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THE APPLICABILITY OF THE QUANTITY THEORY OF MONEY IN A MULTICURRENCY ECONOMY: LESSONS FROM ZIMBABWE

2009-2019

by

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ABSTRACT

One of the first economic theories to ever study the effects of money on price levels is the Quantity Theory of Money (QTM). Both traditionally and empirically, the tenets of this study have been studied in mono currency economies. However, due to the ever-changing modern-day economies, countries suffering from intense economic problems like inflation have abandoned the use of their own local currencies opting to use multiple foreign currencies as legal tender. This study explores the applicability of the Quantity Theory of Money in a multicurrency economy, a yawning gap in scholarship. More so, no studies have sought to simultaneously look at the different approaches to the QTM in one study to establish their applicability in a multicurrency economy. It is thus imperative to explore if the foundations of this theory still hold sway in today's dynamic economies which were not in existence when the theory was introduced. The study used the case study of Zimbabwe which from early 2009 up until 2019 used a multicurrency system. The study analysed the period 2009:1 up until 2019:2. It deployed two different approaches to the Quantity Theory of Money (the transactions approach to the QTM and the Cash Balance Approach to the QTM as the base theories of analysis since the main goal is to analyse both the money supply and the money demand dynamics' effect on the price levels. Effects of the exchange rate on the price levels and issues to do with imported inflation also formed part of the study's objectives and these were based on the Purchasing Power Parity, the Quantity Theory of Exchange Rate, the Cost Push Inflation and the Rational Expectations theories respectively. To study the research objectives, the study made use of the Structural Vector Autoregressive model and the Autoregressive Distributive Lag modelling techniques as regression models. The variables studied included, the inflation rate, money supply, money demand, exchange rates, international oil prices, international food prices as well as the interest rates. Secondary data used in this study was obtained from the Zimbabwe Statistical Agency, the Reserve Bank of Zimbabwe, IMF, World Economic Outlook, the South African Reserve Bank and the Federal Reserve Bank of the United States of America.

The results of this study revealed that the applicability of the Quantity Theory of Money in a multicurrency economy could not be ascertained. Though both the money supply and the money demand variables had effect on the inflation rates, the proportionality of the effects of the variables to the inflation rates could not be established. Therefore, in response to one of the motives of this study i.e., to study the QTM applicability from both the money supply and the money demand side, both prove to be inapplicable in the Zimbabwean multicurrency use

context but however, both money supply and money demand shocks exhibit the same effect on the rate of inflation. However, of particular interest is the comparison between the M1 variable and the demand for credit variable which exhibit the closest likeness as compared to the other monetary aggregates variable. Thus, from this study, in the Zimbabwean economy during the multicurrency era use, money demand shocks and money supply shocks overally exhibited similar effects to the inflation rate as represented by the CPI variable.

Additionally, the study answered the research question of whether foreign exchange rates had an effect on the price of goods and services in Zimbabwe during the period under study. It was concluded that there was a correlation between the study variables, implying that inflation rates in Zimbabwe were indeed influenced by the foreign exchange rates during the period under study. Ultimately, in the study that examined the presence of imported inflation in the country during the period of the study, it was proven that typically there existed a positive long run relationship among foreign prices, foreign inflation rates and the domestic inflation rates.

DECLARATION

I declare that *The Applicability of The Quantity Theory of Money in A Multicurrency Economy: Lessons from Zimbabwe - 2009-2019* is my own work, that it has not been submitted for any degree or examination in any other university and that all sources used or quoted have been indicated and acknowledged as complete reference.

Tariro Chivige 2022

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DEDICATION

I dedicate this study to my son Mason Kutenda. This one is for you MK.

To Farirai Anashe and Kudzwaishe Makomborero, the sky is indeed the limit for you mwanasikana.

LIST OF ABBREVIATIONS

ADF	Augmented Dickey Fuller
ARDL	Autoregressive Distributed Lag
CBA	Cash Balance Approach
CEC	Conditional Error Correction
CPI	Consumer Price Index
CYN	Chinese Yuan
DGP	Data Generation Processes
EC	Error Correction
ECM	Error Correction Model
GDP	Gross Domestic Product
GoZ	Government of Zimbabwe
IMF	International Monetary Fund
IRF	Impulse Response Function
MZN	Mozambique Metical
OLS	Ordinary Least Squares
PP	Phillip Peron
PPP	Purchasing Power Parity
QTM	Quantity Theory of Money
RBZ	Reserve Bank of Zimbabwe
SIC	Schwartz Information Criterion
Stats SA	Statistics South Africa
SVAR	Structural Vector Autoregression
UAE	United Arab Emirates
USD	United States Dollar
VAR	Vector Auto Regression
VECM	Vector Error Correction Model
ZAR	South African Rand
ZIMSTATS	Zimbabwe Statistical Office

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CHAPTER ONE: INTRODUCTION

1.1 Introduction and background

The principal role of the reserve bank in any economy is to secure the stability of prices and one major way this can be achieved is by manipulating the quantity of money in circulation in a nation's economy (Handa, 2009). Uncontrolled prices can have catastrophic consequences for most economies, especially in developing countries (Pettinger, 2021). Countries with extremely high rates of inflation tend to have particularly low standards of living as the general populace will ultimately be unable to afford even basic necessities of life (Pettinger, 2021). Such countries almost always end up having severe political problems because the population becomes irritated and restless owing to the incessant cost of living. Zimbabwe, Venezuela, South Sudan and Hungary are examples of countries that have experienced very high rates of inflation which also contributed to their unstable political climates (Boesler, 2014). Most Governments thus rely on their Reserve Banks or Central Banks to manage the supply or quantity of the currency in circulation in order to ensure that inflation rates stay within a healthy and manageable range (Heakal, 2021).

The origin of the theory of money reaches back to the mid -16th century but it however formed the central core of classical monetary analysis in the early nineteenth century when economists studied price levels and found that the quantity of money in an economy's circulation has a significant impact on price levels and thus it is important to consistently monitor how much money is in circulation in an economy (Humphrey, 1974). The Quantity Theory of Money (QTM) is among the theories that are regarded as building blocks in the construction of economic theory. Such theories amongst others include, the Keynesian economics, supply side economics, classical economics as well as monetarism economics (Beattie, 2021). The foundation of the theory is rest on an assumption that long run movements in price levels are determined primarily by long run movements in the excess of money over real output (Fisher, 1911). Yet, some economic growth theories propose that in the long run there is a negative relationship between inflation and the overall performance of any economy. Such theories include the works of Fama and Schwert (1977) . Numerous studies on the subject reveal that the economic instability brought about by high rates of inflation in an economy distort decisions of private agents with regard to investment decisions, production and saving which ultimately stifle economic growth (Cheruvu, 2021). With regards to the adverse effects of inflation on the performance of an economy, there is a general agreement within the economics fraternity that the prime objective of monetary policy ought to be that of price stability (King,

1999) and that central banks should be committed to maintaining low inflation (Blejer *et a*l., 2000). This means that central banks have both great powers and great responsibilities within their economies.

While many empirical studies across the globe have examined the relationship between local inflation rates and the money supply within an economy, few researchers have investigated this relationship in a multicurrency economy, especially one without its own currency. Sunge and Makamba's (2020) study of inflation and price levels is one of only a few.

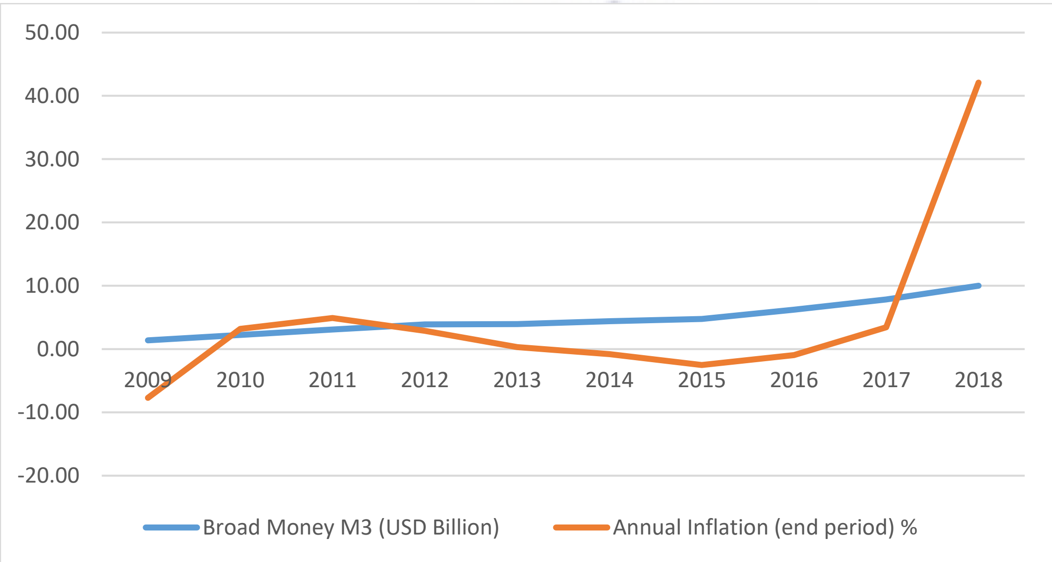
A multicurrency economy is one in which a country adopts the use of a number of currencies as legal tender within its borders. This can be done alongside a country's own currency (de facto dollarisation) or the legal tender can just be a basket of foreign currencies without a local currency (de jure dollarisation), (Schuler, 2000). In the latter scenario, it becomes highly complicated for the central bank to practice autonomy over its monetary policy, and it therefore cannot explicitly control the quantity of the currencies in circulation. This study therefore wishes to test whether the QTM can be applied in a multicurrency economy, both with and without its own currency (though pegged at par with the USD) in the currency basket.

For almost two decades, Zimbabwe experienced a lengthened economic catastrophe which culminated in a hyperinflation episode between 2007 and 2008, (IMF, 2009). According to the IMF the country recorded an inflation rate of 79.6 billion percent month-on-month and 89.7 sextillion percent year-on-year in mid-November 2008 (IMF, 2009), the highest ever recorded in the country. During this period of hyperinflation, Zimbabwe's economy experienced a sharp fall in output (IMF, 2009). There was a contraction of the economy by as much as 40% between 2000 and 2007 and the inflation rate jumped to over 66,000%. The country experienced constant shortages of fuel, food, medicine, and hard currency and the GDP per capita dropped by 40%, agricultural output fell by 51% and industrial production dropped by 47% (IMF, 2009). These severe economic blows led to the abandonment of the local currency (the Zimbabwean Dollar) as a medium of exchange in April 2009 (Kavila and Roux, 2017).

From June 2008 onwards, informal dollarisation of the economy had started manifesting as economic agents responded to the failure of the local currency to fulfil the basic functions of money. In 2009, the Government of Zimbabwe formally adopted a multicurrency system (RBZ, 2010). With the adoption of the multicurrency system, there was an abrupt end to hyperinflation (IMF, 2009; RBZ, 2010) and the US Dollar, the South African Rand as well as the Botswana Pula became the major currencies for trading purposes in the country.

