the trade policy since both value addition and liquidity are linked to imports in the economy.

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Acronyms

ADF: Augmented Dickey-Fuller

AIC: Akaiki Information Criteria

AR: Auto Regressive

GDP: Gross Domestic Product

HQ: Hannan-Quinn Information Criteria

INF: Inflation

I(0): Integrated of Order Zero

I(1): Integrated of Order one

IRF: Impulse Response Functions

JB: Jarque-Berra

LM: Lagrange Multiplier

LR: Likelihood Ratio test

MoF: Ministry of Finance

RBZ: Reserve bank of Zimbabwe

OLS: Ordinary Least Square

OECD: Organization for Economic Cooperation and Development

PP: Phillips-Perron

VA: Value added

LD: Liquidity

SIC: Schwarz (Bayesian) Information Criteria

VAR: Vector Auto regression

VDC: Variance Decompositions

VECM: Vector Error Correction Model

UNIDO: United nations industrial development organization

UN-OHRLLS**:** Un Office of the High Representative for The Least Developed Countries, Landlocked Developing Countries and Small Island Developing States

UNCTAD: United Nations Conference on Trade and Development

WTO: World trade Organization

ZIMASSET: Zimbabwe Agenda for Sustainable Socio-Economic Transformation

ZIMSTAT: Zimbabwe National Statistics Agency

CHAPTER ONE

INTRODUCTION AND BACKGROUND OF THE STUDY

1.0 Introduction

Value addition to commodities is one of the main target under goal 9 of the sustainable development goals (SDGs) adopted by the international community in September 2015 (UNIDO, 2015). According to a report from (UNCTAD , 2013), the developing country share in global value added trade increased from 20% in 1990 to over 40% in 2013 and that the economies with the fastest-growing participation in global value addition grow about 2 percentage points faster than the average. It is therefore in the interest of the international community to safeguard a conducive policy environment which promotes research in all developing countries so as to ensure that they catch up in terms of technology development, innovation, industrial diversification and value addition to products. As such value addition and beneficiation can serve as a primary engine not only for job creation and economic growth but also for technology transfer, investment flows and skills development as well as poverty eradication by 2030 (UNIDO, 2015).

(Lamy, 2012) Indicated that trade in intermediate products now accounts for more than half of world merchandise export. This has important implications for developing country governments seeking to boost export competitiveness such as Zimbabwe since it is one of the exporters of intermediate goods hence the need to transform these goods into finished products which are more valuable. Joint (OECD-WTO, 2012) statistical work analyzing trade in value-added terms has confirmed that in global value chains, export competitiveness depends on efficient access to imports of intermediate goods as well as services and restricting imports now amounts to shooting your own exporters in the foot, implying that the more open the country is the more it will benefit from international trade.

The international community believed that reallocation of economic activity from low value added and low productivity activities and sectors, to higher value-added and higher productivity activities and sectors is crucial for integration into the global economy, employment creation and broad-based economic growth (UN-OHRLLS, 2016). The government of Zimbabwe in an attempt to achieve goal 9 of the SDGs, also singled out value addition as one of the four key clusters under the country's economic blue print, the Zimbabwe Agenda for Sustainable Socio-Economic

Transformation (ZIMASSET) which was crafted in 2013. However, Zimbabwe's growth rates are still very low and its exports are mainly raw and semi-finished agricultural commodities and minerals, in fact there are low value added products which makes up more than 80% of the country's exports in 2014 (Ministry of finance Zimbabwe, n.d.), despite government efforts to promote value addition. Since 2013 there has been a lot of unrest and debate amongst the policy makers and advisers in the economy as some feel that focusing on value addition is more important while others are of the idea that liquidity crunch, which is one of the major problems that are currently existing in the economy should be dealt with first. Also, those who are in favor of value addition as a priority are in favor of the implementation of import restrictions such that the government had to draft a statutory instrument (SI 64) as a way of protecting domestic firms which are into value addition business from competition from imported finished products that can be produced locally. This has diverted the attention of policy makers mainly towards addressing the liquidity crisis and import trade rather than focusing on value addition. Liquidity refers to how quickly and cheaply an asset can be converted into cash in other words money in the form of cash is the most liquid asset (The Economic Times, n.d.). Liquidity might be any savings account or the cash lying with an individual or organization that can be accessed in case of any unforeseen happening or any financial setback (Brunnermeier & Pedersen, 2009). However, one cannot tell with certainty whether focusing on liquidity and imports is a noble idea or not, as such the need to investigate whether value addition, liquidity and imports are connected in any way so as to assist policy makers whether to narrow their focus on one of these issues or to address them simultaneously so as to achieve the desired goals of growth and poverty eradication by 2030.

According to (Yifu, 2012)'s model of development, developing countries seeking to boost growth, should focus on removing bottlenecks and obstacles in tradable industries so as to align with their evolving comparative advantages which suggests that value addition is crucial for growth and development. (Nzenzema, 2015), in their diamond beneficiation study for Zimbabwe found that diamonds are exported in their cheap raw form and in some instances re-imported as expensive finished products and this has contributed significantly to the Zimbabwe's growing trade deficit since 2012 and that this situation is further worsening the liquidity crisis. (Amin, 2012) did a study on the nexus between liquidity/profitability trade-offs for working capital management in Nigeria's manufacturing sector and the findings were that, liquidity is vital to ensure survival of the sector, in other words liquidity is vital for value addition. However, (Goldberg, Kennedy, &

Miu, 2012) did a study on what drives liquidity and found that it is supply and demand of liquidity that affect real activity, inflation and asset prices not real activity affecting liquidity which opposes (Nzenzema, 2015)'s findings.

Since value added is a component of Gross Domestic Product (GDP), (intermediary output + value added =GDP), it means that the higher the value added the higher is the GDP for that given period (Saaed & Hussain, 2015), did a study on the impact of exports and imports on Economic Growth in Tunisia and economic growth was found to Granger Cause imports. The results provide evidence that growth in Tunisia was propelled by a growth -led import strategy as well as export led import. Imports are thus seen as the source of economic growth in Tunisia. This implies that if growth is import led, so is value addition. (Ugur, 2008), made an attempt to analyze empirically the relationship between imports and economic growth in Turkey. The empirical results derived show that while there is a bidirectional relationship between GDP and investment goods import and raw materials import, there is a unidirectional relationship between GDP and consumption goods import and other goods import.

However, (Asafu-Adjaye & Chakraborty, 1999), considered three variables: imports, real output and exports (for the period 1960-1994) for India. They did not find any evidence of the existence of a causal relationship between these variables for the case of India. This suggests there may be no causal relationship between imports and value addition. Also, (Hussain & Saaed, 2014), examined the nexus of Imports, exports and Economic growth in Saudi Arabia, using annual data for the period 1990- 2011, but the result of the causality between imports and economic growth was statistically insignificant. (Islam, Muhammad, & Shahbaz, 2012), did a research on imports nexus growth for 62 countries including Zimbabwe and their findings confirm the importance of imports as source of economic growth, at the same time the results of Granger causality test indicate mixed results for some countries.

Since the above literature suggests mixed results on the nexus between these variables, it is in the interest of this study to investigate the nexus between value addition, liquidity and the categories of imports in Zimbabwe.

1.1 Background

Zimbabwe's economy faces many fundamental problems that will need to be addressed before any type of economic development can take place, of which value addition, liquidity and high levels of imports are part of them as alluded in the (RBZ, 2016)September monetary policy statement. Since the adoption of multicurrency system in 2009, the Zimbabwean economy has been characterized by a number of challenges, these include the deterioration in external sector position due to growing import dependence against a background of poor export performance with most of the exports being low value added, subdued foreign capital inflows, an external debt burden, frequent power outages, a limited fiscal space, low domestic output and weak domestic demand, de industrialization, slow savings and money supply growth, and a growing liquidity crises in the economy. According to the (RBZ, 2016) September monetary policy statement, the economy is hungry for production and productivity. On one hand the public-sector wage and salary bill being one of the highest in the world at more than 90% as a share of fiscal revenue and inflation at -1.4% being low or in negative territory (deflation) for two years now since 2014, real wages and salaries have increased, crowding out capital and social expenditure thus undermining the economy's capacity to enhance employment and to be competitive.

(Ministry of finance Zimbabwe, n.d.) In its 2016 economic review, highlighted that, the business climate, on the other hand, is affected by limited access to foreign finance and in addition the increasing fiscal gap in the absence of external financing has led to a decline in private sector activity and a reduction in domestic credit as financial institutions try to contain foreign exchange induced demand pressures attributable to lending activities .Hence the need to , transform the economy from a consumptive to a productive one through addressing liquidity challenges, production(value addition) and the country's level of import dependence

Low value addition is a challenge in the economy as evidenced by exportation of Ferroalloys, Raw Tobacco, Raw Sugar, Diamonds and gold which are Zimbabwe's main exports (ZIMSTAT, 2016). **Table 1** shows Zimbabwe's top ten exports for 2014 which are mainly raw and semi-finished products as an example.

Table 1:2014 Exports from Zimbabwe (Top 10 Products)

Product	%Contribution to total exports
1. Semi Manufactured Gold	21.3
2. Flue Cured Tobacco of the Virginia Type (partly or wholly stemmed or stripped	15.9
3. Nickel Ores and Concentrates	15.1
4. Ferro Chrome Containing by Weight > 4% Carbon	9.7
5. Platinum unwrought in Powder form	5.4
6. Other Cane not containing Added flavoring or coloring matter	5.4
7. Unsorted diamonds	5.1
8. Unwrought nickel	0.9
9. Black Tea fermented, partly fermented or flavored	0.8
10. Portland Cement 0.8	0.8
Total of top 10 Products	**80.4**

Source: ZIMSTAT Trade Bulletin, Second Quarter (2016)

Value addition concept was developed by the economists Alfred Marshall in the 1890s. (Boland, 2009), defined value addition in general as the process of changing or transforming a product from

its original state to a more valuable state and broadly as to economically add value to a product by changing its current place, time and from one set of characteristics to other characteristics that are more preferred in the marketplace.

Figure 1 illustrates value addition in tobacco and it clearly illustrates that the more value is added on the commodity the higher the returns which is definitely not happening in Zimbabwe.

Figure 1: An illustration of value addition using Tobacco as an example

Source: Savanna Tobacco, (2014)

Most of Zimbabwe's tobacco is exported as either leaf or crushed tobacco as such the country is losing millions of US dollars due to failure to add value on our tobacco to produce cigarettes which gives returns between 80% to 90% per kilogram of tobacco .If the country had managed to add value to the 2014 tobacco output which was 216 million kilograms (ZIMSTAT, 2016), for example , a minimum of US$6,4 billion would have been made if it was sold in cigarette form instead of approximately US $1,2 billion if sold in crushed form or $650 million if sold as leaf. Zimbabwe 's tobacco is sold mainly as leaf as such the country is likely to realize less than its full potential, using the 2014 hypothetical figures above, it is clear that the economy is losing a lot, if it can lose approximately $5 billion (US$6,4 billion less US$1,2 billion) in one commodity in a single year. This demonstrates the importance of value addition in Zimbabwe which makes it an essential area in the turnaround of the economy hence the need to investigate whether other current economic issues such as liquidity and imports have a bearing in the failure of value addition in the economy, so as to enable sound policy recommendations and implementation.

Through the ZIMASSET agenda, Government has identified some of the various opportunities for value addition in the agricultural sector, these include: Beef canning, Fruit Juice manufacturing, Oil expression, Fruit jam and avocado processing, Cotton and clothing industry development, leather and allied industries development. However, since 2009, liquidity crisis is believed to be one of the impediments for the country to explore, these various opportunities for value addition that the government has identified. On the contrary, since 1980, value addition in the country was very low reaching even lower level between 2003 to 2008, this may be wondered why it is so since liquidity crunch was not a problem during the period, instead the economy was facing challenges of too much liquidity. It is then in the interest of this research to investigate whether liquidity (too much or too little) affect value addition activities in Zimbabwe or not by making use of the period 1980 to 2015 which is characterized by periods of both too much liquidity (1997 to 2008) and too little (liquidity crunch) liquidity (2009 to 2015). (Brunnermeier & Pedersen, 2009), highlighted that liquidity plays an important role as it allows one to seize opportunities since if one has cash and easy access to fund and a great deal comes along, then it's easier for you to seize that opportunity.

Accessing liquid funds has been a major challenge in Zimbabwe since dollarization as individuals and organizations are facing withdrawal limits due do cash crises in the country as such it is alleged

that these liquidity challenges are impeding investments and activities in value added business. Long queues at banks and withdrawal limits of around US$100 or less per day for many banks since October 2015 act as evidence that the economy is indeed facing a liquidity crunch. With the prudential Liquidity Ratios (for banking sector) for June 2015, December 2015 and march 2016 are; 44.95%, 45.35%, and 48.96% respectively (RBZ ,2016) it is also evidence that there is a liquidity crisis since a ratio of less than one means the bank is not able to convert its illiquid assets into cash quickly and without difficult.

Furthermore, due to Low levels of local production to meet consumer demand, there has been increased demand for foreign exchange for import purposes, this is supported by the **table 2** which shows that Zimbabwe is importing more than what it is exporting.