The peaceful political environment that prevailed after 2009 brought about by the Government of National Unity in Zimbabwe together with the enactment of sound economic reforms resulted in a remarkable enhancement of economic activity (RBZ, 2010). Noticeable benefits were realised in respect of inflation, with annual inflation being recorded at 7.7% by the end of December 2009 (RBZ, 2010). The annual inflation rate took an uphill trend, to close the years 2010, 2011 and 2012 at 3.2%, 4.9% and 2.9%, respectively, before declining to 0.3% by the end of 2013. It continued to fall until 2015 when it reached -2.5%. It then started to increase again in 2016 where it recorded -0.93%. From there, it started to rise, closing 2018 at 42.10% (RBZ, 2019). Figure 1.1 below displays the trend of inflation and the money supply during the period of study. This relationship in some periods does not clearly corroborate to the tenets of the QTM, thus, it becomes imperative to study the overall effect that money supply had on the inflation rates.

Figure 1.1: Broad Money /Inflation rate Analysis



Source: Author's Computation

Despite the relative evidence of stability that was brought about by the multicurrency system, there were still mounting worries over the adverse effects of the performance of the major currencies that were in use in Zimbabwe, especially the US Dollar/South African Rand exchange rates and the levels of inflation that were recorded in the two respective countries. Amongst other things, this study thus, seeks to establish whether, due to the dependence of Zimbabwe on other currencies, (which it had no control over), the changes in the money supply of the external currencies among other economic determinants (money demand changes, foreign exchange rate changes as well as effects of imported goods) had an effect on the price levels in Zimbabwe. If not, the study seeks to interrogate and understand the causes of the changes in the price levels of goods and services in Zimbabwe.

1.2 Problem statement

Many researchers have attributed the excessive printing of the Zimbabwean Dollar as the main determinant of the hyperinflation that the country experienced between 2002 and 2008 (Makochekanwa 2007, Hanke 2008, Pindiriri 2012). In most developing countries, the same sentiments have been shared and also inconsistences in government policies amongst other things, have been identified as determinants (Pindiriri, 2012). Zimbabwe has had its fair share of high inflation rates which ravaged the economy between 2002 and 2008 where the country experienced unbearable hyperinflation levels. To date, most research on inflation in Zimbabwe mainly focuses on the hyperinflation era where the country was using its own currency, the Zimbabwean dollar. Increases in money supply have been viewed as the biggest culprit causing inflation during this era (Pindiriri and Nhavira, 2011).

Following the hyperinflation era, Zimbabwe experienced an incredible shift in its macroeconomic environment as a result of the implementation of the multicurrency system in 2009 (RBZ 2012). During the period under study, the Zimbabwean economy showed some signs of recovery. According to the reports published by the Reserve Bank of Zimbabwe in 2019, the country's real GDP growth rates began to increase from 5.4% in 2009 to as high as 16.7% in 2011. However, the growth rate began to moderate to an estimated 0.8% in 2016. Such positive growth was mainly attributed to improved Government policies, coupled with stability subsequent to the adoption of a multicurrency system. However, despite these positive growths, some pockets of inflationary pressure were still being experienced in the economy, giving rise to questions as to what was fuelling these increases (Kavilla and LeRoux, 2017). In 2009, the annual inflation rate stood at -7.7% and increased to 3.2% in 2010 before rising again to up to 4.9% by 2011-year end. The country then began to experience some form of disinflation and subsequently deflation up until 2015 where the annual inflation rate stood at -2.5%. It however began to increase in 2016 where it recorded -0.93%, and closed 2018 at 42.10% (RBZ 2019).

This is a puzzling phenomenon to most researchers and policy makers because while the country was experiencing a positive GDP growth, it was concurrently experiencing mixed movements in the rate of inflation as well as the introduction of a pseudo currency. Contemporaneously, the quantity of broad money in the economy continued to increase regardless of the fluctuations in the inflation rates. The quantity of broad money in circulation in Zimbabwe in 2009 was US$ 1,381,247,220 and by year end of 2016 the figure stood at US$ 6, 200, 282, 300 giving a 178.82 percentage increase. By the end of 2018, M3 stood at USD 10, 009, 905, 300 (RBZ 2019).

Another interesting phenomenon, during the period of study, was that the period 2014 to 2019 coincided with the introduction of a surrogate currency the bond notes and coins into the Zimbabwean monetary system. Bond coins were introduced first in December 2014 with a value of 1:1 with the USD but without a solid seigniorage contract with United States of America (RBZ, 2014). Later in 2016, Zimbabwe started issuing bond notes in addition to the coins, both with the same value as the USD (RBZ, 2016). This form of surrogate currency might have destabilised the multicurrency system and compounded price instability since the bond currency was subject to much arbitrage, especially on the parallel market (McGrath, 2016). The pegging of the Bond currency at par with the US Dollar was however scrapped in February 2019, when the monetary authorities then introduced its official currency into the currency basket (RTGS Dollar) which had a fixed exchange rate against the US Dollar (RBZ, 2019).

In mid-2019 through Statutory 142 of 2019 , the Zimbabwean Government abolished the complete use of the multicurrency system where the use of all foreign currencies to settle domestic transactions was removed and the basket of multi-currencies, was only to be used to settle international payments or a few exempt services (Government of Zimbabwe, 2019). Under the new framework, all domestic transactions were now to be settled in Zimbabwe dollars, the sole legal tender in Zimbabwe that is represented by bond notes and coins and electronic currency, that is, RTGS dollar (Ncube, 2019). However, in 2020 during the wake of the Corona virus pandemic, the country found itself back to the use of the foreign currency when the monetary authorities through Statutory Instrument 85 of 2020 authorised the use of the US Dollar to purchase goods and services that were charged in the local currency. According to the Government, the move was made to combat the nation against the Covid 19 anticipated negative effects (Government of Zimbabwe, 2020).

Many saw this as a bid by the Government to re-dollarize the economy via the backdoor (Mushoriwa and Chinyama, 2020). However, regardless of the reintroduction of the formal use of the US Dollar even with some employees in the country (even civil servants through a COVID 19 allowance) now getting a part if not their full salaries in US Dollar, the economy still has not recovered from the inflation induced effects that started in the country around 2016 when the country was still under the multicurrency use. Inflation rates are still creeping up almost every month and citizens fear that the country may go back to the 2006-2008 situation where high inflation rates ravaged the country. The demand for the US dollar keeps soaring in the country and spikes in the prices of basic commodities show how the Zimbabwean dollar (ZW$) is failing to hold against its benchmark, the US dollar (Matiashe, 2022).

The peculiar situation the Zimbabwean economy found itself in is of great economic interest as there has been only quite a few countries that have adopted the use of a complete multiple foreign currencies as legal tender and then introduce a surrogate currency into the currency basket as well. The adoption of the surrogate currency into the currency basket later on also makes the study of great importance to the economics literature. Economics principles however advocate for the economic fundamentals to be in the right place before such a move could be taken. Given the previous bad experiences that a country like Zimbabwe experienced just before the adoption of the multicurrency economy, it is of great benefit to also study the inflation dynamics even during the period that the country had attained some sort of stability. This study therefore gives room to explore the dynamics of inflation and the applicability of the traditional theories of economics in the modern-day economies that continue to evolve, Zimbabwe being a case study. Since the country is now a dual currency use economy, it is hoped that this study will also give insights on what might have gone wrong during the first multicurrency use period so that lessons may be learnt to enable the crafting and implementation of better policies so as to possibly avoid a resurgence of the hyperinflation era experienced before.

1.3 Research objectives

The main objective of the research is to investigate if the Quantity Theory of Money (QTM) is applicable in a multicurrency economy. However, the specific objectives are outlined as follows:

- To investigate the effects of money supply shocks on the price level in a multicurrency economy.
- To examine the effects of money demand shocks on the price level in a multicurrency economy.
- To evaluate the effects of the changes in the foreign exchange rate on the price level in a multicurrency economy.

- To assess whether Zimbabwe experienced imported inflation during the multicurrency use era.

1.4 Hypothesis

I. H_0: Money supply shocks do not have any effect on the price levels in an economy.

H_1: Money supply shocks have an effect on the price levels in an economy.

II. H_0: Money demand shocks do not have any effect on the price levels.

H_1: Money demand shocks have an effect on the price levels.

III. H_0: Changes in the foreign exchange rates do not have an effect on the price levels.

H_1: Changes in the foreign exchange rates have an effect on the price levels.

IV. H_0: The Zimbabwean economy did not experience imported inflation during the period under study.

H_1: The Zimbabwean economy experienced imported inflation during the period under study

1.5 Research questions

The following are the most critical questions that this study seeks to answer:

i. Do money supply shocks have an effect on the prices in a multicurrency economy?
ii. Do money demand shocks influence the prices in a multicurrency economy?
iii. Do changes in the foreign exchange rates have any effect on the price levels in a multicurrency economy?
iv. Did Zimbabwe experience imported inflation during the time it was using a multicurrency system?

1.6 Contribution of the study

The relationship between inflation and money has been among the most pertinent research subjects in the field of macroeconomics. The Quantity Theory of Money is the model, which seeks to justify the relationship and link between the price levels of goods and services as well as the money in an economy (Fisher, 1911). Despite numerous empirical works that have sought to study the causality between money and prices in developing countries, only few researches have tried to analyse this situation in a multicurrency system. Studies that have looked at the applicability of the QTM have mostly either looked at a country that was using its own currency (Amin 2011) and or one which had dollarized (i.e., when a country begins to recognise one foreign currency as a medium of exchange or legal tender alongside, or in place of its own currency (Bailey 2007)).

This study explores if the interpretations of the QTM hold sway in an economy that does not have control over money supply in its country, thus contributing to the literature and body of knowledge on how the Quantity Theory of Money works in a multicurrency economy. The fact that the economy did not have only one or two but a variety of currencies in use also imply that there were different sources of the amount of money in circulation in the country. This research thus, seeks to study and establish if the different currencies and their different sources had a bearing on the increase of the price levels in the Zimbabwean economy. Due to the different monetary policies that affect the multicurrency nation, it is imperative to carry out research that explores how these policies affected the general price levels of goods and services. This will in turn help to ascertain whether the Quantity Theory of Money holds sway in a multicurrency economy. This will further help in modifying and adding value to the strengths of the theory if it can still hold sway in such a different setting.

This study contributes to the discourse on the Quantity Theory of Money approach. This is exhibited where the theory is tested in a different setting where monetary policies of other countries have a bearing on how the monetary environment of the other country depending on its currency is affected. Basically, this study seeks to bring to the fore a new dimension to the Quantity Theory of Money as it tests its strengths and applicability in different economic settings. It also looks at the theory from a different perspective of both the money supply and money demand side, something which previous studies on Zimbabwean inflation has not yet captured (Sunge and Makamba (2020), Kavila and Le Roux (2016). Also, a consensus as to which one of the Quantity Theory of Money proponents has the most applicable opinion on the issue of money supply's and money demand's effects on the price level is still a debate within the economic fraternity. Many studies that have tried to analyse the applicability of the QTM have mainly looked at Fisher's version of the QTM. Other sub theories of the QTM such as the Cash Balance Approach to the QTM and the Modern Quantity Theory of Money have been mainly used as theories of money demand and have been mainly linked to the Quantity Theory of Money while using almost the same variables as those used in the transactions approach to the QTM. This study therefore explores the other arm of the QTM clearly distinguishing it from the transactions approach of the QTM in a single go.