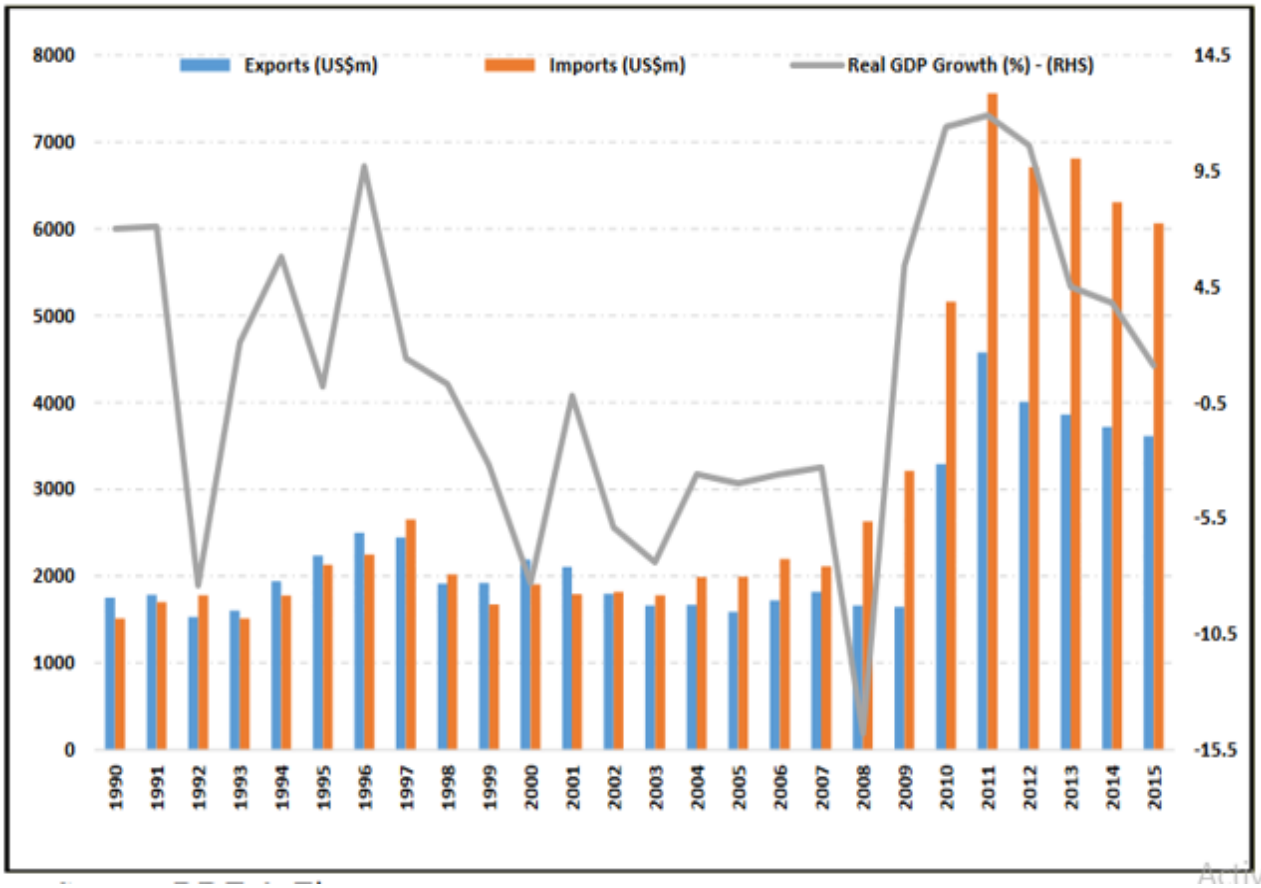
Table 2:Zimbabwe's total trade in percentages from 2009 to 2013

Composition of Total Trade (%)	**2009**	**2010**	**2011**	**2012**	**2013**
Domestic Exports	25.9	35.2	28.9	33.8	30.5
Re-exports	0.7	0.5	0.3	0.4	0.8
Imports	73.4	64.4	70.7	65.8	68.7
Total %	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**

Source: ZIMSTAT (2016)

In the half decade from 2009 to 2013, shown by **figure 2,** the country's level of imports was significantly above exports, whether this was because of people's preferences for foreign goods or because of the un availability of the products, one cannot tell with certainty, since there is a decline in producer activity in value added business as implied by the 2015 Manufacturing Sector Survey which shows a decline in the sector compared to 2014. The weighted capacity utilization has shed 2.2 percentage points from 36.5% to 34.3%, this might be the reason for high imports since domestic production might be failing to meet domestic demand as such individuals are forced to import more of the processed and manufactured commodities hence the need to study the relationship between value addition and imports. The figure below summarizes the trends in exports, imports and real GDP Growth over the period 1990 to 2015

Figure 2:Exports, Imports, Real GDP Growth (1990-2015)



Source: BRZ & ZIMSTAT (2016)

The **figure 2** indicates that from 2003 to 2015, the country's imports exceeded exports as well as stunted GDP Growth over the period despite efforts by the government to improve the situation.

In support of the value addition and beneficiation objective, tax incentives would apply for financial institutions which accept geologically surveyed claims as collateral for small scale miners' borrowing requirements in order to boost mineral output. Encouraging Local Production, the Government also introduced and increased tariffs on products that the country has a comparative advantage on, in order to promote local production. In the same spirit, Government suspended duties on raw materials in order to reduce the cost of production for locally produced products (Ministry of finance Zimbabwe, n.d.). In the leather industry for example, in-order to encourage value addition, Government levied an export tax of US$0, 75 per kg as a deterrent

measure to exportation of raw hides and skins (Ministry of finance Zimbabwe, n.d.). Furthermore, the Government is encouraging the establishment of business ventures that are centered on value adding our primary products, agricultural output included.

However, Zimbabwe's exports remain largely raw and semi-finished agricultural commodities and minerals, in fact there are low value added products in as far as export earnings are concerned. After such efforts to promote producer investments in value-added business in Zimbabwe by the government, activity in value added business has not changed significantly so the questions are;

- Does liquidity play a significant role in determining the level of activity in producer business?
- Is the presence of high imports of consumption goods in Zimbabwe due to lack of value added goods in the economy?
- Do high imports of consumption goods or investment goods results in liquidity challenges in an economy?
- Is value addition, liquidity crises and the nature of imports in an economy connected or related in any way?

In general, the main aim of this paper is to empirically analyze the nexus between value addition**,** liquidity and imports in Zimbabwe.

1.3 Problem statement

Low value added products, liquidity crisis and increased import dependence in the Zimbabwean economy are part of the major problems that are currently existing. The co-existence of these problems, is posing serious challenges to policy makers and advisers as to which problem to address first as evidenced by import controls in statutory instrument (SI) 64, tariffs on raw exports and the introduction of bond notes for liquidity in 2016, hence the need to analyze the relationship between value addition, liquidity and imports so as to assist policy makers to understand the link between these variables. This is of paramount importance for effective policy implementation as the policy makers will be able to make informed decisions on the critical problem that they should

give more attention to, basing on the causal link between the variables so as to avoid worsening of the current situation.

1.4 Objective of the Study

The main objective of this study is to investigate the nexuses between value addition, liquidity and categories of imports in Zimbabwe. In line with this main objective, the study has the following specific objectives:

i. To investigate the effects of liquidity, imports of investment goods & raw materials, and imports of consumption& other goods on value addition;
ii. To investigate the effects of value addition, imports of investment goods & raw materials, and imports of consumption& other goods on liquidity;
iii. To investigate the effects of value addition, liquidity, and imports of consumption& other goods on imports of investment goods & raw materials and;
iv. To investigate the effects of value addition, liquidity and imports of investment goods& raw materials on imports of consumption & other goods.

1.5 Hypotheses

The study seeks to test the following hypotheses; that

- There is a causal link between liquidity and value addition.
- There is no relationship between imports and value addition.
- There is a unidirectional causality between liquidity and imports (where high levels of imports result in liquidity crisis).
- There is no causal link between imports of investment goods &raw materials, and imports of consumption goods.

1.6 Justification of the Study

Exportation of raw agricultural products and importation of manufactured and processed goods, has added to the negative impact on the socio-economy of the country, potential revenue is lost to nations that have embraced innovation and value addition such as South Africa (Ministry of finance Zimbabwe, n.d.).

Understanding the relationship between value addition and current economic challenges such as liquidity, and the categories and level of imports causing balance of payments deficit and negative

growth (deflation) in the economy may help policy makers and advisers to make well informed decisions which is of paramount importance to the turnaround of the economy

Although a number of studies have been conducted on liquidity/finance nexus economic growth as well on imports nexus economic growth, to the best of my knowledge, there is no study on the nexuses between value addition, liquidity and imports, in Zimbabwe. In this regards it helps to fill the research gap on the area

1.7 Data and Methodology

The data used in this study is secondary data, obtained from different sources, UNCTAD, RBZ and ZIMSTAT. In the study, annual data from 1980-2015 is used so as to establish whether there exists a long run relationship among the variables.

Time-series data on GDP and value added is collected from the UNCTAD data base. The data for liquidity (liquidity ratio, proxy for liquidity) is collected from the reserve bank of Zimbabwe and the ratio will be given by M1/GDP while data on imports is obtained from ZIMSTAT and UNCTAD. Both quantitative and qualitative methods of data analysis are used.

Imports are put in two categories, which are; investment goods (MI), and consumption and other goods ($MC_)$, so as to make the analysis more reliable as well as for easy of interpretation since the nature of imports may have a bearing on the link and direction of causality between the variables.

In the study, a VAR approach will be used, where by the model is specified as follows;

$$VA = f(LD, MI, MC) \quad \ldots\ldots (1.1)$$

$$LD = f(VA, MI, MC) \quad \ldots\ldots (1.2)$$

$$MI = f(VA, LD, MC) \quad \ldots\ldots (1.3)$$

$$MC = f(VA, LD, MI) \quad \ldots\ldots (1.4)$$

where; VA is, value added,

LD is liquidity, and

M_i and M_c are imports of investment goods, and consumption and other goods respectively.

1.8 Scope of the Study

The study was carried out for the whole of Zimbabwe considering (the variables) value addition, liquidity and imports at national level for the period 1980 to 2015.

1.9 Outline of the study

The rest of the study is organized as follows; Chapter two reviews both the theoretical and empirical literature on value addition, liquidity and imports. Chapter three outlines the theoretical framework, model specification and a discussion on the definition and justification of variables to be used in the study. The same chapter presents the estimation methods and data sources. Estimation, interpretation and discussion of the results are covered in chapter four. Finally, chapter five will conclude the study by presenting a summary of major findings, policy recommendations, and limitations of the study and areas for further research.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

2.0 Introduction

This chapter presents the relevant theoretical and empirical literature on the nexus between value addition, liquidity and imports. The first section explores the theoretical literature of the study and the second section examines empirical literature of interest to the topic. In the theoretical literature, the link between the variables to be studied with basic theories have been addressed from perspective of a number of theorists in economics and political economy. These theories are selected because of their applicability for investigating the nexus between the variables under study. These are the value-added theory, the liquidity preference theory, the quantity theory of money, the monetary approach to BOP, the absorption approach to balance of trade and the Import substitution theory. Finally, the review will be closed by drawing conclusions from both the theoretical and empirical literature.

2.1 Theoretical literature

2.1.1Value addition theory

The value-added concept was formulated by (Marshal, 1980)which he put forward in the early nineteenth century. According to Marshal Value added indicate the net wealth created by the production of goods and services during a specified period in a corporate. The theory suggests that no enterprise can grow if it fails to generate wealth, in other words an enterprise may exist without making profit but cannot survive without adding value otherwise not adding value may cause its termination.

The **value-added theory** as suggested by (Smelser, 1962) and supported by (Knottnerus, 1983), in political economy states that there are six conditions necessary for value addition to take place and these include resource mobilization and opportunity which are made possible by availability of liquidity. (Knottnerus, 1983), stated that the six conditions required for value addition to take place are; structural conduciveness, structural strain or push, generalized beliefs pertaining to returns, opportunity which is made possible by the availability of resources, mobilization of resources which include liquidity, and effective organizational control.

As explained by the two theorists (Smelser and Knottnerus), there are so many factors that determines value addition which run from economic, social and political factors as suggested by

the six conditions. Although the theory suggests a link between value addition and liquidity, the question remains, 'is it liquidity that influence value addition or does value addition also influence liquidity in the case of Zimbabwe?

2.1.1 Liquidity theories

As suggested by (Keynes, 1930) in the **liquidity preference theory**, individuals also demand cash for speculative purposes, in other words, people demand liquid cash to invest in stock of firms, thereby providing liquidity for firms to add value to their products or to invest in value addition business, however, the **quantity theory of money**(QTM),which was developed by (Fisher, 1911)Irving Fisher (1867-1947) in his book *The Purchasing Power of Money* (revised, 1911) suggests that the general price level is directly proportional to the amount of money in circulation or money supply ,which means money does not affect output implying that liquidity may not affect output or value addition. The Fisher Identity, or The Equation of Exchange which is presented as;

M.V = P.T

where;

M = stock of money in coin, notes, bank deposits (high-powered or liquidity)

V = a measure of the average rate at which a unit of money change hands in effecting transactions in a given year;

P = a measure of the price level which can be a Consumer Price Index

T = the total volume of output in an economy during a given year.

The assumption underlying the equation is that V and M are constant as such any change in M is transformed into an increase in P, hence money is neutral or it does not affect real economic activity. The Cambridge economists especially Pigou modified the equation and included a ratio of cash balances instead of **V** to come up with;

M =k.P.T, known as the Cambridge Cash Balances Equation;

where: **P** = a measure of the price level,

T = the total volume of output in an economy during a given year.

k =the ratio of cash balances or high powered money (M1) to the total money value.

Note that **P** multiplied by **T** again equals the total monetary value of all transactions as such these theories are more concerned with the neutrality of liquidity (as measured by M1) in the economy.

However, the above classical Quantity Theory of Money assumed an economy which is at Full Employment. This implies that further increases in production and trade is almost impossible since the economy is operating at full capacity hence an increase in money would only drive up prices leaving output unchanged. This is not the case with most developing countries as argued by Keynes who was of the idea that underemployment of resources was more often the normal state such that an increase in monetary liquidity would induce productive employment of resources, resulting in increased output and trade hence no neutrality of money (liquidity).

Furthermore, the **monetary approach to BOP (**balance of payments) views any BOP disequilibrium as a monetary disequilibrium as such, if a country is running a current account deficit, this country is actually taking liquidity out of the international system (Brunnermeier & Pedersen, 2009),and this suggests a link between liquidity and imports

2.1.2 Import theories

The **Import substitution** is a national economic theory invented by (Frank, 1957), which is of the idea that for nation to become wealthier, it should reduce its dependence on imports and rely more on locally produced output. Later, the **import replacement theory** was also developed by Jacobs (1985) who spun off the idea from the import substitution theory. As such the Import replacement theory is a micro version of the import substitution theory where entrepreneurs in a given city replace imports of that city with output produced within that city. These two theories can be likened to the `buy Zimbabwe` campaign which is of the view that import substitution and import replacement would lead to more production and value addition in economy.

Furthermore, the **absorption approach to the balance** of trade which was initially established by Alexander (1952) and afterwards expounded on by (Johnson, 1958), view the current account as the difference between what the economy produces (which may be value added output) and what it consumes, or absorbs, for domestic purposes. If absorption exceeds domestic output, the current account will fall since the short fall on the domestic output will be imported (Grossman & Rogoff, 1995) hence high levels imports.

2.2 Empirical literature

2.2.1 Relationship between value addition and liquidity

(Fulton, Baker, & Boehlje, 2002), investigated the Economic Implications for Producer Investments in Value-Added Business for the US (United States) using a qualitative approach and their findings were that the success of Value Added business in the northern and southern region of the US depends upon the nature of the business Investment (risk and returns), availability of resources such as liquidity, organizational structure and the existence of other goals which may be competing or complementary to the goal of business profitability. However, the study was done only for three sub-sectors of agriculture where pork, corn and beef were considered in depth, leaving out the rest of the economy. Another study on the Value-added Business Success Factors for US was done by (Senechal, Larry Leistritz, & Hodur, 2010)S. The used a cross-section of seven farmer-owned commodity processing businesses formed since 1990 in North Dakota, South Dakota and Minnesota and the findings were that a successful equity (liquidity) drive is the first hurdle faced by investors in value added business and the recent success or failure of other value added businesses also appeared to have a great deal of influence on producer attitudes and willingness to invest. (Boland, 2009) did an analysis of the US 2002 Farm Bill's Value-Added Producer Grants Program using qualitative analysis approach and their findings were that the success of value added businesses were largely dependent on the availability of liquidity, as in the higher the grant dollars the more successful the business.

Furthermore, (Nyarota, Kavila, Mupunga, & Ngundu, 2015), did a research on the binding constraints to Zimbabwe's growth dynamics and their findings were that shortages in liquid capital and productivity were the main causes of low growth rates in Zimbabwe, which suggests a link between liquidity and value addition. (Abdi & Aragie, 2012), utilized the growth diagnostic framework as suggested by the World Bank research (2009) to assess the binding constraints to the Horn of Africa countries[1]. The study showed that limited access to finance, low domestic savings, and weak infrastructure, were the significant constraints on economic growth in the sub-region which also suggests a link between liquidity and value addition. (Amin, 2012) did a study

1 Horn of Africa include Djibouti, Eritrea, Ethiopia, Kenya, Somalia, South Sudan, Sudan, and Uganda.

on the nexus between liquidity/profitability trade-offs for working capital management in Nigeria's manufacturing sector and the findings were that, liquidity is vital to ensure survival of the sector which indicate the importance of liquidity in value addition however, the researcher considered the firm's liquidity rather than liquidity for the economy as a whole as such it is necessary to investigate the impact of liquidity at macro level.

However, some studies which were done to investigate the nexus between liquidity and output employed money supply as proxy for liquidity and Gross domestic product for output. The studies include Nhavira's (2009) titled 'Does Money - Growth Still Granger Cause Inflation and Economic Growth in Zimbabwe 1991 - 2005?' The study made use of a VAR approach and the results revealed that money does not granger cause output. Another researcher Kairinza (2012) published a paper on the Unbundling Zimbabwe's journey to hyperinflation and official dollarization for the period post 2004. The paper clearly highlighted that liquidity increases do not impact output in any way but instead lead to hyperinflation. Studies were also done for Nigeria by Fasanya, Onakoya & Agboluaje (2013) using a VAR and granger causality approach. The study also found that money and output are independent variables, the results supported the findings of Nhavira and Kainzira. Barth & Bennett (1974), Kichian (2012) investigated the role of money in Canada using quarterly data and granger causality techniques. M2 was used as a proxy for liquidity and the finds were that there is no causality between money and output. It is in the interest of this study to investigate if liquidity is also independent of output since it is derived from the most liquid component of money supply.

2.2.2 Relationship between value addition and imports

(Rivera-Batiz, 1985) argues that a rise in economic activity would induce an increase in imports, the reason being that high real income promotes consumption. In that regard, there is a direct connection between economic growth and the imports which suggest a connection between value addition and imports. Moreover, imports are also viewed as a potent channel for foreign technology flow into domestic economies by some recent endogenous growth models (Grossman and (Grossman & Helpman, 1991); Lee, 1995; (Mazumdar, 2001). As suggested by (Thangavelu & Rajaguru, 2004) that new technologies could be embodied in imports of intermediate goods, it means that imports drive production as well as value addition. As such it is widely acknowledged that imports play a central role in the countries whose manufacturing base is built on export oriented industries ((Esfahani, 1991); (Serletis, 1992); (Riezman, Whiteman, & Summers, 1996).

As such the studies suggested a link between value addition and imports as value added is embodied in gross domestic product of a nation, in other words imports granger cause production and value addition.

Furthermore, (Saaed & Hussain, 2015) did a study on the impact of imports and exports on Economic Growth in Tunisia and economic growth was found to Granger Cause imports. The results provide evidence that growth in Tunisia was propelled by a growth -led import strategy as well as export led import. Imports are thus seen as the source of economic growth in Tunisia. This may imply that if growth granger cause imports, value addition can also granger cause imports since value added is part of economic growth. (Ugur, 2008), also made an attempt to analyze empirically the relationship between imports and economic growth in Turkey using VAR and granger causality approach. The empirical results derived show that while there is a bidirectional relationship between GDP and investment goods import and raw materials import, there is a unidirectional relationship between GDP and consumption goods import and other goods import, where causality runs from GDP to consumption goods import and other goods import.

However, (Asafu-Adjaye & Chakraborty, 1999) considered three variables: imports, real output and exports (for the period 1960-1994) for India. They did not find any evidence of the existence of a causal relationship between these variables for the case of India. This suggests there may be no causal relationship between imports and value addition. Also, (Hussain & Saaed, 2014) examined the nexus of Imports, exports and Economic growth in Saudi Arabia, using annual data for the period 1990- 2011, but the result of the causality between imports and economic growth was statistically insignificant. (Islam, Muhammad, & Shahbaz, 2012), did a research on imports nexus growth for 62 countries including Zimbabwe and their findings confirm the importance of imports as source of economic growth, at the same time the results of Granger causality test indicate mixed results for some countries and the study put emphasis on growth rather than value addition in the economy hence the need to investigate whether there exists a relationship between value addition and imports in Zimbabwe rather than assuming that it exists since value added is part of economic growth.

The focus is Zimbabwe because she has lived with very low economic growth with a large current deficit since 2003. So, it is wondered if an increase in imports or import expansion causes low

value addition in the economy which is then affecting growth. Moreover, which category of imports may affect value addition or be affected by value addition is another question wondered.

*2.2.*3 Relationship between imports and liquidity

Browne (2016) examines the effects of liquidity on the demand for imports of non-durable consumers' goods in Trinidad and Tobago. A parsimonious vector equilibrium correction model (VEqCM) is used to test the hypotheses that liquidity has both long- and short-run effects. The multivariate co-integration approach of Johansen and Juselius (1990) is used to determine long-run relations and general to specific (Gets) modeling, to determine system dynamic specification. The findings were as follows; Co-integration analysis reveals a long-run relation among consumers' imports, output, liquidity and relative prices. Gets modeling also reveals significant short-run liquidity effects and furthermore asymmetric short-run foreign and domestic price effects.

Moreover, Modeste (2011) estimated the long and short-run elasticities of the traditional and disaggregated expenditure models of aggregate goods imports for Trinidad, using annual data from 1968-2006. The long-run relations in the analysis were determined using the bounds test for co-integration and the short-run analysis determined in an error correction model. The long-run analysis revealed that liquidity and relative prices were positively and negatively related to goods imports respectively. In Modeste's short-run analysis the findings were that contemporaneous changes in liquidity and relative prices were positively and negatively related to changes in goods imports, which means the higher the liquidity the higher the imports.

However, in all these studies none of them looked at the causal link among the three variables; value addition, liquidity and imports, they only considered GDP and liquidity or GDP and imports or imports and liquidity only. GDP figures measures total output in the economy which means it does not separate the primary sector output or intermediary output with value added in the secondary and tertiary sector such that a huge GDP figure does not mean that there is a lot happening in terms of value addition, since it might comprise more of primary sector output hence it becomes necessary to include value added as the appropriate variable in the study as value addition is perceived as the primary engine of growth by the international community in the Agenda 2030.

To summarize, the theoretical and empirical evidence about the causal relation between value addition, liquidity and imports, the evidence is mixed and sometimes uncertain. Some studies suggest that there is a causal link while others indicate that there is no link among the variables. The causality between the variables is different for different studies and there is wide disagreement among different economists. This might be because of the existence of differences among countries in policy issues, political stabilities, and growth or development levels. The other reason for mixed result might be the kind of data used, methodology and procedural errors. Therefore, this study's focus is on analysis of the short run and long run relationship between the variables in Zimbabwe using co-integrated VAR/VECM approach.

CHAPTER THREE

MODEL SPECIFICATION, VARIABLE DEFINITION AND ESTIMATION TECHNIQUE

3.0 Introduction

In this part of the research chapter, the researcher outlines the econometric estimation techniques adopted in investigating the nexus between value addition, liquidity and categories of imports. This chapter begin by presenting the theoretical and empirical model. This chapter will also give definition and justification of variables, estimation procedure, data sources and conclusion.

3.1 Theoretical specifications

The empirical framework of this study is focused on modeling the nexus between value addition, liquidity, investment goods & raw material imports, and imports of consumption & other goods. The presence of endogenous variables on both left and right hand side of the equation makes difficult the estimation and inference process. However, following (Wooldridge, 2010) the Vector Auto Regressive (VAR) approach circumvents this complexity by treating every variable as endogenous in the system as a function of the lagged values of all endogenous variables in the system, such that the relevant factors affecting value addition, liquidity, investment goods & raw materials, and consumption and other goods, when using the VAR approach to analyze time series data, will be specified as follows:

$$y_t = c + \phi_1 y_{t-1} + \phi_2 y_{t-2} + ... + \phi_\rho y_{t-\rho} + \sigma_t \quad \text{.....(3.1)}$$

Where $y = \begin{bmatrix} VA \\ LD \\ MI \\ MC \end{bmatrix}$, in which one variable is exogenous in one model while the other variables are endogenous in that same model and the subscript *t* represents the time periods and the subscripts *1* up to *p* indicate parameter number

A VAR system contains a set of m variables, each of which is expressed as a linear function of p lags of itself and of all of the other m-1 variables, plus an error term. For example, given two variables, x and y, an order p, the VAR would be the following two equations:

$$y_t = \beta_{y0} + \beta_{yy1} y_{t-1} + ... + \beta_{yyp} y_{t-p} + \beta_{yx1} x_{t-1} + ... + \beta_{yxp} x_{t-p} + v_t^y \quad \text{.....(3.2)}$$

$$x_t = \beta_{x0} + \beta_{xy1} y_{t-1} + ... + \beta_{xyp} y_{t-p} + \beta_{xx1} x_{t-1} + ... + \beta_{xxp} x_{t-p} + v_t^x \quad \text{.....(3.3)}$$

where β_{xyp} represents the coefficient of y in the equation for x at lag p. A key feature of the above equations is that no current variables appear on the right-hand side of any of the equations.

v in the VAR represent the innovation terms, while ε is exogenous orthogonal shocks to each variable. The innovation in y_t is the part of y_t that cannot be predicted by past values of *x* and *y*

as such some of this unpredictable variation in y_t is due to ε_t^y, an exogenous shock to y_t that not related to x or any other variable that might be included in the system.

3.2 Justification of the Theoretical model

Vector auto regression (VAR) was introduced by (Sims, 1980) as a technique that could be used by macroeconomists to characterize the joint dynamic behavior of a collection of variables without requiring strong restrictions of the kind needed to identify underlying structural parameters. It has become a predominant method of time series modeling (Handamo ,2016). Other methods that could have been used to make the analysis include the fully modified ordinary least squares technique, however, the technique requires for all the variables be integrated of order1[2], of which one cannot be sure whether all variables will be of order 1with Zimbabwe data because of economic crisis (Tambama, 2011). The 3 stage least square could have also been used but, however, with the existence of structural equations, the reduced form coefficients poses the identification problem with simultaneous equations.

Thus, the VAR approach has recently become somewhat a common instrument for macroeconomic analysis. Alemnesh (2012) used co-integrated VAR approach to analyze the nexus between public investment, trade openness, private investment and economic growth in Ethiopia as well as (Feyera, 2015) used the same approach to analyze the nexus between inflation rate, gross national saving and per capita income in Ethiopia. Similarly, Handamo (2016) used the same approach to analyze the nexus between tax revenue, inflation, private final consumption and economic growth for the same country. Hence analysis of the nexus between value addition, liquidity and categories of imports using co-integrated VAR approach is appropriate.