It is also the aim of this study to contribute to the body of knowledge about the general economic environment that exist in a multicurrency economy. Effects of the changes in the foreign exchange rates of the currencies in the currency basket are also analysed in the study, going a step further as to analysing the effects of the changes in the exchange rates of the major currencies that were in use in the economy in one study. The study also hopes to bring to light how imported inflation penetrates into the local economy by analysing how the changes in the international prices of imported goods affect the local prices in a multicurrency economy. Such literature is still a bit scanty and this study hopes to add insights into the subject matters.

Lastly, the use of the Structural Vector Autoregressive modelling (SVAR) technique is also still very limited in studying both the money supply and the money demand's role in causing inflation. Hence, this study attempts to address this yawning gap by employing the SVAR technique in exploring the relationship between money supply and inflation as well as between money demand and inflation. The effects of the shocks of money supply and money demand and all the other variables of interest are studied to establish if they have any effect on the inflation rate. Analysis as to whether the effects of shocks as compared to direct changes affect the inflation rate the same way will also be brought to light.

Although there might be some studies conducted in analysing the inflation dynamics in a multicurrency Zimbabwean economy which this study may resemble, this study aims at contributing to the already limited existing literature by focusing on specific variables rather than just lumping like variables together. Also, different methodologies are applied as compared to the widely used ones. The period of study also explicitly covers the entire multicurrency era when the country was solely using foreign currencies as legal tender (though a surrogate currency was introduced during the period of study, it was not an official currency as it was pegged at par with the US Dollar).

1.7 Structure of the study

This thesis is structured into Six Chapters. The First Chapter consists of the introduction and the background of study. The foundation to this study is laid down in this Chapter. The subsequent Chapters, namely, Two, Three, Four and Five are stand-alone essays. Chapter Two covers money supply and inflation. It is based on the first objective of the study i.e., to investigate the effects of money supply shocks on the price levels in a multicurrency economy. Chapter Three zooms into money demand and inflation. Chapter Four is on the exchange rate and inflation. The penultimate, Chapter Five explores imported inflation. Chapters Three, Four and Five are based on objectives two, three and four respectively. Ultimately, Chapter Six discusses the results of the empirical studies carried out from Chapters Two up to Five. The Chapter also concludes the study and proffers some recommendations emerging from this study.

CHAPTER TWO: MONEY SUPPLY AND INFLATION

2.1 Background and problem statement

Numerous theories have been propounded with an endeavor to explain the concept of inflation and the reasons behind it. In most developing countries and even in developed ones, the creeping up of prices has been attributed mainly to increased money supply. Poor economic governance and the interference of governments in the affairs and running of reserve banks force the central bank to lose its independence (Kanyenze, Chitambara and Tyson, 2017. This has led most governments in developing countries to promote the printing of money in order to fund government expenses and to gain political support from the masses (Pindiriri, 2012). The Quantity Theory of Money advocates for the view that increasing the quantity of money in circulation has got an effect of increasing the price levels hence continuous printing of money leads to inflation (Sikander, 2021). Such was the case for the Zimbabwean economy. Most studies on inflation in Zimbabwe (Sunde 1997, Pindiriri and Nhavira 2011, Makochekwa 2007) have attributed excessive printing of money by the government as the major force behind inflation, especially in the pre-dollarisation era. Several economic policies that the government crafted, ended up having a severe knock and blow on the economy and they resorted to the printing of more money to try and manage the situation (Cheruvu, 2021). They did this to enable the funding of their politically inspired policies. The economic structures that were present in the country during this period enabled the breeding of inflation which to a certain extent gave rise to structural inflation. This situation was enabled by the fact that the central bank could just print money arbitrarily as it controlled its country's economic affairs (Makochekwa, 2007). This excessive printing of money led the Zimbabwean economy to experience what Hanke and Krus (2012) described as the second highest hyperinflation ever (Hanke and Krus, 2012). Historically, this has only been surpassed by the hyperinflation that was experienced in Hungary in 1946 because of the growth in the central bank's reserve money (Pindiriri, 2012).

Between 1999 and 2008, the Zimbabwean economy suffered one of the worst macroeconomic blows in the world. According to the 2009 Zimbabwe National Budget, at the epicenter of the socio-economic challenges that Zimbabwe faced were unprecedented levels of hyperinflation and declining productive capacity and hence massive de-industrialization, food shortages, loss in value of the local currency, corruption, deteriorating public service delivery particularly education, health, sanitation as well as public utilities and infrastructure (Government of Zimbabwe, 2009). The impact of all the above had sustained negative effects on the country's

Gross Domestic Product (GDP), which resulted in the cumulative fall of GDP by over 40% between the year 2000 and 2008 and this gave rise to unprecedented increase in poverty levels and general despondency (Government of Zimbabwe, 2009). The country recorded a negative GDP growth and a hyperinflation that reached over 200 million percent. Money supply growth reached over 100 000 percent by year 2008 (ZIMSTAT, 2008). According to ZIMSTAT (2008), the consumer price index inflation rate was 12.5 million and its growth rate was 6 723 percent in 2007. Broad money (M3) supply grew by over 64 000 percent in 2007 and 2008. From their analysis, it comes to light that then, there was a direct positive relationship between money supply and the inflation rate.

Due to this hyperinflation, by mid-2008, informal dollarisation had creeped up in the economy as the then local currency continuously lost its value. Economic agents had started to conduct businesses in foreign currency illegally and in September 2008, the Reserve Bank of Zimbabwe retorted to these activities by partly formalizing dollarization through licensing only a select wholesalers and retailers to sell goods in foreign currency (Kavila and Le Roux, 2017).

In February 2009, the Zimbabwean Government formed a Government of National Unity (GNU) and the government formally adopted a multicurrency system in a bid to contain the hyperinflation that had ravaged the country (RBZ, 2009). The country went further to abandon the use of its own currency, the Zimbabwean Dollar. It then officially adopted the sole use of foreign currencies with the United States Dollar and the South African Rand being some of the first currencies to be officially adopted. The move to a multicurrency system led to a sudden positive change in the performance of the Zimbabwean economy. The year-on-year inflation stood at -7.7 percent by the end of December 2009. However, the year-on-year inflation started to rise into the positive territory and closed 2010, 2011 and 2012 at 3.2 percent, 4. 9 percent and declined to 2.9 percent respectively (RBZ 2019).

The inflation and broad money (M3) supply rate which had once been above 1 million percent and 100 000 percent in 2018 respectively, significantly dropped to growth rates below 2 percent and 30 percent respectively immediately after the adoption of the multicurrency system. The money supply growth rate however continued to increase steadily after the adoption of the new system (RBZ 2020).

During the post dollarisation era, adverse inflation pressures remained subdued (Kanyenze, et al., 2017). However, there were some pockets of inflation that started to be noticed in the economy from 2015 up until the abandonment of the multicurrency system in 2019. It is important to note that during this period, from 2009 up until 2019, money supply was always on the increase.

This fluctuation of the inflation rates while money supply continued to be on the increase can be likened to the case explained by the Keynesian economists who argue that when there is spare capacity in the economy, increases in the money supply tend to not have any effect on the inflation rates (Keynes, 1936) . As advocated for by Keynes, the issue could have been that the increase in the money supply could have helped to get the unemployed resources to get used in the economy thereby aiding in the increase in the nation's output as evidenced by the growth in the GDP. This not so clear correlation between money supply and inflation during the multicurrency era raises a lot of questions about the causes of the movements in the inflation rate given the movement in the money supply growth rate in relation to both the GDP rates and the inflation rates. The interrogation of the question as to whether the relationship that existed between money supply and the inflation rates during the pre-dollarization era is still the same relationship that existed during the dollarization era needs to be analyzed. The core intention of this Chapter is to therefore investigate the effects of money supply shocks (changes in money supply) on the price level in a multicurrency economy. For the purpose of this study M1, M2 and M3 will all be used as proxies of money supply in order to investigate the effects of money supply shocks on inflation.

Though this essay closely resembles Sunge and Makamba's (2020) study, it forms the point of departure for this whole study as it forms be basis of comparison for all the preceding chapters in the study. In studying the Quantity Theory of Money, there is need to analyse the relationship between money supply and the inflation rates hence the use of all the monetary aggregates in order to capture the individual effects of the changes in each of them on the domestic price level as done by Sunge and Makamba (2020).

Whereas the study by Sunge and Makamba (2020) made use of the Auto Regressive Distributed Lag model in analysing the relationship between money supply and the inflation rates, this study saw a gap in the literature in the use of the Structural Vector Autoregressive model and sought to bridge the gap. As opposed to the ARDL modelling technique, the SVAR model is a more advanced estimation technique which works best in analysing the applicability of economic theories in different economic settings (Pfaff, 2008). SVAR models have been extensively employed to study the transmission mechanisms of macroeconomic shocks and test economic theories whereas the ARDL model directly looks at the numerical changes and their effect on the other variables. This on its own gives a different orientation as this study analyses the effects of the shocks of contemporaneous variables on the variable of interest.

The SVAR methodology enables the treatment of contemporaneous variables as explanatory variables, which is particularly important when the frequency of the data is relatively long which in this study is (i.e., monthly) (Kratzig, 2004). In addition, this model also allows for one to impose several highly specific restrictions on the parameters in the coefficient and residual covariance matrices. This allows for one to evaluate the effect of an independent shock on all the variables in the equation (Kotze, 2019). These shocks can then be used to generate impulse response and variance decomposition functions to assess the dynamic impacts on different economic variables. In addition, these functions can be used to test whether such shocks affect the economic variables as economic theory would predict so providing a check on the theory. Also, the SVAR model has the advantage over traditional large-scale macro econometric models in that the results are not hidden by a large and complicated structure but easily interpreted and available (Pfaaf, 2008).

This study also therefore introduces the Structural Vector Autoregression (SVAR) analysis methodology and to examine its applicability in the context of the Zimbabwean multicurrency use era macroeconomics. According to this researcher’s knowledge, no such study had made use of this methodology to analyse the subject matter during the study period. This gives the study an opportunity to examine also if the results shown by the ARDL model are still the same as to those shown by the SVAR.

This essay also contributes to the body of literature by using a longer time frame. This provides more observations as more information for analysis is given. The study conducted by Sunge and Makamba (2020) focuses on the period 2009 to 03/2018, this study goes a step further in analysing the economy one-year period ahead thus it provides a more thorough analysis of the multicurrency use period economics.

2.2 Literature review

This section of the Chapter examines the literature germane to money supply and to the price levels. A background of the theory is given in subsection 2.2.1. Previous empirical studies on money supply and inflation are analyzed in subsection 2.2.2. This brings to light the studies conducted for sole use local currency economies as well as dual use dollarised economies. Literature on multicurrency economies is still extremely scanty. Finally, the conclusion of the Chapter is provided in subsection 2.2.3. This gives a general summary of the available literature. It also identifies the yawning gaps in the available literature and body of knowledge.