3.3 Empirical estimation

The empirical outline of this study consists of four models. The first model tests the effects of liquidity, investment goods & raw material imports and imports of consumption & other goods on value addition. The second model tests the effects of value addition, investment goods & raw material imports and imports of consumption & other goods on liquidity. The third model tests the effects of liquidity, value addition and imports of consumption & other goods on investment goods & raw material imports and the fourth model tests the effects of liquidity, value addition

[2] Refers to a non-stationary series that is differenced once to make it stationary

and investment goods & raw material imports on imports of consumption & other goods of Zimbabwe. Following theoretical grounds, the empirical model can be specified as follows:

VA= *f* (LD, MI, MC) …… (3.4)

LD=*f* (VA, MI, MC) …… ... (3.5)

MI=*f* (VA, LD, MC) …… (3.6)

MC =*f* (VA, LD, MI) …… (3.7)

where; VA is, value added,

LD is liquidity,

MI are imports of investment goods & raw material imports, and

MC imports of consumption & other goods.

For the determination of economic analysis, many variables are used in logarithm (log). In time series analysis, this transformation is often considered to stabilize the variance of a series (Gujarati, 2004). Thus, the variables are transformed into log data to avoid heteroscedasticity and to show elasticity of the variables. In this regards, the above functions of equation can be written in logarithmic form as:

$$lnVA = \alpha_1 + \sum_{S=1}^{P} \beta_1 lnVA_{t-s} + \sum_{S=1}^{P} \beta_2 lnLD_{t-s} + \sum_{S=1}^{P} \beta_3 lnMI_{t-s} + \sum_{S=1}^{P} \beta_4 lnMC_{t-s} + \varepsilon_{1t} \text{.....(3.8)}$$

$$lnLD = \alpha_2 + \sum_{S=1}^{P} \gamma_1 lnLD_{t-s} + \sum_{S=1}^{P} \gamma_2 lnVA_{t-s} + \sum_{S=1}^{P} \gamma_3 lnMI_{t-s} + \sum_{S=1}^{P} \gamma_4 lnMC_{t-s} + \varepsilon_{2t} \text{….....(3.9)}$$

$$lnMI = \alpha_3 + \sum_{S=1}^{P} \theta_1 lnMI_{t-s} + \sum_{S=1}^{P} \theta_2 lnLD_{t-s} + \sum_{S=1}^{P} \theta_3 lnVA_{t-s} + \sum_{S=1}^{P} \theta_4 lnMC_{t-s} + \varepsilon_{3t} \text{.....(3.10)}$$

$$lnMC = \alpha_4 + \sum_{S=1}^{P} \mu_1 lnMC_{t-s} + \sum_{S=1}^{P} \mu_2 lnLD_{t-s} + \sum_{S=1}^{P} \mu_3 lnVA_{t-s} + \sum_{S=1}^{P} \mu_4 lnMI_{t-s} + \varepsilon_{4t} \text{.....(3.11)}$$

Where; α_i and ε_i are constant and error term respectively

$\beta_i, \gamma_i, \theta_i, \mu_i$ are parameters to be estimated

3.4 Variable Definition and justification of variables

According to the International Standard Industrial Classification (ISIC, Value added (VA) refers to the difference between total output of a sector without adjusting for depreciation less intermediate inputs of that sector.is the net output of a sector after adding up all outputs and subtracting intermediate inputs. Value addition for a given period can also be estimated as the difference between GDP and primary/extractive sector output (agriculture and mining) at market prices following World Bank definition or simply a summation of value added at sector level. The study uses value addition as a proxy for real economic activity in Zimbabwe since there has been an increase in the level of value added imported goods in the country from 2003 which appeared to have reinforced the decline in capacity utilization in the country for the same period (Confederation of Zimbabwe industries (CZI), 2015).

Liquidity (LD) means how quickly one can get hands on cash as such, liquidity in this study refers monetary liquidity rather than funding, market, risk taking and valuation liquidity. In simpler terms, liquidity is to get your money whenever you need it (The economic times). Following the measures of liquidity suggested by the (Committee on the Global Financial System, 2011) in this study, liquidity is proxied by the ratio of stock of money in coin, notes, bank deposits ('high-powered') to Gross domestic product (GDP) in simple terms it is measured by M1 divided by GDP. This is a measure of how quickly the available output can be turned into liquid cash. Global or National liquidity, is best assessed on the basis of two measures which can be classified into price and quantity measures (Committee on the Global Financial System, 2011). Information about the conditions at which liquidity is provided is obtained from the price measures such as interests, while information on risk related issues in provision is obtained from the quantity measures such as base money and bank liquidity ratios. As such financial stability concerns are captured using both the price and quantity measures. Base money, broader money and foreign exchange reserves are some of the key global monetary liquidity measures and when expressed relative to GDP, they can be used as broad measures at macroeconomic level. Significant increases in ratios such as money base to GDP over a period of time can signal potential situations of excess liquidity in the economy (Committee on the Global Financial System, 2011). Table 3 summarizes the type of liquidity and its possible measures that can be employed;

Table 3:Type of liquidity and the type of measures that can be employed

Type of liquidity	Quantity measures	Price measures
Monetary liquidity	Base money and broader monetary aggregates Foreign exchange reserves	-Policy and money market interest rates -Monetary conditions indices
Funding liquidity	Bank liquidity ratios Maturity mismatch measures CP market volumes	-Libor-spreads swap basis -Qualitative surveys of funding conditions
Market liquidity	Transaction volumes	-Bid-ask spreads on selected global assets -Qualitative fund manager surveys
Risk-taking and valuation	Bank leverage ratios	-risk appetite measures Sharpe, carry-to-risk ratios -Financial asset prices and spreads, Price/earnings ratios

Source: (Committee on the Global Financial System, 2011)

The study considered monetary liquidity a variable of interest because the level of monetary liquidity has not been stable over the years (1980-2015). This is so because the country has been characterized by periods of too much monetary liquidity (1997-2008), too little monetary liquidity or liquidity crunch, (2009-2016) as well as periods of moderate monetary liquidity (1980-1997). In the same periods the country's growth rates were volatile moving from high percentages to low and sometimes from low to high so one may wonder why this is so and this gives rise to the question, does liquidity affect growth in Zimbabwe? Following views by theorists such as Keynes in the liquidity preference theory and fisher in the quantity theory of money as well as Zimbabwe's

economic crises, it makes it appropriate to analyze the impact of monetary liquidity on value addition in the country's economy.

Imports (M) refers to goods bought from other countries and consumed or used within the boundaries of the economy. In this study imports are put in two categories, which are; investment goods & raw materials (MI), and consumption & other goods ($MC_)$. This is done to make the analysis more reliable as well as for easy of interpretation since the nature of imports may have a bearing on the link and direction of causality between the variables, as well as being in line with the broad economic category (BEC). Imports is a variable of interest in the study since imported value added products appear to act as substitutes for the low value added products in the country this can also be explained by the idea of protectionism in international trade. Furthermore, imports act as a leakage in the circular flow of income in the economy, as such this may explain the reason for liquidity crunch in the economy since 2009, when the country's dependence on imports increased.

3.5 Estimation procedures

The following diagnostic tests are done before the model is estimated to ensure suitability of the model to the data;

3.5.1 Stationarity test

Following (Gujarati, 2003), a time series is strictly stationary if all of the moments (the mean, variance and covariance) of its probability distribution are invariant over time. A process whose mean and variance are constant overtime and whose covariance is not dependent on the actual time that it is computed is said to be weakly stationary. (Gujarati, Basic Econometrics, 2003). If a time series is not stationary, it is called a non-stationary time series. In other words, a non-stationary time series will have a time-varying mean or a time varying variance or both. If a time series is non-stationary, we can study its behavior only for the time period under consideration or for a particular episode and as a result, it is not possible to generalize it to other time periods. Since the majority of economic theory is built upon the assumption of stationarity, it is typically required to check that the various variables are stationary before applying standard estimation, this is because regression of a no stationary variable upon a non-stationary variable may lead to the so-called spurious regression in which estimators and test statistics are misleading.

3.5.1.1 Testing for unit roots

To test for stationarity, the unit root test can be used. According to (Davidson & Mackinnon, 1999) a non-stationary time series referred to as integrated of order one or I(1), if its first difference, $\Delta y_t = y_0 - y_{t-1}$, is I(0) or stationary. More generally, a series is integrated of order d, or I(d), if it must be differenced d times before an I(0) series results. A series is I(1) if it contains what is called a unit root and these are normally detected by conducting unit root tests. For the purpose of this study, the null hypothesis is that the time series has a unit root and the alternative is that it is I(0) or has no unit root.

Tests such as the Dickey-Fuller (DF) test, the Augmented Dickey-Fuller (ADF) test and the Phillips-Peron test are the most widely used unit root tests. This study employs the ADF test to determine the existence of a unit root, this is because the original Dickey-Fuller (DF) test is based on a simple autoregressive of order one, AR (1) process and it does not include values of variables beyond one lag, such that there may be serial correlation among error terms so that results based on such tests may be biased and as a result not valid.

3.5.1.1aThe Augmented Dickey-Fuller test

The Augmented Dickey-Fuller test avoids this problem because it corrects for serial correlation by adding lagged difference terms (Greene, 2003).

Assuming the random walk model with a drift around the stochastic trend which is correctly specified by augmenting the lagged values of the explained variables Δy_t , the ADF test can be estimated in the following three cases;

Case one: When there is intercept only

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + ... + \beta_p \Delta y_{t-p} + \varepsilon_t \quad \text{.....(3.12)}$$

Case Two: When there is intercept and trend

$$\Delta y_t = \alpha_0 + \alpha_t t + \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + ... + \beta_p \Delta y_{t-p} + \varepsilon_t \text{.....(3.13)}$$

Case Three: when there is no intercept and trend

$$\Delta y_t = \gamma y_{t-1} + \beta_1 \Delta y_{t-1} + ... + \beta_p \Delta y_{t-p} + \varepsilon_t \text{.....(3.14)}$$

The null being $\gamma = 0$ (the data has a unit root i.e. the data need to be differenced to make it stationary) and alternative hypothesis of the ADF t-test can be: $\gamma \neq 0$ (the data is stationary and does not need to be differenced)

Where, ϵ_t represents the white noise. The appropriate critical values to be used to test for the presence of a unit root are provided by the Dickey-Fuller. After estimating the equations with ordinary least square method, the resulting t-statistics are compared with the respective critical values given in the Dickey-Fuller tables.

3.5.2 Econometric Method

3.5.2.1 Vector Autoregressive (VAR) Modeling and Co-Integration Analysis

Before using the VAR approach, it is also necessary to check for Co-integration among variables so that either the co-integrated VAR approach or VECM may be used instead. Co-integration test is employed to check long run linear relationships among variables in the presence of short-run deviations from the long run equilibrium. The procedure for co-integration testing and estimation of the VAR for this study is based on the methodology developed and used by Johansen (1988, 1991), and Johansen and Juselius (1990). This method is preferred to the single equation based Engel-Granger two step procedure because it allows testing for the presence of more than one co-integration vector as well as allowing the model to be estimated without restricting the variables as endogenous and exogenous.

3.5.2.2a The Vector Error Correction Model (VECM)

When variables of a VAR model are stationary in their differences and at the same time co-integrated a Vector Error Correction model (VECM)is used to model them. The study employed a VEC model as value addition, and the categories of imports were found to be co-integrated. This was done in order to capture both the short run and long run information about the variables. A VEC model say for two variables taking equation 3.2 and 3.3 above, may appear as follows:

$$\Delta y_t = \beta_{y0} + \beta_{y1}\Delta y_{t-1} + ... + \beta_{yp}\Delta y_{t-p} + \phi_{y1}\Delta x_{t-1} + ... + \phi_{yp}\Delta x_{t-p} - \lambda_y\left(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}\right) + v_t^y \quad \textbf{.....(3.15)}$$

$$\Delta x_t = \beta_{x0} + \beta_{x1}\Delta y_{t-1} + ... + \beta_{xp}\Delta y_{t-p} + \phi_{x1}\Delta x_{t-1} + ... + \phi_{xp}\Delta x_{t-p} - \lambda_x\left(y_{t-1} - \alpha_0 - \alpha_1 x_{t-1}\right) + v_t^x \quad \textbf{.....(3.16)}$$

Where $y_t = \alpha_0 + \alpha_1 x_t$ is the long-run co-integrating relationship between the two variables λ_y and λ_x are the error-correction parameters that measure how y and x react to deviations from long-run equilibrium.

3.5.2.2b Lag length determination

Davidson and Mackinnon (1999), recommended that prior to co-integration testing and estimation of the VAR an appropriate lag length should be determined because the co-integration results may be sensitive to the number of lags included in the model. The appropriate lag length is determined using model selection criteria such as the Akaiki Information Criteria (AIC), the Final Prediction Error (FPE), the Hannan-Quinn Information Criteria (HQ), and the Schwarz (Bayesian) Information Criteria (SIC). The number of parameters which minimizes the value of the information criterion is selected since this is the main objective of the method.

3.5.2.3 Johansen Co-Integration Test

The existence of more than one variable with a unit root makes it necessary to check for co-integrating vectors. The Johansen co-integration test makes it possible to estimate all co-integrating vectors especially when there are more than two variables In a more general way, if there are n variables with unit roots, there are at most $n-1$ co-integrating vectors. The Johansen(1988) test procedure makes use of two statistics, the likelihood ratio tests (the trace) which tests current (actual) values of the fundamentals and the maximal eigenvalue (λ maximum) which whether the largest eigenvalue is zero relative to the alternative that the next largest is zero, The initial maximum Eigen test, to test whether the rank of the matrix is zero has the null hypothesis that rank (Π)= 0 and the alternative that rank (Π) = 1. The null hypothesis that rank (Π) = 1,2... and the alternative hypothesis that rank (Π) = 2, 3...are used for further tests. However, both trace and maximum Eigen test have the null hypothesis of no co-integration against the alternative of co-integration. The test statistics for the two tests are given as;

$$\lambda \max imum(r_0, r_0 + 1) = -Tln(1 - \lambda_{r+1})$$

and $$\lambda trace(r) = -T\sum_{i=r+1}^{n} ln - (1 - \lambda i)$$

where r is the number of co-integrating vectors , λ is the estimated characteristic root (Eigen values) from the matrix and T is the number of observations.