2.2.1 Theoretical literature review

The Monetarist Theory of Inflation: The Quantity Theory of Money

The monetarist school of thought was developed in the 1970's. It is a body of work which subscribes to the notion that the amount/size of money in an economy is more important than any other factor affecting the economy. Economists usually consider monetarism as the body of work which subscribes to the notion that changes in the growth rates of the monetary aggregates in an economy play a very critical role in explaining the economic activity inclusive of the changes in the nominal and real income, as well as the price levels (Hafer, 2001). Some scholars have demonstrated the stability of the demand for money function, a result which implies that variations in money supply growth primarily determine changes in nominal income. The Monetarist theory birthed what is now known as the Quantity Theory of Money (QTM). This theory is among the oldest macroeconomic theories that explain the relationship between the quantity of money in circulation and the general level of prices of goods and services in an economy. The theory was propounded by Fisher (1911). Fisher believed in the long run neutrality and short run non-neutrality of money. The works of Fisher then inspired Friedman who modernised the QTM. His view is that inflation is always, and everywhere a monetary phenomenon, which arises from a more rapid expansion in the quantity of money than in total output (Bordo and Rockoff, 2011). Generally, the Quantity Theory of Money refers to the proposition that changes in the amount of money lead to increases in price levels in an economy, *ceteris paribus*. Basically, what the theory states is that a percentage change in the money supply results in an equivalent level of inflation or deflation. The Quantity Theory was explained by various Economists. Even though they believed in the same ultimate result of changes in money supply causing changes in the price levels, they took different routes to that final conclusion.

The Transactions approach to the Quantity Theory of Money.

The Transactions approach to the QTM was pioneered by Fisher in 1911. He reaffirmed the quantity statement that *ceteris paribus*, changes in the money supply will always bring about the exact change in the price levels. Fisher's version of the Quantity Equation was put forward in terms of the number of transactions rather than in terms of the quantity of commodities purchased, thereby the naming of his view as the Transactions approach to the Quantity Theory of Money. Fisher defines money as what is generally acceptable in exchange for goods - the legal tender. In his analysis, money included, both notes and coins and also demand deposits. In coming up with his Quantity Equation, he stated that the price level may be said to depend on the quantity of money in circulation, its velocity of circulation (which he defines as the amount of money expended for goods in a given year divided by the money in circulation) and the volume of trade (the amount of goods being bought by money).

The Equation of Exchange, introduced by Irving Fisher identifies the exact mathematical relationship between the concerned variables and his version took the following form:

$$MV = PT \text{ .... } (2.1)$$

Where:

M represents the money supply, which includes currency in circulation plus checkable deposits.

V represents the income velocity of money which has been defined as being equal to the money value of income and output divided by the money stock.

P is the general price level.

T is the overall level of transactions in an economy.

From the above theory, a rudimentary theory of inflation can then be developed:

$$P = MV/T \text{ .... } (2.2)$$

To then transform this equation into the Quantity theory, Fisher (1911) put forward propositions about economic behaviour:

> *(i) The velocities of circulation of "money" (currency) and deposits depend ... on technical conditions and bear no discoverable relation to the quantity of money in circulation. Velocity of circulation is the average rate of "turnover" and it depends on countless individual rates of turnover. These ... depend on individual habits. ... The*

average rate of turnover … will depend on the density of population, commercial customs, rapidity of transport, and other technical conditions, but not on the quantity of money and deposits nor on the price level.

(ii)(except during transition periods) the volume of trade, like the velocity of circulation of money, is independent of the quantity of money. An inflation of the currency cannot increase the product of farms and factories, nor the speed of freight trains or ships. The stream of business depends on natural resources and technical conditions, not on the quantity of money. The whole machinery of production, transportation and sale is a matter of physical capacities and technique, none of which depend on the quantity of money.

The two statements above thus, go on to reveal that, when velocity and the transaction variables are invariable, if monetary authorities increase their money supply, the level of prices will then increase in proportion to the increase in money supply. However, Fisher pointed out that such scenarios mentioned above would not occur in disequilibrium periods, thus it can only occur in equilibrium periods (money demand= money supply). This then implies that in equilibrium, the equation would become:

$$M = P \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2.3)}$$

or

$$\Delta M = \Delta P$$

However, since data on the number of transactions is usually not collected and is mostly unavailable in the public domain, national income was taken to substitute the value of T in Fisher's Equation since the data of national income came to be gathered and became commonly available. This then meant that Fisher's Quantity Equation then became:

$$MV = PY \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(2.4)}$$

From the equation above, Fisher alluded to the fact that there should be a proportional relationship between the money supply growth rates (MV) and the growth rates in the price levels (PY). From this, it can be said that money supply must be neutral, resulting from the stationary velocity of money and unaffected real output level in the long run following the permanent changes in the growth rate of money supply. In the long run, changes in the money supply leads to an increase in prices. Consequently, the growth rate of money supply will be equal to the growth rates in inflation.

In explaining the Quantity theory as explained by early economists, Humphrey (1997) tried to dissect it from the views of Fisher (1935) and Wicksell (1906). What Fisher basically did in his illustration of the Quantity theory was to bring to light five interrelated propositions which are; (1) the equiproportionality of prices and money, (2) the causality of money to prices (a unidirectional causality), (3) the short run non-neutrality and the long run neutrality of money, (4) independence of money supply and (5) the relative-price/absolute-price dichotomy attributing relative price movements to real causes and absolute price movements to monetary causes in a stationary, fully employed economy (Humphrey, 1997).

With respect to the proposition of the proportionality of money stock, Fisher realizes that this proposition can only work when trade and velocity are provisionally held fixed. However, trade and the velocity of money undergo their own secular of change independent of money stock and this gives reference to proportionality referring to the partial effects of money on prices. Fisher then explains this by stating that the velocity of money depends on exogenous factors such as population, trade activities interest rates etc. while on the other hand, trade is influenced by natural resources, technological development and other such factors.

On the neutrality of money in the long run, Fisher argues that an inflation of the currency cannot increase the product of business since the latter depends on natural resources and technical conditions, not on the quantity of money. This therefore means that the long run independence of money in the exchange equation means that money cannot permanently influence real activity though in the short run, the influence can be seen temporarily.

On the proposition of money -prices causality, Fisher disputes the bidirectional causality of money and prices and strongly states that the causal effect is from money to prices. Fisher shows this by proving that no variable in the Quantity Exchange equation is capable of permanently absorbing the impact of a change in money stock and thus prevent the effects of the changes on prices.

Regarding the independence of money supply, Fisher argues that money supply owes its determination to some other influences outside the Quantity Equation. Lastly with respect to the relative-price/absolute-price dichotomy, Fisher states that real factors do not change the absolute prices in a stationary and fully employed economy. He claims that changes in prices cannot be caused by the cost push factors emanating from trade union forces, commodity shortages and other such factors but claims that such forces only affect relative prices and not absolute prices.

Keynesian View on Money Supply and Inflation

When analysing the traditional theories of money, one cannot leave out the works of John Maynard Keynes (1936). Keynes proved not to agree with the traditional quantity theories of money which advocated for a direct proportionality between the quantity of money and prices. According to Keynes, the effect of changes in the money supply on prices were neither direct nor proportional (Keynes, 1936). Keynes stated that the classical scenario only applies to a special case (that which we do not live in) and not the general case. He however advocated for a situation where there is neither a direct nor a proportional relationship between money and prices. Keynes believed that the traditional quantity theories of money failed to incorporate the value of money into the building blocks of their theory (CMAP, 2020). He then advocated for the combining of the value theory and the monetary theory. Also, he further criticised the classical theorists view of the neutrality of money. According to him, the problems of the real world are related to the theory of shifting equilibrium whereas money enters as a link between the present and future (CMAP, 2020). Basically, what Keynes then brought to light was that changes in the quantity of the money in circulation only affect the absolute price levels but does not have an effect on the relative price levels. Keynes also brought the theory of interest into the monetary theory.

Keynes managed to reformulate the quantity theory of money by stating out his own assumptions to the relationship between money and prices. These were highlighted as follows:

a) As long as there is any unemployment, all factors of production are in perfect elastic supply.

b) There is homogeneity in all unemployed factors of production and they are all perfectly divisible and interchangeable.

c) There are constant returns to scale in the economy.

d) As long as there are unemployed resources in the economy, there is proportionality between the changes in the effective demand and the change in the quantity of money.

According to Keynes, contrary to the monetarist view that increase in the supply of money causes increases in the price levels (inflation), he explained inflation as an excess of aggregate demand over full employment in the economy (Keynes, 1936). In his book, his view on the relationship between money supply and the price levels stems from the theory of demand. Keynes severed the close relationship between the quantity of money and the level of aggregate demand by showing that even with constant money supply, some inflation may still be visible.

With his criticism of the monetarist assumption of full employment, Keynes argued that since the economy is not always at full employment levels, it is then not possible for the increases in the money supply to causes increases in the price level. Rather, since there is underemployment, increase in the money supply can only influence the aggregate demand, output, and employment through the manipulation of the interest rates (CMAP 2020).

Given the above-mentioned assumptions, the effect of the changes in the quantity of money on the price levels is reliant on the rates of interest (theory of interest) (Bajracharya 2018). What happens when the supply of money increases (decreases) is that the rates of interest will fall (increase). This shows the inverse relationship that exist between these two variables. As a result of the Marginal Efficiency of Capital (MEC) which refers to the expected rate of profit or the rate of return from investment over its cost (Bajracharya 2018), changes in the interest rate will have an effect in the volume of investments in an economy. In this particular case, a fall in the interest rates caused about by the increases in the money supply will increase the volume of investment in the economy.

Levels of investment in the economy will then influence the level of aggregate demand via the multiplier effect. Which will in turn influence the income levels, output and eventually employment levels. Due to the assumption of the perfect elasticity of the factors of production in a level of underemployment, both the wage and non-wage factors will be available at constant rates of renumeration. This means that the prices will not rise due to the increase in the output levels as there is underemployment as well as constant returns to scale (Keynes, 1936).

Under the above stated scenario, according to Keynes (1936), output together with employment will increase in the same proportion as effective demand. Effective demand will also then increase with the same proportion as the quantity of money. It is important to note that this scenario will only be present on the short run. Things differ in the long run as the economy goes into full employment. According to Keynes (1936), in the long run, when the economy finally gets to the full employment level, the situation becomes the same as that of the Classical

QTM where changes in the money supply will now be proportionate to the changes in the price levels.

At full employment levels, output ceases to respond to any changes in the money supply and also in effective demand. The elasticity of supply of output changes to zero from infinity when the economy was underemployed. The entire effect of the changes in the money supply will now be completely channelled to the price levels which change in proportionate levels.

Keynes supported the above explanation himself when he stated that "So long as there is unemployment, employment will change in the same proportion as the quantity of money; and when there is full employment, prices will change in the same proportion as the quantity of money." (Keynes 1936, p. 296).

However, the changes Keynes' theory brought about was that he merely removed the rigid relationship between aggregate demand and the quantity of money and also considered the less than full employment economy in which the increased aggregate demand was more likely to raise the level of the economy's aggregate output rather that the price levels (Institute of distance learning, 2017).

2.2.2 Empirical literature review

Different scholars have used different proxies for the money supply variable ranging from the use of M1 or M2 or even M3 monetary aggregates as proxies. Some came up to similar conclusion on the perfect use of either of the aggregate while some got conflicting results. In this study, an analysis of the studies that have made use either or in some instances all of the monetary aggregates in different studies is given.