3.5.2.6 Granger causality Test

In order to identify which variable causes another, Granger (1969) and Sims (1972), proposed a causality test in multivariate time series analysis. Granger (1988), highlighted that if co-integration exists between two variables, then causality must exist in at least one direction. Given two variables say x and y ,if the lagged values of x predict y better, x is said to granger cause y and this is referred to as unidirectional causality. If the lagged values of x predict y and at the same time lagged values of y predict x , then there exists a bidirectional causality between the variables and these are also termed feedback effects. Otherwise if a series x does not provide statistically significant information about the future variables of another series y in means x does not granger cause y . From the two-variable system in equations (3.2 & 3.3), if x Granger causes y , then some or all of the lagged values x of have non-zero effects on y . Testing for Granger causality amounts to testing the joint blocks of coefficients The null hypothesis of this VAR in testing the joint block of coefficients is;

$H_0 : \beta_{yx1} = \beta_{yx2} ... = \beta_{yxp} = 0$, which can be tested using a standard Wald r χ2 of F test.

And that for y does not granger cause x is ; $H_0 : \beta_{xy1} = \beta_{xy2} ... = \beta_{xyp} = 0$.

3.5.3 Diagnostic Checks after model estimation

Once the VAR models are estimated, some diagnostic tests should be done. These are important in order to make sure that the results obtained from VAR estimation can be used for forecasting or policy purposes. These post-estimation tests are mostly performed on the residual of the VAR.

3.5.3.1 Tests for Normality of a Vector White Noise Process

A joint asymptotic test is performed using the Jarque-Bera normality test. The purpose of the test to determine whether the regression errors are normally distributed, this is done by comparing the third and fourth moments of the transformed process with the theoretical values obtained for a Gaussian process. The null hypothesis for the joint testis that residuals are normally distributed. Rejection of the null hypothesis at the standard critical values indicate that the residuals are not

normality distributed. The test statistic is calculated from the skewness and kurtosis of the residuals as follows: $JB = S_3^2 + S_4^2$,

where $S_3^2 = Tb_1'b_1/6$, and $S_4^2 = T(b_2 - 3_k)'(b_2 - 3_k)/24$

Where, b_1 and b_2 are the third and fourth non-central moment vectors of the standardized residuals, k is kurtosis and T is the number of observation.

3.5.3.2 Error Vector Autocorrelation Test

When using time series data, autocorrelation normally exists between consecutive error terms which may result in estimation results and inferences not to be trustworthy. A multivariate test for residual serial correlation up to some specified lag order, known as the Breusch-Godfrey Lagrange Multiplier (LM) test is employed in this study. The null hypothesis of the LM test for autocorrelation is that the residuals are not serially correlated against the alternative that the residuals are correlated. If the p-value is less than 0.05 then we reject the null hypothesis.

3.5.3.3 Heteroscedasticity Test

The white's test is used to check whether the variance of the errors in the model are constant or not as well as to check if there is no problem of misspecification. The test is based on the null hypothesis that residuals are homoscedastic [$E(\mu_i^2) = \sigma^2$].If the White test statistic is significant, that is, p-value is less than 0.05; the null hypothesis of homoscedasticity and no misspecification will be rejected.

3.5.3.4 Impulse Response Function and Variance decomposition

3.5.3.4aImpulse Response Function (IRF)

To investigate the interrelationships among variables and to assess adjustments of variables to long run equilibrium impulse response analysis should be performed. When analyzing the dynamic behavior of a variable due to a random shock or innovation in other variables, the necessary information is obtained from the impulse-response functions. The functions show the sign, magnitude and persistence of shocks on the dependent variable there by indicating the cross effect on current and future values of the endogenous variable due to one standard deviation shock to the other variable. Impulse response functions are interpreted under the assumption that all the other shocks are held constant thus, there is need to orthogonalize the shock through Cholesky

decomposition (Handamo ,2016), so as to eliminate the problem of interpretation when error terms are correlated. Since all variables are considered to be endogenous in this study it implies that a shock to one variable in this VAR, directly affects that variable and at the same time that shock is transmitted to other variables in the same model. Therefore, in this study the impulse response traces for instant, how value addition, responds overtime to a shock in another variable (liquidity, investment goods & raw materials(MI) imports, and consumption & other goods ($MC_)$ imports,) and compares this response to shocks from other variables. As such in a system of four variables, there are 16 impulse response functions. If the time path of the impulse response function becomes zero over time, the system of the equations is stable, however they can explode if unstable.

3.5.3.4b Variance Decomposition

Enders (1995), proposed that the forecast-error variance decomposition yields additional information to the researcher concerning the fluctuation in a time series attributable to other variables at selected time horizons. This therefore allows conclusions to be drawn concerning the movements in a particular series due to its own earlier shocks as well as shocks arising from other variables in the model. Variance decomposition provide a different method of depicting system dynamics through the decomposition of variation in an endogenous variable into component shocks which gives relative importance of each random innovation to the variables, whereas the impulse response function traces the effect of a shock to endogenous variables in the VAR. In this study, decomposing the forecast-error variance yields additional information concerning how value addition, liquidity, investment goods & raw materials(M_i), imports and consumption & other goods ($Mc_)$ imports are linked. Variance decomposition can indicate which variables have short-term and long-term impacts on another variable of interest.

3.6 Data sources

The data used in this study is secondary data, obtained from different sources, UNCTAD, RBZ and ZIMSTAT. In the study, a time series analysis is utilized, annual data from 1980-2015 is used so as to establish whether there exists a long run relationship among the variables. Time-series data on GDP and value added is collected from the UNCTAD data base. The data for liquidity (liquidity ratio, proxy for liquidity) is collected from the reserve bank of Zimbabwe and the ratio will be given by M1/GDP while data on imports is obtained from ZIMSTAT and UNCTAD.

3.7 Conclusion

The chapter gave a description of the theoretical and empirical model as well as the procedure and diagnostic tests that will be employed in this study in an attempt to analyze the nexus between value addition, liquidity and categories of imports.

CHAPTER FOUR

ESTIMATION, PRESENTATION AND INTERPRETATION OF THE RESULTS

4.0 Introduction

The empirical results and their interpretations will be presented in this chapter.

4.1 Data description

Table 4:Descriptive statistics

	LNVA	LNLD	LNMI	LNMC
Mean	8.805892	-0.825617	6.446964	7.039821
Median	8.800401	-2.040221	6.132295	7.174320
Maximum	9.317220	23.01074	7.765187	8.907021
Minimum	8.490849	-2.659260	5.591733	5.186268
Std. Dev.	0.231662	4.506566	0.659897	1.269783
Skewness	0.601419	4.495851	0.531981	0.064186
Kurtosis	2.581853	23.42608	1.750259	1.488489
Jarque-Bera	2.432502	747.1131	4.040801	3.451719
Probability	0.296339	0.000000	0.132602	0.178020
Sum	317.0121	-29.72222	232.0907	253.4336
Sum Sq. Dev.	1.878362	710.8197	15.24123	56.43221
Observations	36	36	36	36

The mean and median values of LNVA, LNMI and LNMC are very close to each other as shown in Table 4 above except for LNLD. This implies that the three variables follow a normal distribution. There is also variability in observation since the standard deviation is not equal to zero for all variables. Therefore, the assumptions of variability and normality required by the regressions analysis are fulfilled for these three variables

4.2 STATIONARITY TESTS

Table 5: unit root tests

Variable	ADF Test statistics	1%Critical Value	5%Critical Value	10%Critical Value	P-value	Decision
LNVA	-1.085312	-4.243644	-3.544284	-3.204699	0.9173	Not stationary
DLNVA	-4.654692	-4.252879	-3.548490	-3.207094	0.0037***	Stationary(1)
LNLD	-3.985415	-3.632900	-2.948404	-2.612874	0.0004***	Stationary(0)
LNMI	-2.937418	-4.243644	-3.544284	-3.204699	0.1637	Not Stationary
DLNMI	-6.198439	-4.252879	-3.548490	-3.207094	0.0001***	Stationary(1)
LNMC	-2.103254	-4.243644	-3.544284	-3.204699	0.5262	Not Stationary
DLNMC	-5.679058	-4.252879	-3.548490	-3.207094	0.0003***	Stationary (1)

where ***, entails stationarity at 1 %level of significance and I(.) shows the order of integration. The ADF test results at level shows that the critical values for LNVA, LNMI, and LNMC are greater than the ADF test statistics; therefore, we fail to reject the null hypothesis that the variable has a unit root. However, they are stationary in their first differences hence they are integrated of order 1, except for LNLD which is stationary in level.

4.3 Econometric Analysis

4.3.1 Lag Order Selection for Endogenous Variables

Among the classical procedures, the information criteria such as Likelihood Ratio (LR), Akaike (AIC), Schwarz (SC) and Hannan-Quinn (HQ) and Forecast Prediction Error (Lutkepohl, 1993) have been used to decide lag length that helps to estimate VAR model. As indicated by **table 6** below, the LR, FPE and HQ propose an optimal lag of two at a 5% level of significance.

Table 6 Optimal lag order selection criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-67.26350	NA	0.001166	4.597645	4.782676	4.657960
1	-33.59684	56.47311	0.000377	3.457860	4.383013*	3.759437
2	-12.15547	30.43291*	0.000281*	3.106805	4.772080	3.649643*
3	4.440653	19.27292	0.000315	3.068345*	5.473743	3.852445
4	18.30644	12.52394	0.000498	3.206036	6.351556	4.231397

4.3.2 The Johansen Co-integration Test Result

ADF test found that the series are non-stationary at level and stationary at first difference. To capture the existence of long run relationship among the variables, this study employs the Johansen system framework to detect the existence of co-integrating relationships by the use of trace and maximum eigenvalue statistics

Table 7:Unrestricted Co-integration Rank Test (Trace)

Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Probability
None *	0.6907	50.2374	42.9152	0.0079
At most 1	0.2727	19.1826	26.8721	0.2201
At most 2	0.2311	8.6722	12.5179	0.2015

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level

Table 8:unrestricted co-integration rank test(Trace)

Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Probability
None *	0.6908	31.0548	25.8232	0.0093

At most 1	0.2727	10.5103	19.3807	0.5645
At most 2	0.2311	8.6722	12.5179	0.2015

Max-eigenvalue test indicates 1 co-integrating equation at the 0.05 level, * denotes rejection of the hypothesis at the 0.05 level.

Both the trace and the maximal Eigenvalue tests identified one co-integrating relationship at the 5% level of significance. This evidence show that there exists long-run relationships among value addition, liquidity, imports of investment & raw material goods, and imports of consumption & other goods.

4.3.3 GRANGER CAUSALITY

The Granger causality test was performed to examine the presence of bidirectional causality as described by Granger. Granger-causality/Block Exogeneity Wald/ test result shows that the lagged values of the variables have significant roles in explaining the current and future values of the variables.

Table 9 shows the existence of bidirectional causality between value addition and all categories of imports. The results indicates that VA granger causes MI and MC and at the same time MI and MC granger causes VA, and this is in line with the import replacement theory which suggested a link between the variables. The result that VA granger causes Mi and Mc is in agreement with Rivera-Batiz (1985)'s findings that a rise in economic activity would induce an increase in imports, the reason being that high real income promotes consumption and that of Saeed and Hussan (2015) which indicate that output granger cause imports. However, the result slightly differs from Uğur (2008)'s which shows that there is a bidirectional relationship between output and investment goods import and raw materials import and a unidirectional relationship between output and consumption goods import and other goods import, where causality runs from output to consumption & other goods import. In this study, a bidirectional relationship is found to exist between value added output and the two categories of imports instead.

Liquidity is also found to granger cause imports of investment & raw material goods, and imports of consumption & other goods while imports of these goods does not granger cause liquidity. This supports the findings of Modeste (2011) and Browne (2016) as well as being in line with the monetary approach to BOP which suggests that imports are a result of monetary liquidity.

The results also indicate that liquidity granger causes value addition, while value addition does not granger cause liquidity. This is in line with the liquidity preference which is of the idea that liquidity enables individual units to seize opportunities as well as the findings of Fulton *et al* (2002), Seneschal *et al* (2010), Nyarota et al (2015) and Boland (2009), that liquidity is vital for success in value added business. This explains why Zimbabwe's total value added output declined significantly and the closure of many manufacturing firms since 2009 when the economy was experiencing high liquidity challenges

However, the results differ from the proposition of the classical quantity theory of money which proposes that there is no causal relationship between high powered money or liquidity and output, as well as the findings of Nhavira (2009) that money is independent of output for the Zimbabwean case.

Table 9:Results of the Granger Causality/Block Exogeneity Wald Tests

Equation Excluded	LNVA	LNLD	LNMI	LNMC
LNVA		1.2631 (0.5318)	18.7469 (0.0001)	11.8129 (0.0027)
LNLD	23.8936 (0.0000)		64.8892 (0.0000)	55.1335 (0.0000)
LNMI	6.8381 (0.0327)	0.5758 (0.7498)		1.6291 (0.4428)
LNMC	6.6722 (0.0356)	0.2358 (0.8888)	2.2396 (0.3263)	

Note: The numbers in parenthesis show the p-values for the corresponding Chi-square statistics.