Using M1 as a measure of money supply, Sanusi, Eita and Meyer (2021) employed the use of the Bayesian VAR approach to study the effects of money supply shocks to the inflation rate in South Africa. The results of the study using the impulse response analysis showed that positive shocks to money supply persuaded the monetary authority to respond by raising the interest rate in the economy. Interestingly, a positive shock to money supply could not motive a significant response to inflation with just a slight decline. This result to an extent showed that inapplicability of the QTM in the South African context. (Addp, 2016) while also analysing the relative importance of real and nominal shocks in explaining inflation dynamics in the Ghanaian economy using the Structural Vector Autoregressive (SVAR) model, showed that inflation in Ghana was mainly fuelled by shocks to the real variables instead of the nominal variables' shocks. The study confirmed the increasing importance of inflation being a structural rather than a monetary phenomenon since inflation proved to be more responsive to real rather than nominal shocks in the short run. From the study, inflation remained relatively stable in response to the money supply and exchange rate shocks while it declined by a greater magnitude in response to a positive output (real) shock. The results of these studies could then give questions as to whether the QTM could be applicable in developing country's economies as both South Africa and Ghana are still developing economies.

Contrary to the findings above, analysing the money supply shocks to the inflation rate in BRICS countries between 1994 and 2013, Kutu and Ngalawa (2016) using a Panel Structural Vector Autoregressive model stated that money supply plays an important role in curbing the inflation rate in the countries that they studied. This was after their study showed a result that money supply shocks exerted a very large impact on variations in the rate of inflation. The variations however weakened over time. A positive money supply shock (M1) also caused a temporary increase in the CPI in a study conducted by (Adrangi, Baade and Raffiee 2019). Studying the response of the UK economy to the monetary shocks, the study revealed that the statistical significance of many of the impulse responses on the money supply variable showed that the monetary shocks in the UK economy during the period of the study were not the main reason behind changes in other macroeconomic variables.

In a bid to try and promote the use of the SVAR as an analytical tool, the International Monetary Fund sponsored a number of research articles in which inflation dynamics were studied in different countries. Moriyama (2008) for period 1995 to 2007, Almounsor (2010) for period 1995−2007 and Ayubu (2013) for 1993 to 2011. All these studies explored the inflation dynamics in Sudan, Yemen and Tanzania, respectively. All the three studies based their research on the effects of money supply shocks on price levels in different countries basing their theory on the transactions approach to the Quantity Theory of Money and using the Structural Vector Autoregressive Model for their model analysis. All the three studies had identical variables of interest i.e., foreign inflation (proxied by the international oil prices), output (proxied by GDP), money supply, the exchange rate and the inflation rate (proxied by the CPI). The recursive identification model was used in all the studies, and the ordered variables were foreign inflation, output, money supply, exchange rate and finally CPI. All the variables in the studies were seen to be significant in causing inflation in the study countries. However, just like the results found in the BRICS countries as well as the UK economy, in all the three studies, money supply was seen to be among the least significant variables considered to be causing inflation.

In his analysis of the long run relationship between M2 and the inflation rates, (Luca, 2021) analysed the several aspects of the QTM for a panel of 27 countries. The study included both the money supply variable M2 together with the money demand variable growth rate of a credit aggregate amongst other variables such as the interest rates and the real GDP growth rate. The results of the study found that in most of the countries that the researcher studied, the slope relationship between the trends of money growth and inflation produced by time-varying parameters VARs has been near-uniformly one-for-one for all countries and sample periods showing a positive relationship between money supply (M2) and the inflation rate. While using the OLS estimation technique and using M2 as the money supply variable, Kirimi (2014) also found a positive relationship between monetary aggregate variable and the inflation rate variable (CPI).

Using the M2 variable, international oil prices, credit, interest rate as well as the output gap, (Adayleh, 2018) analysed the inflation dynamics in the Jordanian economy using the Fully Modified Ordinary Least Square (FMOLS) approach as well as the impulse response function and the variance decomposition analysis tests. The results of the study revealed that just like most studies in developing economies using the M2 variable, the shocks on the monetary supply variable together with the shocks on the credit and oil price variables showed a positive and significant effect on the inflation rates. Amongst all the variables that were included in this study, in the long run, international oil prices proved to be the highest contributor to the inflation rate in Jordan supporting the view that import dependant countries are prone to international shocks on macroeconomic variables. Though M2 and credit were significant and positive variables in determining the inflation rates, the effect was only minimal. On the other hand, the output gap and interest rate had a negative effect on inflation in the Jordanian economy. Other studies have also showed that changes in M2 variable also exerts some direct pressure on the inflation rates. Chaudhary and Xiumin (2018) in analysing the inflation determinants in Nepal using the multiple OLS equations estimation technique also got a similar result to that of (Adayleh, 2018). The results from the study revealed a positive relationship between money supply and the price levels in the long run. However, the money supply (M2) variable was not the major determinant of the inflation rate, with imported prices being the major determinant. Money supply had significant impact on inflation however it had less impact compared to other variables. Such a trend of imported prices having major effects on the domestic interest rates also been shown in many studies of countries that are import reliant.

The long run implication of the QTM in Nigeria was studied by Santon (2012) for the period 1960 up to 2009 using the Johansen cointegration method. The variables used included the nominal interest rate proxied by the money market interest rate, price index, real GDP and money supply (M2). The study specifically sought to establish if there was a long run equilibrium relationship between money and prices in Nigeria. A long run relationship was identified among the variables. Granger causality test revealed a unidirectional causal relationship for money supply and inflation. Even though causality did not run strictly from inflation to interest rates as suggested by Fisher (1936), a reverse causality between the variables was found. A similar study was also conducted for Nigeria by Omanukwue (2010). The variables of these two studies were almost the same, the only difference was that Omanukwue added the variable financial sector development proxied by the ratio of demand deposits to time deposits. Omanukwue assumed that the velocity of money was not constant and thus introduced a measure of the financial sector development in the QTM analysis. This particular study used the Engel-Granger two stage test for cointegration to examine the long run relationship of the variables. Just like the study by Santon (2012), the later study also concluded that changes in broad money supply granger causes changes in the prices and also that long run relationship existed between money, interest rates, prices, and the financial sector development satisfying some of the tenets of the QTM.

The results of the applicability of the QTM in developed countries have not been much different from those from the developing countries. The direct positive relationship that has been found between the monetary aggregates and the inflation rates is almost similar in both types of economies. In an illustration of the QTM in the United States and three model economies, Gimenez and Kirkby (2016) explored if the QTM would hold sway in monetary model economies using three different monetary frameworks. These frameworks were the Cash in Advance framework which focused on the transactional role of money, the New Keynesian framework which focused on the role of money as a liquid asset and the Asset Search Money framework which focused on the role of money as a way of solving problems of single coincidence of wants. The study used M2 as the proxy for money supply and the annual rates of CPI inflation as their variables. For the period of study 1960-2009, the study showed that the Quantity Theory of Money held in the USA in the long run, and it failed to hold in the short run just as alluded to by Fisher. In the short run, it was discovered that the QTM failed to hold due to prices responding too quickly to changes in the growth rates of money.

Another study was conducted in Pakistan by Farooq, *et al.,* (2015) in which the applicability of the QTM was tested between 1961 and 2010. It used the variables, inflation rate, GDP growth rate, growth in money supply and growth in velocity of money. The authors sought to determine whether inflation in Pakistan was a monetary phenomenon or not. The study's main objective was to investigate the dynamic relationship between the growth in money supply, GDP growth, velocity of money and the prices. The traditional ordinary least squares were used to test the objectives of the study and it was concluded that inflation was positively dependant on money stock although not proportionately. The Engel-Granger pair wise causality test revealed that there was a positive relationship between inflation and money supply operating from growth in money supply to the rate of inflation. The results revealed that the quantity theory of money is valid to the extent that inflation is a monetary phenomenon and the causality relationship operates from money growth to the prices, although the original QTM theory that growth in money stock is followed by a proportionate growth in rate of inflation in the economy was not proved. The same result was also evident in a study conducted by Waheed and Shoukat (2014) where the authors analysed if inflation was a monetary phenomenon in Pakistan from 1984 to 2013. The study sought to analyse the relationship and the link that existed between inflation, money supply and economic growth. It employed the Johansen cointegration technique to study the relationship in the long run and the error correction mechanism for the short run relationship. The results of the study revealed that in the long run, money supply has positive effects on the inflation rate though the issue of direct proportionality could not be ascertained.

However, Onodugo *et al* (2018) examined the use of monetary policy instruments in tackling inflation in Nigeria where the relationship between money supply and inflation was also examined for the period 1970 to 2015. The study employed the ordinary least squares multiple regression. The variables of the study included inflation rate, money supply, the interest rate, exchange rate, investment, and the monetary policy rate. Results revealed that the monetary policy instruments, money supply included, did not statistically influence inflation in Nigeria. Altunoz (2014) while studying the validity of the Quantity Theory of Money in the Turkish economy also rebutted and rejected the exogeneity of money supply and the neutrality of money hypothesis as suggested by Quantity Theory of Money. However, the study concluded on a bi-directional causality between inflation and money supply. Thus, the Quantity Theory of Money in the Turkish economy was not supported during the period of study (1985-2013).

Conflicting results have also been noticed even while using the M3 variable as a proxy of the money supply. The results when using the broad money aggregate M3 does not differ much from that of all the other monetary aggregates. Ngarambe *et al* (2016) researched on the monetary policy and inflation control in Rwanda between 2006 and 2015 using quarterly data. The variables of the study included money supply, inflation rate, exchange rate, interest rate, real output and international oil prices. M3 was used as a proxy for money supply. The study used the Johansen cointegration technique to study the long run association of the variables as well as the Vector Error Correction Model (VECM) to analyse the short run association of the variables. Results of the study revealed that real output, money supply and the exchange rate were important determinants of prices in the long run. Surprisingly, international oil prices were however found to insignificantly affect the price level as with most developing nations. In the short run, it was discovered that only inflation inertia followed by real output were important in determining the level of inflation with other variables having no effect on inflation.

Some studies incorporate the use of a multiple of money aggregates as proxies for the money supply in a single study. This is usually done in a bid to try and assess the monetary aggregate that best suits to be used as a proxy of the money supply variable as there has not been a consensus within the economics fraternity as to which of the monetary aggregates acts as the best proxy. Shafie, Tan and Sek (2022) while using all the three monetary aggregates to study the determinants of inflation in Malaysia between 1997 and 2018 used an ARDL approach for the analysis of the data. The empirical results of the study showed that the M3 monetary aggregate came out as the best proxy for the money supply variable. From the results of the study, money supply proved to have short-run impact on inflation. The QTM tenets proved to only hold partially in the short run but however becoming invalid in the long run. Also, while studying the monetary policy in a dollarised economy in Peru, Zenon (2012) carried out a pairwise variance decomposition analysis between inflation rates and the main monetary aggregates (real cash balance, M0, M1, M2, M3 and M3a). The variance decomposition revealed how much of the inflation variation was explained by each of the particular monetary aggregates. Results from the decomposition analysis also showed that in addition to the M3 variable as that found in the study earlier mentioned above, inflation was also mainly explained/affected by real cash balance, M2 and M3a. Shen and Dong (2019) however suggested that the M1 variable is a better proxy for the money supply. In their analysis of the structural relationship between the Chinese money supply and the inflation rates, the results showed that M1 was the leading indicator of feeding in changes to the inflation rates. The study made use of the M0, M1 and M2 variables as proxies of money supply. The overall effect of the money supply variables was that increase of M0, M1 and M2 increases CPI. However, though there was a significant short-term relationship between China's inflation and money supply, in the long run, the influence of money supply on inflation gradually weakened and stabilized at a relative level.