4.3.4 Vector Error Correction Model (VECM)

In order to take into account the co-integrating relationships among the variables, VEC model was employed. Thus, in this analysis the optimum lag of two is chosen for the VAR using information criteria results. The VECM model consist the dynamics of both short run and long run adjustments. The result of ADF and Johansen co-integration tests supported the existence of long-run equilibrium relationships among LNVA, LNLD, LNMI and LNMC. In this regards, this

study aimed to examine the relationship between value addition, liquidity and categories of imports using the VEC model. The Johansen co-integration test however, confirms that there is one co-integration equation so that there will be a single long-run relation among the variables.

The result of the long-run relationship after estimating the unrestricted co-integrating vector with ad-hoc normalization on LNVA is given by

Table 10:The Estimated Long-Run Model for LNVA

Variable	LNLD	LNMI	LNMC	C
Coefficient	-0.0302 [1.8109]	3.0887 [6.3066]	-2.6006 [-0.4109]	0.1360 [2.9353]

Note: Values in parentheses are t-Statistics

$$LNVA_t - 0.1360 + 0.0302LNLD_t - 3.0887LNMI_t + 2.6006LNMC_t = ECM_t$$

The above long-run equilibrium equation show that, ceteris paribus, imports of investment & raw material goods (MI), and imports of consumption & other goods (MC) have significant positive and negative long-run impact on value addition respectively. This result shows that 1 percent point increase MI increases VA by 3.0887 percent point while a 1 percent point in MC reduces VA by 2.6 percent point in the long run which is in line with standard economic theories of import substitution and import replacement that suggests a negative relationship between MC and VA. However, liquidity does not significantly affect value addition in the long run, which means that the two variables are not dependent on each other in the long run.

4.3.5 The Short Run Relationship

In order to capture the short-run dynamics of the model, error correction mechanism will be applied. The coefficient of the error correction term indicates how quickly variables converge to equilibrium. Coefficients of the one-period lagged differences in the table can be interpreted as the short run parameters representing the short-run causality.

Table 12 below shows that value addition slowly converges to equilibrium as indicated by the error correction term in the equation, however, the result indicate that value addition is significantly and negatively affected by imports of consumption & other goods in the short run.

This simply means that a 1 percent point increase in MC will reduce VA by 0.26 percent. In the case of Zimbabwe, this may explain the reason for a continuous decline in value addition since 2003 when the economy's dependence on imports of consumption increased, which further resulted in huge trade deficits being experienced. The result further indicated that liquidity and import of investment & raw material goods have significant negative and positive effects, respectively to value addition in the short run. Which means increase in liquidity in the short run is perceived as a likely increase in inflation in the near future as such investors do not rush into value addition as they forecast a decline in demand as such this suggests that rational investors do exist in Zimbabwe.

Table 11: Short-Run Coefficients when dependent variable is D (LNVA)

Error Correction Model	Dependent Variable: D(LNVA)	
	Coefficient	t-value
ECM 1	-0.0968	-2.0439
D(LNLD(-1))	-0.0171	-4.1631
D(LNMI(-1))	0.2424	2.3071
D(LNMC(-1))	-0.2601	-2.3450

R^2 = 0.797906, F-statistic = 8.291186

The result in Table 13 below indicates that neither value addition nor imports has a significant effect on liquidity, as such liquidity fluctuations is not dependent on any of these variables in the short run and that deviations in liquidity does not return to equilibrium. In the case of Zimbabwe, this may mean that liquidity is influenced by other factors such as government policy (monetary policy to be precise) in the short run rather than value addition and imports.

Table 12:Short-Run Coefficients when dependent variable is D (LNLD)

Error Correction Model	Dependent Variable: D(LNLD)	
	Coefficient	t-value
ECM 1	0.9142	0.2457
D(LNVA(-1))	14.72112	0.84987
D(LNMI(-1))	0.59657	0.06702
D(LNMC(-1))	4.20237	0.4821

R^2 = 0.265181, F-statistic = 0.757845

The short-run impacts of value addition and liquidity on imports of investment & raw material goods are found to be positive and statistically significant while imports of consumption & other goods is positive and statistically insignificant. Which implies that an increase in value addition will motivate producers to buy more MI simply because this increase in VA or total output may act as increase income in the economy which will further induce importation of MI as investor so as to increase current production and meet the increased demand for goods in the economy. The relationship relationship between LD and MI may be explained by the idea that increases in liquidity enables investors to seize opportunity as explained by Keynes in the liquidity preference theory. Furthermore, the results indicate that for example, a 10-percentage-point increase in value addition and liquidity increases imports of investment & raw material goods by 20.1 and 0.4 percentage points, respectively, in the short run. However, the impact of imports of consumption & other goods on imports of investment & raw material goods is positive but insignificant in the short run.

Table 13:Short-Run Coefficients when dependent variable is D (LNMI)

Error Correction Model	Dependent Variable: D(LNMI)	
	Coefficient	t-value
ECM 1	-0.4579	-3.7211
D(LNVA(-1)	2.014910	3.8218
D(LNLD(-1))	0.048122	2.6345
D(LNMC(-1))	0.535667	1.9662

R^2 = 0.942521, F-statistic = 34.43511

The short run coefficients in **table 15** below indicate that there is short run causality from independent variables to dependent variable, both value addition and liquidity for which their coefficients are positive and significant. The impact of value addition on imports of consumption and other goods is positive and this result is consistent with recent endogenous gross theories which suggests that increase in output induces consumption and further importation of goods. Furthermore, increases in monetary liquidity as explained by the monetary approach to BOP that an increase in liquidity induces people to import more resulting in BOP deficits in the economy, hence a positive relationship between LD and MC.

Table 14:Short-Run Coefficients when dependent variable is D (LNMC)

Error Correction Model	Dependent Variable: D(LNMC)	
	Coefficient	t-value
ECM 1	-0.2922	-1.9723
D(LNVA(-1)	-2.346157	-3.12376
D(LNLD(-1))	-0.090986	-3.49659
D(LNMI(-1))	0.101822	0.24606

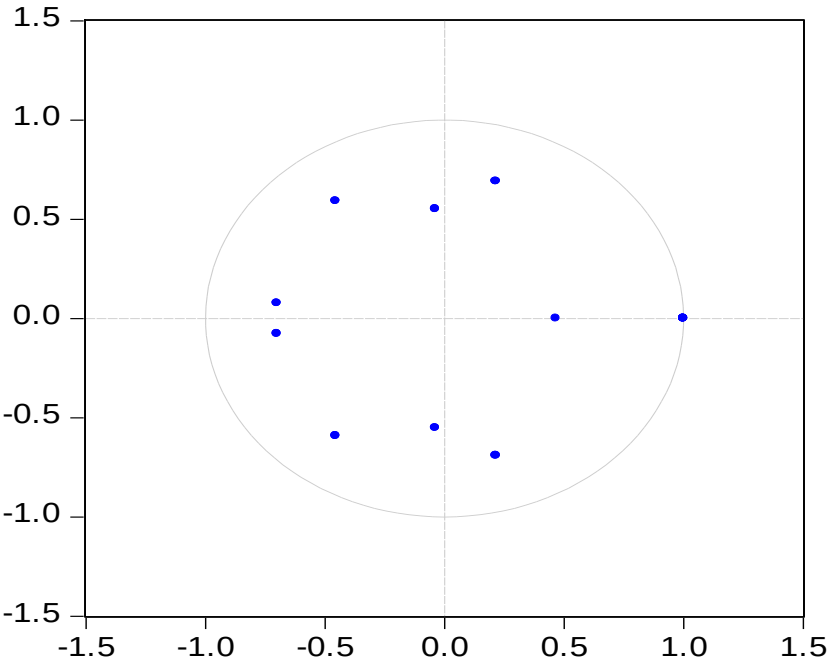
R^2 = 0.839007, F-statistic = 10.94404

4.4 Post-Estimation Diagnostics

Different post-estimation diagnostic tests were performed to guarantee that the residuals from the models are Gaussian in which the assumptions are not violated and the estimation results and inferences are trustworthy. The diagnostic test results could also be used as indicators of the validity of employing impulse-response functions and variance decomposition analyses. For the detailed result of the post-estimation diagnostics see appendix

4.4.1 Test for model stability

Figure 3: Inverse roots of the characteristic polynomial



The test results show that the Modulus of the inverse roots of the polynomial are less than one and lies within the unit circle. Accordingly, it can be concluded that the estimated VEC model is stable or stationary.

4.4.2 Residual Vector Normality Test

Multivariate version of the Jarque-Bera tests is used to test the normality of the residuals. It compares the 3rd and 4th moments (skewness and kurtosis) to those from a normal distribution. The test has null hypothesis stating that the residuals are multivariate normal. The result in the **appendix 1** shows that the null hypothesis cannot be rejected at 1% level of significance which means that the joint test indicates that the residuals are normally distributed.

4.4.3 Residual Vector Serial Correlation LM Test

Appendix Table 2 shows the p-values of statistical significance at 5% level for test of residual vector serial correlation. The p-values imply that the chi-squared statistics at all lags are not large enough to help reject the null of no autocorrelation at any of the usual critical values. In this case, the serial correlation Lagrange Multiplier (LM) test fails to reject the null hypothesis of no serial correlation. Thus, the result indicates that the residuals of the estimated error correction model do not suffer from any type autocorrelation.

4.4.4 Residual Vector Heteroscedasticity Test

The VEC residuals heteroscedasticity test performed (result in **table 16**) suggests that there is no enough evidence to help reject the null of no heteroscedasticity at 5% level of significance. Therefore, the residuals of the model are found to be homoscedastic. This, together with the results of the other pre and post estimation diagnostic tests, suggests the validity and robustness of the estimated results.

Table 15:Diagnostic checks for VECM

Test	Statistic		p-value
	Lag	Chi-square	
Residual Vector Serial Correlation LM	1	12.32938	0.7210
	2	16.42094	0.4240
	3	10.40316	0.8447
	4	12.07465	0.7388
Residual Vector Normality (Jarque-Bera)	Joint		0.0124
Residual Vector Heteroscedasticity	Joint	219.8121	0.1604

4.4.5 Impulse Response Function

The results also indicate that value addition contribute significantly (negatively) to shocks to itself. The response of value addition to one standard deviation positive shock of liquidity is positive in the future ten years. However, in the short run value addition respond positively to shock in imports (in the first 2 to 3 years), and after that value addition response negatively to shock in imports.

Impulse Response Functions for liquidity indicate that value addition does not significantly contribute to shocks in liquidity in the long run. The results indicate that the short run fluctuations in liquidity is also attributable significantly to shocks to itself. However, liquidity does not respond significantly to shocks in imports.

Impulse Response Functions is also computed for imports of investment& raw material goods, and for consumption & other goods. The results indicate that the fluctuations in both imports of investment& raw material goods, and for consumption & other goods is attributable significantly to shocks in imports of consumption & other goods. The result from **appendix 7** indicates that shocks to liquidity will have significant and negative impact on both imports of investment& raw

material goods, and for consumption & other goods, thus it means that imports respond significantly to shocks in liquidity which is in line with the monetary approach to BOP.

4.4.6 Variance Decomposition Function

The variance decomposition further provided evidence of relationships among value addition, liquidity and the categories of imports. Therefore, the variance decomposition makes possible to determine the relative importance of each variable in creating fluctuations in other variables. **Appendix 6** present full decomposition of the variation in LNVA, LNLD, LNMI and LNMC.

The result reveals that all the variation in LNVA is explained by the lagged value of the variable itself in the first period. But in the second period, LNLD also explains about 30% of the variation and this variation in liquidity continue its explanation increasingly until the last period where it explains about 65.9% of variation in value addition. On the other hand, the variation in LNMC take relatively significant shares after 3rd period in explaining the variation in LNVA and slightly increasing throughout the period. The results further showed that a huge variation in LNVA in the data is explained by LNLD (65.9%) in the long run. In summary, over thirty-five years, about 65%, 1% and 14 % of the forecast error variance of LNVA is explained by disturbances in LNLD, LNMI and LNMC respectively.

Appendix 6 show that value addition is responsible for explaining about 50% of the variation of LNLD in the first period, this percentage start to decline until it goes down to 25% in period thirty-five. On the other hand, the variation in LNLD in the data is explained by the lagged values of the variable itself increasingly from 49.8% in the first period and goes up to 70% in period thirty-five. The role of LNMI and LNMC in LNLD variability was almost constant through time and is about 2% and 1% respectively.

Variance Decompositions is also computed for LNMI and LNMC. The forecast error variance of both LNMI and LNMC are each significantly explained by the lagged values of itself in the short run while most variance in the two variables in the long run is explain by the variation in liquidity. Variation in LNMI explained by itself in the first period is 77.7% and that for LNMC explained by itself in the first period is 87%. However, variation in LNMI and LNMC explained by liquidity in the long run is about 44% and 34% respectively, which is more than the variation explained by the lagged values of each variable itself in period thirty-five (Variation in LNMI explained by itself in period thirty-five is 13% and that for LNMC explained by itself in the same period being

32%). As such this shows the increasing importance of liquidity in explaining variation in imports in the long run.

4.5 Conclusion

This chapter presented the results from the estimated equation on the investigation of the relationship between value addition, liquidity and categories of imports. The chapter also gives possible explanations for the study findings. The next chapter concludes the study.

CHAPTER FIVE

CONCLUSIONS AND POLICY RECOMMENDATIONS

5.0 Introduction

This chapter provides conclusions, summary of findings, policy recommendations and areas for further research. Limitations of the study will also be presented in this chapter.