Looking at the Zimbabwean case, Pindiriri (2012) examined the causes of inflation in the post-dollarised Zimbabwe using monthly data from January 2009 up to December 2011. The study made use of the time series econometric methodology which was based on monthly data to study the factors that caused inflation in a dollarised Zimbabwe. Growth rates of the CPI, real income, exchange rate (USD/ZAR), interest rate, imports, expected inflation and money supply (M3) as variables of the study. The study established that consumer expectations about future inflation, current exchange rate, import values and to a smaller extent money supply are the major factors influencing post-dollarization inflation. Also using the M3 variable Maune, Matanda and Mundonde (2020) looked at the effects of money supply on prices in Zimbabwe from the period 1980 to 2019. This study included periods of hyperinflation, the dollarisation period and even periods when Zimbabwe had a stable economy using its own currency. The study made use of the multi-linear regression modelling technique to empirically examine its objectives. The variables of the study were inclusive of fiscal deficit, exchange rates, money supply (M3) and the inflation rate. The findings of the study however revealed that CPI was inversely related to the exchange rates and fiscal deficits. Also, the CPI was positively sensitive to the money supply variable M3, as advocated by the Quantity Theory of Money. The results were also in sync with Pindiriri (2012) showing positive relationship between M3 and the inflation rates.

Kavila and Le Roux ((2017) also investigated the reaction of inflation to macroeconomic shocks in Zimbabwe from 2009 to 2012. The study employed the use of the Vector Error Correction Modelling approach (VECM) as it sought to investigate the long run relationship of the variables unlike studies which used the VAR model which focused on the short run relationship between variables. It observed the effects of the international food and oil prices, US dollar/South African Rand exchange rate and money supply on the price levels in Zimbabwe. The exchange rate of the South African Rand against the US dollar and the increase in international food and oil prices were seen as the major determinants in the increases of the price levels in Zimbabwe. The results were however contradictory to the finding of Nhavira (2009) who found an inverse relationship between money supply as proxied by M3 and the inflation rate.

Now including all the main monetary aggregates in a single study, Sunge and Makamba (2020) studied the applicability of the Quantity Theory of Money looking at the effects of money supply on the price levels in post-dollarised Zimbabwe (2009-2018). The study used the Auto-Regressive Distributed Lag (ARDL) approach to analyse the objectives of their study. The study employed the inflation rate, M1, M2, M3, interest rate spread, financial development, market capitalisation growth and budget deficit as their variables. It discovered weak evidence of the Quantity Theory of Money before the introduction of the Bond currency. It also established that inflation was mainly attributed to budget deficits. However, traces of the QTM were seen post the introduction of the Bond currency.

Looking at the empirical literature available on the applicability of the Quantity Theory of Money in different economies, it is evident that the full applicability of all the tenets of the QTM is to a greater extent not applicable in today's economies. In most studies, the results reveal that the quantity theory of money is valid to the extent that inflation is a monetary phenomenon and also in the causality relationship operates from money growth to the prices. The tenets of the original QTM that the growth in money stock is followed by a proportionate growth in rate of inflation in the economy is still yet to be proven in most economies. It is also important to note that different results are found for economies with quite big similarities and gives rise to questions as to how exactly inflation dynamics in different economies work.

2.2.3 Literature gap

Many traditional scholars have endeavoured to bring out their own angle of the Quantity Theory of Money. All these scholars try to show how changes in money supply can affect changes in the price levels.

Numerous studies have analysed the applicability of the QTM but mainly in mono-currency economies which have a say in their own monetary policies. A handful of studies have also been conducted on dollarised economies though most of these also have their own currency as part of the monetary system. There is need to note however, that only a few studies have tried to analyse the applicability of the QTM, either in a sole use foreign currency economy (Gatchet *et al* 2008) and in a multicurrency system, especially one without its own currency in circulation. This then presented a need to contribute to the existing body of knowledge and literature, a narrative as well as a view of the QTM from a multicurrency economy perspective.

Previous studies on Zimbabwe provide some insight on the subject matter. However, there is a yawning gap in literature that this study addresses. First, the study by Kavila and le Roux (2017) exhibit a gap in terms of time because the data used ends in 2012. It leaves a seven-year gap which could provide more recent information on the effects of the shocks of money supply on inflation.

Secondly, though Sunge and Makamba's (2020) study used the required monetary aggregates. their focus was on the effect of the monetary aggregates and not on the effects of the shocks. That explains why the scholars used the ARDL techniques, omitting the question of the effects of the shocks of money supply on inflation unanswered. This study saw a gap in the literature in the use of the Structural Vector Autoregressive model and sought to bridge the gap. As opposed to the ARDL modelling technique, the SVAR model is a more advanced estimation technique which works best in analysing the applicability of economic theories in different economic settings (Pfaff, 2008). Also, the study did not look at the entire period Zimbabwe was using the multicurrency system without its own legal tender in circulation as opposed to the current study.

Lastly, the study by Maune et al, (2020) has used data from mixed regimes, which might not portray an accurate reflection of the effects of the shocks of the monetary aggregates compared to when the multiple currency regime is studied in isolation.

Moreover, as can be seen from a variety of models that have been used in studying the applicability of the Quantity Theory of Money, no study has sought to make use of the Structural Vector Autoregression Modelling technique in a multicurrency economy. This then exhibits a yawning gap in literature as different modelling techniques can at times give different interpretation of results, thus raising a need for such a technique to be put to test.

Lastly, there has not yet been consensus in the world of economics as to which one amongst the monetary aggregates best brings out the Quantity Theory of Money to light. Different studies have employed different monetary aggregates as proxy for money supply. Most studies that have explored the relationship between inflation and money supply in Zimbabwe have mostly employed M3 as the proxy for money supply, ignoring the other monetary aggregates. Literature on this subject is still scanty. This study therefore goes a step further by analysing the effects of all the three main monetary aggregates on the inflation rate.

2.3 Research methods

As evidenced by the literature review, a number of tools have previously been used to analyse the different study objectives which ultimately sought to scrutinise the relationship between money supply and the price levels, if any. While the majority of these studies mainly used the Vector Auto Regression modelling technique, some studies could also be found using the Vector Error Correction Model and Granger Causality tests. Only a handful used the Structural Vector Autoregression model. In an attempt to be innovative and to bring to light a different view of modelling, this study employed the Structural Vector Auto Regression modelling technique. The use of this technique is not fully exhausted in the current study area hence this study seeking to bridge this yawning gap, especially in a multicurrency setup. Such a modelling technique has not yet been employed in the Zimbabwean economic case.

The rest of this section will consist of the data sources and characteristics, analytical framework of the study and the model specification.

2.3.1 Analytical framework

In 2009 when the Zimbabwean Government introduced the multicurrency system, the country solely used foreign currency as its legal tender in all aspects (transacting and investments). However, with the passage of time, the monetary authorities indicated that there were shortages of small denominations of the US Dollar in the market and this hindered operations as customers were failing to get change when transacting (RBZ, 2014). In a bid to try and solve the problem, in November 2014, the bond coins (Zimbabwean fiat money) were introduced at par with the US Dollar and their circulation started in December 2014. This currency initially came in small denominations such as 1 cent, 5 cents, 10 cents and 25 cents. This meant that the Zimbabwean monetary authorities now had some form of control over the money supply in the economy as they could inject or withdraw these bond notes as they so wished (Makochekanwa, 2016).

Due to this situation, the study period is therefore divided into two periods. The first period, 2009:02 up until 2014:11 is where the country was strictly using foreign currency as legal tender and 2014:12 up until 2019:02 was when the country had its own fiat currency in the basket of currencies that were in circulation. This was done to separately analyse the impact of the monetary aggregates both in periods of sole use foreign currency as well as in periods when there was a pseudo local currency within the currency basket. There are various steps to be discussed before the final estimation takes place, as detailed below.

2.3.1.1 Unit root tests

Prior to estimating the SVAR model, the initial step would be to conduct the unit root test. This is because macroeconomic variables are usually known for their non-stationarity nature. Unit root tests were thus performed to check for stationarity. The Augmented Dickey Fuller (ADF) and the Phillips-Perron (PP) tests were used to ascertain the existence of unit root.

2.3.1.2 Diagnostics tests

Tests for the stability of the model are conducted by analysing the root of the characteristic polynomial in which all the roots must lie within the unit circle. The optimal lag length is also estimated using the information criterion and also the use of the principle of parsimony. However, in instances when the diagnostic tests (stability test, serial correlation and normality test) are not satisfied, there was need to iteratively check for the lag that satisfied at least the stability condition among the available tests.

Residual tests were also conducted which included the Autocorrelation LM tests and the normality test. This is to test that the model residuals characteristics are consistent with the model's assumptions before the SVAR is run. To enable the estimation of the SVAR model, the obtaining of the impulse response function and the variance decomposition, it becomes necessary to use the structural shocks rather than the forecast errors. Impulse response functions measure the responsiveness of the dependent variables to shocks in the error term while variance decomposition shows the proportion of movement in the dependant variables that are a result of its own shocks versus shocks to other variables. This study thus, employs the use of variance decomposition as it is able to provide information about the relative importance of each shock to the variables in the SVAR. By using this decomposition, it gives room to the examination of how the contribution of these shocks has evolved over time and whether these shocks play a role in determining the long run variation in the endogenous variable (CPI). However, in this study the main motive is to identify the impact of each independent (exogenous) variable to the endogenous variable, thus a little deviation from the main strands of literature may be observed.

2.3.1.3 Structural vector autoregressive models (SVAR)

The SVAR models combine the basic structure of the VAR approach with a number of widely accepted restrictions derived from economic theories used on traditional macroeconomic modelling (Kratzig, 2004). The model of the study's regression must be based on a certain economic theory, thus making the use of the SVAR a perfect model to use in this study to examine the applicability of these economic theories in today's economies (Systematic Risk and Systematic Value, 2017). One of the important features of SVAR models is that contemporaneous variables may be treated as explanatory variables. This then enables one to study and identify the impact of contemporaneous variables on one specific variable of interest (Kotze, 2019). Also, SVAR's tend to fit data well and only involves minimal identifying restrictions.

From the general VAR model, the dynamic movements of endogenous variables are described by their own past values as:

$$x_{t} = k + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \ldots + \beta_p x_{t-p} + \mu_t \ldots\ldots\ldots\ldots (2.5)$$

Where: x_t is a vector of endogenous variables at time t, k is a vector of constants, β's are matrices of coefficients, p is the number of lags included in the system and μ_t is a vector of residuals (Kratzig, 2004) . The above equation above can also be expressed as

$$x_{t} = k + \beta(L)x_{t} + \mu_t \ldots\ldots\ldots\ldots (2.6)$$

Where L is the lag operator.

The above VAR is a generalised model, which does not impose restrictions on the form of B (L) which is the dynamic relationship between the variables.