5.1 Conclusions and summary of the findings

The study examined whether there are nexuses between value addition, liquidity and imports of investment & raw material goods (MI), and imports of consumption & other goods (MC) in Zimbabwe using data from 1980-2015. Co-integration and Vector Error Correction approaches have been applied for the identification of nexuses between the variables both in the short run and in the long run. The study applied the shocks or impulse accounting to study the response of the variables on each other and percent contributions of volatility of a variable on other variables. Based on the findings of the study from econometric results, the following conclusions are derived;

The study found no evidence of Granger causality between value addition and liquidity. These results support the proposition of the quantity theory of money which states that high powered money and output does not affect each. As such an increase in money is transformed into an increase in the price level or inflation. The study confirms the findings of Barth & Bennet (1974) for Canada, Nhavira (2009) for Zimbabwe case and Fasanya et al (2013) for the case of Nigeria, although these studies differ in that they concentrated on money supply instead of liquidity.

However, according to the impulse response and variance decomposition, some variation in liquidity is also explained by variation in value addition in the long run. Variance decompositions also showed that value addition only respond to shocks of liquidity in the long run, as such it can be concluded that the two variables respond to the same shocks in the long run.

The results indicate that VA granger causes Mi and Mc, while Mc granger causes VA, and this is in line with the import replacement theory which suggested a link between the variables. The result that VA granger causes MI and MC is in agreement with Rivera-Batiz (1985)'s findings that a rise in economic activity would induce an increase in imports, the reason being that high real income promotes consumption and that of Saeed and Hussan (2015) which indicate that output granger cause imports. However, the result slightly differs from Uğur (2008)'s shows that there is a bidirectional relationship between output and investment goods import and raw materials import

and a unidirectional relationship between output and consumption goods import and other goods import, where causality runs from output to consumption and other goods import. In this study, a bidirectional relationship is found to exist between value added output and imports of consumption and other goods.

Liquidity is also found to granger cause imports of investment & raw material goods, and imports of consumption & other goods while imports of these goods does not granger cause liquidity. This supports the findings of Modest (2011) and Browne (2016) as well as being in line with the monetary approach to BOP which suggests that imports are a result of monetary liquidity.

In a nutshell, the study concluded that there is no strong evidence of both short run and long run causality between value addition and liquidity in Zimbabwe. However, there is evidence of causality between liquidity and imports as well as causality between value addition and imports in Zimbabwe. Therefore, both liquidity crunch and low value addition should be treated as separate major economic challenges that are aiding to the poor performance of Zimbabwe.

5.2 Policy Implications and recommendations

The researcher basing on the findings of this study and the suggestions of the reviewed literature urges that the government should address value addition and liquidity challenges simultaneously. Since both value addition and liquidity are connected to imports, the government should make trade policy its priority. Implementation of policies that discourages importation of value added consumption goods should be considered, however bearing in mind that competition is necessary for the production of quality value added goods. If the issue of quality is ignored, tariffs on value added consumption goods would worsen the trade balance as domestic consumers will keep on substituting the low quality domestically produced goods with high quality imports.

Furthermore, since importation of investment and raw material goods positively affect both value addition and liquidity in the long run, the government should continuously promote the importation of such goods as these are good for the growth of the economy. The Government needs to consider policy consistency as well so as to infuse confidence in the domestic economy by investors. A solid institutional frame work should be established such as the rule of law and good governance so as to make the economic environment more conducive for doing business there by enabling the turnaround of the economy.

5.3 Limitations of the study and suggestions of areas for further research

This study employed co-integrated VAR or VEC model, another econometric technique such as the ARDL model among other sophisticated econometric techniques can be employed.

Studies can be done to find out what are the factors then that are affecting liquidity in the economy. Lastly, this study examined whether there are nexuses between value addition, liquidity and imports during the period 1980-2015 and this was done only at aggregate level and, thus, the impacts of disaggregated approach using ARDL Co-integration are open to research.

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APPENDICES

APPENDIX 1 : DATA USED

YR	VA	LD	Mi	Mc	zim $ m1	Official Exchange Rate (US$/Z$)
1980	4879	0.21	291	194	630	0.630597
1981	5267	0.17	368.4	245.6	678.8	0.717154
1982	5229	0.18	371.4	247.6	825.2	0.815796249
1983	4912	0.12	336.6	224.4	751.4	1.10546
1984	5041	0.11	268.2	178.8	873.9	1.5024
1985	5519	0.1	307.45	251.55	972.4	1.641227638
1986	5585	0.11	353.65	289.35	1062.3	1.678133915
1987	5635	0.12	340.45	278.55	1204.7	1.663063363
1988	5912	0.12	386.1	315.9	1572.5	1.942879347
1989	6133	0.12	369.12	399.88	1866.9	2.27014756
1990	6601	0.12	376.8	408.2	2368.5	2.636435539

1991	6918	0.07	452.64	490.36	2778.3	5.0511
1992	6456	0.08	468.48	507.52	3059.9	5.4815
1993	6673	0.11	422.88	458.12	5464.3	6.935
1994	7034	0.1	610	390	6558.8	8.3871
1995	7021	0.13	339.84	722.16	9760.5	9.3109
1996	7803	0.14	379.84	807.16	13273.1	10.81748353
1997	7910	0.13	556.16	1201.84	19600.6	17.68731898
1998	7558	0.08	800.64	1701.36	24669.4	37.31156579
1999	7763	0.11	908.04	3039.96	34316.4	38.13846678
2000	7242	0.12	1702	5698	52599.8	55.05766067
2001	7197	0.3	1470.62	4923.38	128492.2	55.035773
2002	6722	0.87	1329.4	4450.6	348482.5	55.035773
2003	6136	0.5	1004.64	3363.36	2761760.4	826.446281
2004	5873	0.19	757.3	2687.7	6866977.7	5712.647857
2005	5579	0.08	581.68	2062.32	44461068.2	84587.57
2006	5380	34.96	399.96	1418.04	629062800	250
2007	5185	2413.1	400.62	1420.38	4.19954E+11	30000
2008	4870	1E+10	406.34	1440.66	2.16412E+27	4894167
2009	7280	0.12	2357.1	5499.9	1032508.035	
2010	8113	0.14	1572.9	3670.1	1372035.055	
2011	9087	0.17	1333	5332	1845026.811	
2012	10047	0.18	1407	5628	2089394.225	
2013	10432	0.16	1613.1	6876.9	1959980.239	
2014	10754	0.17	1644.26	7009.74	2158488.761	
2015	11128	0.18	1731.96	7383.63	2428916.025	

APPENDIX 2

VEC Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: residuals are multivariate normal

Date: 04/20/17 Time: 21:04

Sample: 1980 2015

Included observations: 32

Component	Skewness	Chi-sq	df	Prob.
1	-0.688684	2.529527	1	0.1117
2	-0.450441	1.082116	1	0.2982
3	-0.275051	0.403483	1	0.5253
4	1.163894	7.224796	1	0.0072
Joint		11.23992	4	0.0240

Component	Kurtosis	Chi-sq	df	Prob.
1	4.316062	2.309360	1	0.1286
2	3.681363	0.619008	1	0.4314
3	3.450973	0.271169	1	0.6025
4	4.948917	5.064370	1	0.0244
Joint		8.263907	4	0.0824

Component	Jarque-Bera	Df	Prob.

1	4.838887	2	0.0890
2	1.701124	2	0.4272
3	0.674652	2	0.7137
4	12.28917	2	0.0021
Joint	19.50383	8	0.0124

APPENDIX 3

VEC Residual Serial Correlation LM Tests

Null Hypothesis: no serial correlation at lag order h

Date: 04/20/17 Time: 21:15

Sample: 1980 2015

Included observations: 32

Lags	LM-Stat	Prob
1	12.32938	0.7210
2	16.42094	0.4240
3	10.40316	0.8447
4	12.07465	0.7388

Probs from chi-square with 16 df.

APPENDIX 4

VEC Residual Heteroskedasticity Tests: No Cross Terms (only levels and squares)

Date: 04/26/17 Time: 01:24

Sample: 1980 2015

Included observations: 32

Joint test:

Chi-sq	Df	Prob.
219.8121	200	0.1604

Individual components:

Dependent	R-squared	F(20,11)	Prob.	Chi-sq(20)	Prob.
res1*res1	0.868694	3.638702	0.0159	27.79822	0.1143
res2*res2	0.947203	9.867276	0.0002	30.31050	0.0650
res3*res3	0.731775	1.500514	0.2472	23.41679	0.2688
res4*res4	0.802080	2.228904	0.0865	25.66657	0.1771
res2*res1	0.959864	13.15346	0.0000	30.71565	0.0591
res3*res1	0.824960	2.592140	0.0536	26.39872	0.1530
res3*res2	0.896258	4.751634	0.0055	28.68027	0.0942
res4*res1	0.785300	2.011711	0.1169	25.12959	0.1965
res4*res2	0.870791	3.706656	0.0148	27.86530	0.1126
res4*res3	0.524788	0.607378	0.8398	16.79321	0.6664

APPENDIX 5

VEC Granger Causality/Block Exogeneity Wald Tests

Date: 04/27/17 Time: 10:52

Sample: 1980 2015

Included observations: 32

Dependent variable: D(LNVA)

Excluded	Chi-sq	Df	Prob.
D(LNLD)	0.999728	2	0.6066
D(LNMI)	0.968131	2	0.6163
D(LNMC)	4.991012	2	0.0825
All	8.150173	6	0.2273

Dependent variable: D(LNLD)

Excluded	Chi-sq	Df	Prob.
D(LNVA)	1.767842	2	0.4132
D(LNMI)	0.705590	2	0.7027
D(LNMC)	0.063837	2	0.9686
All	2.645287	6	0.8519

Dependent variable: D(LNMI)

Excluded	Chi-sq	Df	Prob.
D(LNVA)	24.63477	2	0.0000
D(LNLD)	22.31672	2	0.0000
D(LNMC)	3.921043	2	0.1408
All	59.61789	6	0.0000

Dependent variable: D(LNMC)

Excluded	Chi-sq	Df	Prob.
D(LNVA)	10.96840	2	0.0042
D(LNLD)	22.07296	2	0.0000
D(LNMI)	0.980466	2	0.6125
All	23.28578	6	0.0007

APPENDIX 6: Variance decomposition

Variance decomposition of LNVA

Period	S.E.	LNVA	LNLD	LNMI	LNMC
1	0.062421	100.0000	0.000000	0.000000	0.000000
2	0.084502	67.39376	30.39408	0.880130	1.332025
3	0.094602	61.85692	33.93276	1.328782	2.881539
4	0.111453	45.86556	45.48468	1.332446	7.317320
5	0.119352	45.04043	45.59834	2.228529	7.132703
6	0.131734	40.11501	49.85032	1.969612	8.065058
7	0.141105	35.34868	51.59052	1.831109	11.22970
8	0.147988	34.16469	52.73224	1.758717	11.34435
9	0.155918	32.11136	54.41929	1.606087	11.86326
10	0.161937	30.26246	55.88154	1.614957	12.24105
11	0.167555	29.34283	56.79279	1.548882	12.31549
12	0.173686	27.99784	57.91931	1.459450	12.62340
13	0.179349	26.95193	58.76038	1.409806	12.87788
14	0.184753	26.30271	59.43934	1.373457	12.88449
15	0.190391	25.43266	60.16690	1.330107	13.07033
16	0.195526	24.72255	60.74545	1.306058	13.22594
17	0.200721	24.16520	61.23884	1.268837	13.32713
18	0.205832	23.55741	61.73700	1.238846	13.46675
19	0.210689	23.06150	62.16025	1.218578	13.55967
20	0.215465	22.61575	62.55228	1.195375	13.63659
21	0.220177	22.16049	62.92634	1.172861	13.74031

22	0.224722	21.77747	63.25305	1.154071	13.81541
23	0.229229	21.42436	63.56019	1.134872	13.88058
24	0.233634	21.08007	63.85058	1.118793	13.95056
25	0.237938	20.77540	64.11253	1.103976	14.00809
26	0.242190	20.48692	64.35907	1.088915	14.06510
27	0.246365	20.21360	64.58980	1.075480	14.12112
28	0.250462	19.96595	64.80266	1.063180	14.16821
29	0.254503	19.72965	65.00457	1.051314	14.21447
30	0.258474	19.50631	65.19395	1.040435	14.25930
31	0.262385	19.29954	65.37081	1.030029	14.29962
32	0.266244	19.10260	65.53860	1.020120	14.33868
33	0.270043	18.91685	65.69682	1.010986	14.37535
34	0.273790	18.74230	65.84609	1.002275	14.40933
35	0.277488	18.57572	65.98797	0.993964	14.44235

Variance decomposition of LNLD

Period	S.E.	LNVA	LNLD	LNMI	LNMC
1	5.683344	50.12959	49.87041	0.000000	0.000000
2	6.487454	49.74870	48.23452	0.805094	1.211681
3	7.057653	44.21571	52.26334	1.012809	2.508140
4	7.310881	42.54034	53.48157	0.987135	2.990947
5	7.641131	40.35210	55.60062	1.218563	2.828719
6	7.856424	38.88267	57.04913	1.378198	2.690002
7	8.055649	37.82595	58.00829	1.429733	2.736025
8	8.265814	36.67834	59.09587	1.606437	2.619352
9	8.466343	35.63653	60.13145	1.718341	2.513685
10	8.692719	34.99172	60.79910	1.812335	2.396845
11	8.915390	34.29000	61.59221	1.829183	2.288610
12	9.129841	33.65552	62.33095	1.829251	2.184286
13	9.335607	33.10291	62.96558	1.839704	2.091809
14	9.544577	32.52548	63.60547	1.867695	2.001362
15	9.741849	32.03163	64.16366	1.882739	1.921971
16	9.938594	31.59312	64.66012	1.898220	1.848536
17	10.12712	31.14396	65.16132	1.913006	1.781717
18	10.31211	30.73990	65.60897	1.931407	1.719723
19	10.49487	30.37122	66.01581	1.951002	1.661964
20	10.67538	30.01948	66.40605	1.966962	1.607511
21	10.85168	29.70049	66.76280	1.979141	1.557567
22	11.02607	29.39800	67.10002	1.991823	1.510157
23	11.19728	29.10881	67.42167	2.004061	1.465455
24	11.36626	28.84310	67.71793	2.015527	1.423451
25	11.53295	28.59153	67.99863	2.026021	1.383819

26	11.69700	28.35190	68.26617	2.035499	1.346430
27	11.85865	28.12689	68.51719	2.044765	1.311152
28	12.01831	27.91246	68.75597	2.053956	1.277616
29	12.17578	27.70919	68.98247	2.062501	1.245842
30	12.33129	27.51723	69.19655	2.070510	1.215709
31	12.48485	27.33372	69.40112	2.078140	1.187022
32	12.63649	27.15892	69.59594	2.085424	1.159709
33	12.78638	26.99274	69.78115	2.092441	1.133667
34	12.93455	26.83382	69.95827	2.099110	1.108797
35	13.08102	26.68213	70.12740	2.105415	1.085051

Variance decomposition of LNMI

Period	S.E.	LNVA	LNLD	LNMI	LNMC
1	0.172981	15.93716	6.362245	77.70059	0.000000
2	0.498676	24.76096	49.34432	10.39489	15.49983
3	0.543241	30.18363	42.81300	9.706694	17.29668
4	0.583259	26.22337	47.52025	9.286203	16.97017
5	0.608157	25.60192	46.85305	11.24282	16.30220
6	0.658070	25.47041	44.87909	11.31150	18.33900
7	0.691916	24.62733	45.97418	11.75959	17.63890
8	0.719990	23.70632	45.00568	11.42907	19.85892
9	0.753363	23.50476	44.78038	11.99857	19.71630
10	0.778986	22.66895	45.09559	12.31043	19.92502
11	0.808696	22.68709	44.73362	12.46354	20.11574
12	0.836428	22.41354	44.52720	12.47522	20.58404
13	0.861755	22.05394	44.74607	12.57489	20.62510
14	0.886041	21.83096	44.54616	12.66580	20.95708
15	0.911550	21.65645	44.57471	12.81329	20.95555
16	0.934710	21.42876	44.57865	12.87805	21.11454
17	0.958407	21.31586	44.48453	12.92073	21.27888
18	0.980902	21.13326	44.48346	12.98890	21.39438
19	1.002809	20.97374	44.48882	13.05972	21.47773
20	1.024571	20.86234	44.42989	13.11721	21.59055
21	1.045934	20.74118	44.42840	13.16772	21.66270
22	1.066567	20.62556	44.40882	13.20755	21.75806
23	1.087035	20.52976	44.38240	13.25019	21.83765
24	1.107006	20.42831	44.37741	13.29464	21.89965
25	1.126654	20.34160	44.36115	13.33143	21.96583
26	1.146030	20.26342	44.34227	13.36453	22.02977
27	1.165014	20.18341	44.33512	13.39652	22.08496
28	1.183683	20.11112	44.32161	13.42675	22.14052
29	1.202113	20.04440	44.30967	13.45606	22.18987

30	1.220232	19.97957	44.30129	13.48314	22.23600
31	1.238097	19.92023	44.28995	13.50771	22.28210
32	1.255712	19.86356	44.28061	13.53155	22.32427
33	1.273067	19.80907	44.27290	13.55436	22.36367
34	1.290200	19.75862	44.26382	13.57578	22.40178
35	1.307112	19.71048	44.25605	13.59609	22.43738

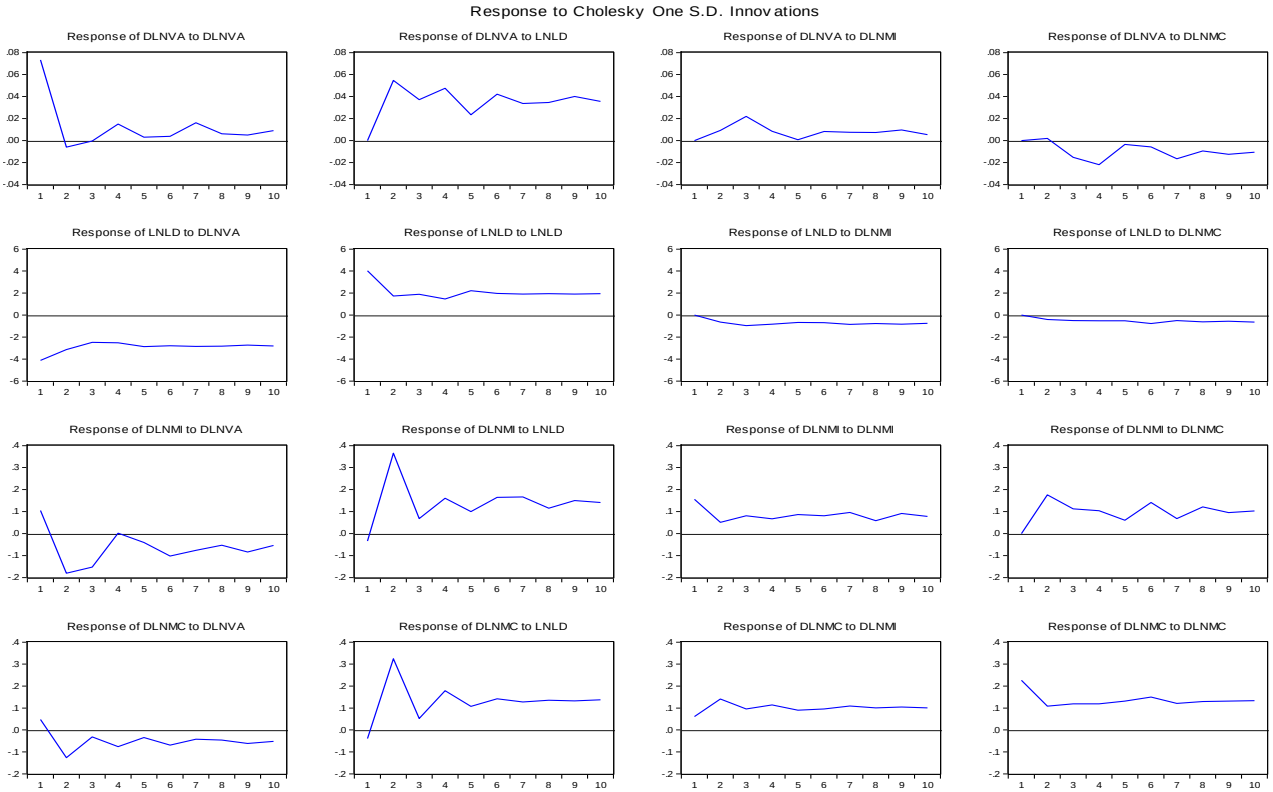
Variance decomposition of LNMC

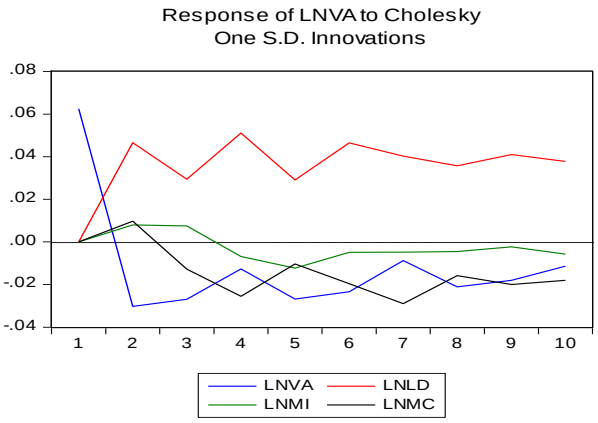
Period	S.E.	LNVA	LNLD	LNMI	LNMC
1	0.246430	3.053117	2.618611	6.785013	87.54326
2	0.470494	14.83029	44.53888	10.66990	29.96093
3	0.500053	14.55197	40.12509	12.54320	32.77974
4	0.564100	15.62276	40.92188	13.10739	30.34797
5	0.598263	15.29345	39.64207	13.43760	31.62688
6	0.646034	15.81684	38.73835	13.32372	32.12109
7	0.679818	15.62379	38.48838	14.12479	31.76304
8	0.715253	15.52212	38.24886	14.41982	31.80921
9	0.750631	15.85201	37.59682	14.66675	31.88443
10	0.783434	15.75891	37.45844	14.76904	32.01361
11	0.813607	15.73994	37.21302	14.95289	32.09414
12	0.843958	15.75656	36.92647	15.11891	32.19805
13	0.872991	15.75873	36.82839	15.29994	32.11293
14	0.900993	15.76967	36.62099	15.37732	32.23202
15	0.928581	15.80774	36.46518	15.46668	32.26039
16	0.954701	15.77888	36.36711	15.55921	32.29481
17	0.980432	15.79401	36.24543	15.64676	32.31380
18	1.005619	15.80586	36.13583	15.72019	32.33811
19	1.030069	15.80801	36.05707	15.78318	32.35174
20	1.053936	15.81348	35.96134	15.83669	32.38849
21	1.077337	15.81782	35.88820	15.89398	32.40001
22	1.100142	15.81704	35.82126	15.94624	32.41546
23	1.122589	15.82459	35.75189	15.99123	32.43229
24	1.144567	15.82760	35.69253	16.03285	32.44703
25	1.166096	15.82898	35.63844	16.07175	32.46084
26	1.187259	15.83234	35.58461	16.10845	32.47461
27	1.208055	15.83470	35.53776	16.14324	32.48431
28	1.228486	15.83688	35.49266	16.17474	32.49571
29	1.248600	15.83976	35.44965	16.20403	32.50656
30	1.268381	15.84135	35.41077	16.23205	32.51583
31	1.287857	15.84315	35.37357	16.25837	32.52490
32	1.307053	15.84528	35.33824	16.28311	32.53338
33	1.325966	15.84690	35.30553	16.30639	32.54119

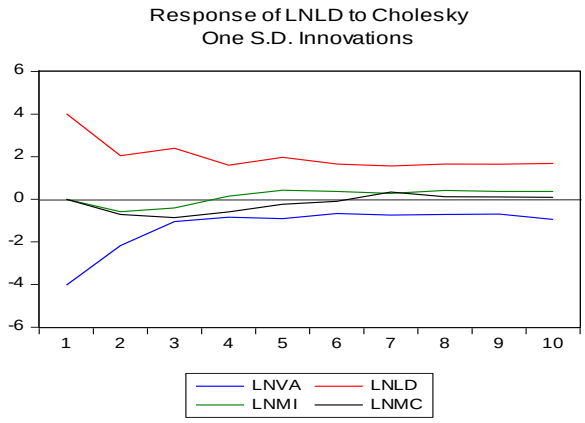
34	1.344612	15.84853	35.27417	16.32828	32.54902
35	1.363005	15.85013	35.24457	16.34912	32.55618

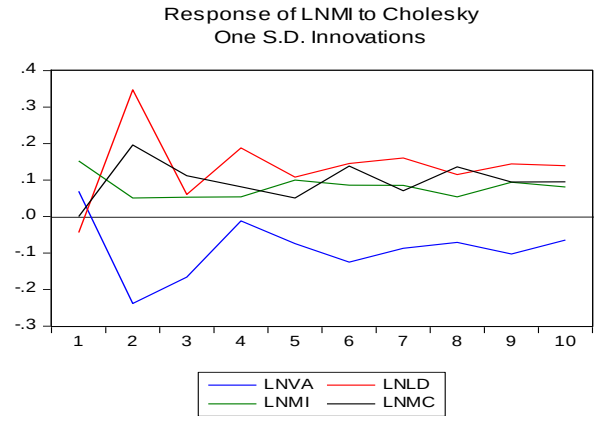
Cholesky ordering: LNVA LNLD LNMI LNMC

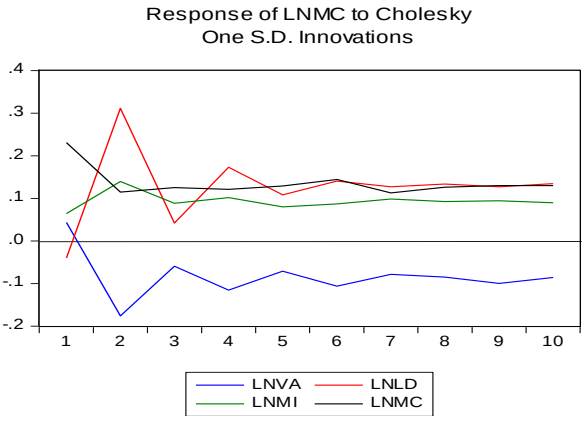
APPENDIX 7




Response of LNVA to Cholesky
One S.D. Innovations
.08
.06
.04
.02
.00
-.02
-.04
1 2 3 4 5 6 7 8 9 10
LNVA
LNLD
LNMI
LNMC


Response of LNLD to Cholesky
One S.D. Innovations
6
4
2
0
-2
-4
-6
1 2 3 4 5 6 7 8 9 10
LNVA
LNLD
LNMI
LNMC


Response of LNMI to Cholesky
One S.D. Innovations
.4
.3
.2
.1
.0
-.1
-.2
-.3
1 2 3 4 5 6 7 8 9 10
LNVA
LNLD
LNMI
LNMC


Response of LNMC to Cholesky
One S.D. Innovations
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.3
.2
.1
.0
-.1
-.2
1 2 3 4 5 6 7 8 9 10
LNVA
LNLD
LNMI
LNMC