The SVAR model taken from the VAR model can then be identified as:

$$A_0 X_t = A(L)X_{t-1} + \varepsilon_t \ldots\ldots\ldots\ldots (2.7)$$

X_t is a vector of endogenous variables and the matrix A_0 is of order *n x n* and it describes the contemporaneous relationships between the variables.

A (L) is a non-singular matrix of coefficients and L represents the Lag operator

ε_t Is the vector of structural shocks of order *N x 1*.

Note: It is important to know that exogenous variables can also be added into the model as observed in this study.

The equation above is in structural form, making an OLS estimation impossible. The equation must then be changed to its reduced form by multiplying it with an inverse matrix A_0^{-1}. Putting the equation in the reduced form is necessary as equation 2.7 is not directly observable and the structural shocks cannot be correctly identified (Kratzig, 2004) . This results in the following equation:

$$X_t = A_0^{-1}\, A(L) X_{t-1} + e_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2.8)$$

e_t is an *n x 1* vector of serially uncorrelated structural disturbances of the model. The vector is obtained as:

$$A_0 e_t = \varepsilon_t \text{ or } e_t = A_0^{-1} \varepsilon_t \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ (2.9)$$

SVARs generally identify their shocks as coming from distinct independent sources and thus assume that they are uncorrelated (Kotze, 2019). The error series in reduced-form VARs are usually correlated with each other. One way to view these correlations is that the reduced-form errors are combinations of a set of statistically independent structural errors. The most popular SVAR method of identification is the recursive identification method. This method (used in the original Sims paper) uses simple regression techniques to construct a set of uncorrelated structural shocks directly from the reduced-form shocks.

Restrictions on the model were put and the model identification tests were conducted. In order for the system to be just identified, sufficient restrictions must be exposed so as to recover all structural innovations from the reduced form VAR residuals (Killian, 2011).

In order to identify the SVAR model from an estimated VAR, it is necessary to impose k (k-1)/2 restrictions on the structural model (Kotze, 2019). In this analysis, since there are 6 variables of study there is therefore need to impose 15 restrictions on the model for it to be just identified.

Method of identification: The recursive identification system (Cholesky decomposition)

This study made use of the recursive identification system which is based on the Cholesky decomposition to identify the model. Recursive identification assumes that the error terms in the model are not constructed to be correlated with each other but are allowed to be correlated with the repressors in the set of linear equations (Kilian and Lutkepohl, 2017).

In the recursive identification, the ordering of variables is deemed particularly important. The method assumes a sort of "casual chain" of shocks (Whelan,2016). The variable that is placed on top is to be the most exogenous (it is only affected by a shock to itself at time *t*) variable in the study and that placed at the bottom must be the most endogenous variable i.e., the dependent variable of the study (Whelan, 2016). Each variable contemporaneously affects all the variables ordered afterwards, but it is affected with a delay by them. The reasoning behind this relies on the argument that certain variables are sticky and don't respond immediately to some shocks.

According to Whelan (2016) the ordering of the variables in the SVAR identification should be influenced by theory and or empirics.

The idea of certain shocks having effects on only some variables at time *t* can also be re-stated as some variables only have effects on some variables at time *t* and this method delivers shocks and impulse responses that are identical to the Cholesky decomposition. For example, in a model with 3 variables only thus 3 shocks y1, y2 and y3 ordered respectively. Shocks in y1 will not affect any other shock in the model in the same period, shock in y2 will only affect y1 shock in the same period and shock in y3 will affect shock in y2 and y3 in the same period (Systematic Risk and Systematic Value, 2017).

There are a number of potential sources where the economic rationale of identifying restriction may come from. One of the rationales is economic theory. A restriction may be imposed based on the tenets of a certain economic model or an encompassing model that includes various alternatives to structural models (Kilian and Lutkepohl, 2017). For example, Stock and Watson (2001) used economic theory to rank their identifying restrictions. In their paper while analysing the effects of a monetary policy shocks, their restrictions were that: Inflation depends only on past observations of other variables, contemporaneous federal funds rate does not effect unemployment but contemporaneous inflation does and that contemporaneous inflation and unemployment both inform the funds rate. The structural approach to time series modelling uses economic theory to model the relationship among variables. Economic theory, however, sometimes does not provide sufficient information on the dynamic specification of the relationship between variables. Moreover, estimation and inference may be distorted by the existence of endogenous variables on both the left- and right-hand sides of the equations. There can also be other factors that can influence restrictions such as information delays, physical constraints, institutional knowledge and market structure (Kilian, 2011).

In this Chapter, the identification of the model was made using a recursive structure of VAR's by modelling the effects of the contemporaneous variables on the main variable of interest (CPI). Literature from Mariyama (2008) revealed that international oil prices is treated as the most exogenous variable. Due to its nature as a foreign variable, it is assumed that oil prices affect all the other variables in the model but these variables cannot affect it in return.

Usually, in a normal economy, where the central bank can set up money supply as a policy variable, the exchange rate will in that case be influenced or affected by the money supply, by the interest rates and even the output (Krugman and Obstfeld, 2006). However, in this case, the exchange rate that is being looked at is a foreign exchange rate (USD/ZAR). This means that exchange rate is being imposed on the local market, the exchange rate is a foreign variable and it cannot be affected by any local economic variable movements. All domestic variables will not have an effect on the exchange rate; however, this exchange rate will be affected by the international oil price hence it was ordered second. The rationale behind this is that changes in the international oil prices tend to have effects on the major currencies in the world, and also South Africa being an importer of oil, changes to its prices will have an effect on its currency.

The demand shocks are assumed to affect all the other variables in the model except for the exchange rate and the international oil prices. According to Keynes (1936), in order for the government to stimulate demand, it should increase its expenditure, and this will in turn increase government output. In general, having increased output will lead to a GDP growth which shows rising economic productivity and will lead to the value of money in circulation to increase. This can be due to each unit of currency being subsequently exchanged for more valuable goods and services. Mariyama (2008) showed that a shock on demand (GDP) had a contemporaneous positive impact on prices and negative impact on money supply which made money supply to have a significant positive contemporaneous effect on prices.

Money supply is assumed to be affected by international oil prices, foreign exchange rate and by the output. Increases in national income causes an aggregate demand shock which in turn leads to effect on the money supply. *Ceteris paribus*, a larger money supply will in turn lower market interest rates thereby making it less expensive for consumers to borrow (Krugman and Obstfeld, 2006). On the opposite, limited money supply tends to raise the interest rates, thereby making it expensive for both consumers and investors to take out loans. The level of the current money supply (liquid money) in a way coordinates with the total demand for the liquid money to help determine the interest rates.

Interest rates are ordered fifth in the model where apart from the foreign variables, interest rates are affected by the output and the money supply. Due to the fact that the country does not have autonomy over its monetary policy, the country will have to first look at the quantity of money supply in circulation before setting up the interest rate in order to promote economic growth. An increase in money supply on the market will cause the interest rates to fall thereby promoting investments in the country as advocated for by Keynes (1936). The level of output that a country record will therefore have an effect on the interest rates.

Lastly, CPI was ordered last due to the nature of the model used in this study. This study explores the effects of all the above-mentioned variables on the price level, thereby making the variable CPI the most endogenous variable. This model therefore assumes that CPI is affected by all the above-mentioned variables. Inflation is posited to be affected by changes in oil prices, money supply (monetary innovations), changes in foreign exchange rate, interest rates and aggregate demand shocks. Money supply shocks affect prices as they generate excess supply/demand conditions in the money market. Similarly, domestic prices are impacted via pass-through effects from fluctuations in the foreign exchange rate via imported goods' prices. Lastly, the Phillips curve suggests that aggregate demand, would impact inflation at least in the short and medium run (Killian 2012).

This ordering of the variables implies that A_0 is given by:

$$A_0X_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ A_{21} & 1 & 0 & 0 & 0 & 0 \\ A_{31} & A_{32} & 1 & 0 & 0 & 0 \\ A_{41} & A_{42} & A_{43} & 1 & 0 & 0 \\ A_{51} & A_{52} & A_{53} & A_{54} & 1 & 0 \\ A_{61} & A_{62} & A_{63} & A_{64} & A_{65} & 1 \end{bmatrix} \begin{bmatrix} loil_t \\ lzarusd_t \\ lcap_t \\ lmi_t \\ llr_t \\ lcpi_t \end{bmatrix} \ldots\ldots\ldots\ldots (2.10)$$

The matrix above x depends on the order of variables and hence is not unique, thus there is need to rely on some theoretical argument to justify this identification scheme. One of the main drawbacks of this approach is that economic theory cannot be incorporated directly into the model, thus the use of empirics and economic assumptions.

2.3.1.4 Impulse response function

The impulse response functions basically show/ track the impact of any variables/ shocks to that variable on others in the model system. It is a very essential tool in studying the empirical casual analysis and policy effectiveness analysis. The IRF function describes the evolution of the variable of interest along a specified time horizon after a shock in each moment (Lin 2006). In this study, the IRF describes the direction of the response of CPI to the other contemporaneous variables shocks (international oil prices, money supply, exchange rate, interest rate and income)

In an SVAR model, impulse response functions are generally affected by the ordering of the variables, hence the variables had to be ordered first before running the SVAR (Kilian and Lutkepohl, 2017). The results of the IRF differ when the ordering is changed hence ordering of variables is of paramount importance in an SVAR model. In the model outlined above, the lower triangular matrix chosen's interpretation is that an impulse/shock in the first variable can have an instantaneous impact on all the other variables, whereas an impulse in the second variable can also have an instantaneous effect on the third to last variables but not on the first one, and so on.

After running of the SVAR estimation, impulse response functions will then be run to examine the effects of a shock in the contemporaneous variables to the variable of interest, the CPI. Greater emphasis was put on the effect of a shock on the monetary aggregates (M1, M2 and M3) as that is the foundation of this study.

2.3.1.5 Forecast error variance decomposition

The impulse response function explained above explores the impact of shocks from the independent variables to the dependant variable. On the other hand, the variance decomposition analysis illustrates the relative importance of each of the variables in the study (Kilian and Lutkepohl, 2017). After analysing the effects of shocks to the CPI, an analysis of the variance decomposition then shows the importance of each variable in the model (inclusive of the dependant variable, CPI) in explaining the variations in the dependent variable (CPI). The variance decompositions indicate the percentage of a variable's forecast error variance attributable to innovations in all the variables included in the system (Sugiarto 2015). In the analysis, in each lag, each variable will have a percentage that will show how much it contributes to the changes in the dependant variable. The total of all these figures should equal to a hundred and the variable with the highest value is the one that explains variations in the dependant variable the most during that lag. An analysis will then be made using all the lags to analyse the variables that determine the variations in the dependant variable the most, over time. The effects may differ from one period to the other, and this may be explained by the different events that will be occurring in the economy, and some of these effects may have some economic stimuli behind them.

2.3.2 Data sources and characteristics

The data used in this Chapter was obtained from the Reserve Bank of Zimbabwe (RBZ) website, the International Monetary Fund (IMF) website and from the South African Reserve Bank. Monthly data from 2009:02 up until 2019:02 was used due to its desirable characteristic of low correlation among contemporaneous variables. Though the objective of this Chapter is to examine the effects of the shocks of money supply on inflation, other theories and empirics also reveal that there are some other variables other than money supply which also affect the price levels in economies, hence the inclusion of other independent variables as outlined below. The variables to be studied for the main objective of this Chapter are:

Consumer Price Index (CPI): CPI can be defined as a comprehensive measure used for estimation of price changes in a basket of goods and services representative of consumption expenditure in an economy (Oxford, 2013). The study made use of the Zimbabwean CPI for the period under review. Consumer Price Index is used as a measurement for the inflation rate in this study. In Zimbabwe, the calculation of the inflation rate is based on the different weights of different baskets of goods/services. The data for compiling the inflation rate weights and basket is taken from the Poverty Income Consumption and Expenditure Surveys conducted by Zimbabwe National Statistics Agency (ZIMSTAT) which is the sole official statistics agency in the country. The weights assigned to the commodities reflect the commodities relative importance to households' expenditures (RBZ.2019).

In compilation of the Consumer Price Index, the ZIMSTAT makes use of the United Nations guidelines and manuals to make sure that their calculations comply with universal standards. They make use of the Modified Laspeyres method which the United Nations strongly recommends. This method compares the commodity prices in two consecutive time periods. The use of the geometric mean in calculating averages is used, instead of the arithmetic mean.

The structure of the CPI basket is based on the internationally agreed Classification of Individual Consumption according to Purpose (COICOP) (RBZ, 2019). The baskets consist of 12 divisions, 41 groups, 83 classes and 117 sub-classes in total. Below is a table which shows the different baskets and the weights that are used in calculating the CPI in Zimbabwe.

Table 2. 1: CPI categories and weight*s*

Category	Weights
Food and non-alcoholic beverages	33.5

Alcoholic beverages and tobacco	4.4
Clothing and footwear	6.0
Housing water electricity gas and other fuels	17.7
Furniture, household equipment and maintenance	9.9
Health	2.2
Transport	9.8
Communication	3.4
Recreation and culture	2.1
Education	5.7
Restaurants and hotels	1.4
Miscellaneous goods and services	3.9
All Items	100.0

Source: RBZ (2019)

In the table above, there are 495 products which are distributed among the sub-classes within the classes and division outlined above. It is however important to note that in reporting the CPI, the ZIMSTAT normally just branches the CPI into two different categories i.e., Food and Non-Alcoholic Beverages and the Non-food categories with weights of 33.53 and 66.47, respectively.

Empirics has shown that past lags of inflation usually have an effect on the current value of inflation (Addip, 2016; Sanusi, Eita and Meyer (2021). The same result is also expected in this study.

Money Supply: this is the total quantity of money that is in circulation within an economy. It is a total of the different aggregates that represent money, namely M1, M2 and M3. The study used the total quantity of the money that was in circulation during the period under study. Depending on the regression being conducted, the variable is split into:

M1: These are the notes and coins in circulation plus the transferable deposits held by the depository corporations,

M2: This is M1 plus the savings deposits and time deposits, and

M3: This is M2 plus negotiable certificates of deposits.

As stated in the identified literature gap, most studies only concentrate and base their studies on any one of the monetary aggregates for analysis when studying the relationship between money supply and inflation. In a bid to showcase the effects of each of the main monetary aggregates on the inflation rate, this study ran different regressions analysing each monetary aggregate's impact on the rate of inflation. The theory that this study is based on (Quantity Theory of Money) states that there be a positive significant relationship between the money supply and the inflation rates (Fisher 1911). Ceteris paribus, this study therefore expects that there be a positive significant relationship between the monetary aggregates (M1, M2 and M3) and the inflation rates. Past empirics have also shown a positive relationship between money supply and M1(Kutu and Ngalawa, 2016; Adrangi, et a., 2019), M2 (Luca, 2021; Kirimi, 2014; Adayleh.2018) and M3 (Chaudhay and Xiumin, 2018; Kirby, 2016; Zenon, 2012)

Income: In essence national income basically refers to the total amount of money earned within a country (Oxford, 2013). Rather, some refer to it as the total market value of all the final goods and services produced in an economy in a given period of time and it is usually represented by the GDP value. Due to the unavailability of monthly GDP figures which are usually used as proxies for national income, this study made use of the grand market capitalisation as a proxy for the income variable as done by Sunge and Makamba (2020). For Stock Market investors, growth in GDP is important. The performance of the stock exchange closely mirrors the performance of the GDP in the country (Bhoroma, 2020). As the grand market capitalisation increases, income also increases, hence increases in the GDP. Empirics usually favour between the manufacturing price index and the industrial price index as proxies for the GDP. However, no consensus has been made as to which of the two is a better proxy. In the Zimbabwean case, both indices are included in the grand market capitalisation figure, thus this study deemed it fit to take it as a proxy for the GDP.

The main contributors to economic activity in Zimbabwe are the mining sector, agriculture sector and the manufacturing sector (RBZ,2019). These three main sectors are largely represented on the Zimbabwe Stock exchange and make up the indices together with other counters from other economic sectors of the economy. In that regard, the ZSE Market Capitalisation figure may be seen to mirror to a large extent, the economic activity of a nation, especially Zimbabwe. However, there could be incidences where the aforementioned proposition might not be observable, especially when the stock market performance is driven by sentiments or speculative activity. However, speculation and sentimental effects of investors are usually short termed as the baseline performance fundamentals of the stocks usually help to correct the situation. Nevertheless, the main driver of the stock exchange remains largely the performance of the baseline real economic sectors from which the counters operate from. In addition to the aforementioned, during the period of study, the country largely used the USD and there was minimal speculative activity linked to. In this regard, there should be appositive relationship between the income variable and the inflation rate.

The QTM explains that income is invariable in the long run hence it does not affect the inflation rates. However, according to the Keynesian economics, continued increases in the output (which determines the nation's income levels) leads to inflation (Mankiw, 1998). Therefore, it is expected that there be a positive significant relationship between the inflation rates and the income variable. Mariyama (2008) showed that a shock on demand (GDP) had a contemporaneous positive impact on prices and negative impact on money supply which made money supply to have a significant positive contemporaneous effect on prices. Such results have also been experienced in studies by Makena (2017) when using the manufacturing index as a proxy for income found a positive relationship between income and the inflation rate. Masiyandima, et al., (2018) also showed a positive relationship between the income growth rate and the inflation rate.

International Oil prices: This is the international price of crude oil in US Dollar per barrel. Zimbabwe as a small open economy which is import dependant is prone to international macroeconomic shocks. Zimbabwe relies heavily on oil for most of its productive sectors. This is due to the fact that oil is a major substitute of electricity in the country. This means that shifts in the international oil prices have an impact on the general price levels of goods and services in Zimbabwe via the cost push inflation, thus prompting the inclusion of the variable. The shocks can be felt indirectly via increases in production costs of firms where these changes will be felt in the retail price of goods and services through increases in mark-up the firms would have put so as to absorb the increase in production costs. This channel of pass through is known as the first-round effects (Abere and Akinbobola, 2020). Thus, the expected sign of the international oil price is a positive one as once confirmed by the studies of (Adeyle.2018; Bass. 2019)

Exchange Rate: This is the the rate at which a country's currency can be changed for the currency of another country (Oxford, 2013). In this section of the study, the exchange rates represent the rate at which the South African Rand was exchanged for the US Dollar. Zimbabwe's trade statistics show that Zimbabwe's biggest trading partner both in exports and exports is South Africa. Due to the nature of Zimbabwe being more of an importer rather than an exporter, this makes it vulnerable to shocks on the currencies of its trading partners. South Africa being the biggest trading partner of Zimbabwe, movements in its currency values therefore to a certain extent has a bearing on the price levels in Zimbabwe via the exchange rate pass through effect. Therefore, movements in the value of the Rand against the USD are expected to have an effect on the price levels in Zimbabwe as evidenced by the studies of Pindirii (2012), Kavilla and LeRoux (2016), Maune, et., al (2020) where the depreciation of the Rand against the USD effected a price increase in the country. The strengthening of the net exporting nation's currency, say South African Rand, is therefore expected to have a negative effect on a net importer's price level, say Zimbabwe inflation.

Interest rates: In Zimbabwe the average lending rates were derived from individual banks and microfinance institutions' lending rates to both individuals and corporates. The average captures all economywide attributes of the lending rates and were collated by the Zimbabwean Reserve Bank on a monthly basis from banks' monthly returns. Generally, interest rates are a cost to borrowing and in that regard an increase in lending rates, ceteris paribus, will likely stall inflation as that discourages supply of money in the economy.

2.4 Results, interpretations and analysis

This section outlines the procedures that were followed to ascertain the applicability of the Quantity Theory of Money in a multicurrency system. The period of study was subdivided into two periods such that the first period covers the time when Zimbabwe dollarized and was solely using multi-currencies, mainly US Dollar and the South African Rand. Other currencies like the Botswana Pula, the British pound and the Chinese Yuan were permissible, but were not used prominently as the other two that were highlighted earlier on. The second period covers the period when Zimbabwe reintroduced its pseudo local currency into the currency basket. The pseudo currency was pegged at par with the US Dollar. Broadly, results are structured in such a way that there are pre-modeling checks, the modeling of the structural VAR, post modeling checks and interpretation thereof.

It is also critical to note that the variables in the study are international oil price, Rand/US$ exchange rate, income, money supply, interest rate and inflation denoted by loil, lusdzar, lcap, lmi (i=1,2 or 3), llr and lcpi, respectively.

2.4.1 Empirical analysis: 2009: 02 to 2014: 11

2.4.1.1 Stationarity tests

For the purpose of running stationarity tests, the Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) tests were employed in this study. The results of ADF and the PP tests for all the variables in the study are shown in Table 2.2 below.

Table 2. 2: Stationarity Tests

	ADF			PP		
Variable	**Level**	**First difference**	**Conclusion**	**Level**	**First difference**	**Conclusion**
LCAP	1.393	-7.517***	I(0)	1.204	-8.336***	I(1)
LCPI	2.548**	-4.874***	I(0)	0.502	-6.295***	I(1)
LLR	0.276	-6.480***	I(1)	0.502	-6.295***	I(1)
LM1	2.163**	-7.316**	I(0)	2.511**	-7.598***	I(0)
LM2	3.148**	-3.615***	I(0)	2.918***	-6.050***	I(0)
LM3	4.828***	-2.510**	I(0)	2.632***	-4.891***	I(0)
LOIL	0.520	-6.199***	I(1)	0.824	-6.165***	I(1)
LUSDZAR	0.396	-5.536***	I(1)	0.2780	-5.536***	I(1)

*Source: Author's Estimations. *** H_0 rejected at 1% level of significance, ** H_0 rejected at 5% level of significance,* H_0 rejected at 10% level of significance*

According to Table 2.2 above, some variables are stationary at level while others become stationary only after first differencing. Stationarity test results are not that necessary when running SVAR models. As demonstrated by Sims et al. (1990), consistent estimates of VAR coefficients are obtained even when unit roots are present. Considering the results in Sims et al. (1990), potential non-stationarity in the VAR under investigation should not affect the model selection process. Moreover, maximum likelihood estimation procedures may be applied to a VAR fitted to the levels even if the variables have unit roots; hence, possible cointegration restrictions are ignored. This is frequently done in SVAR modeling to avoid imposing too many restrictions, and we follow this approach in this study.

2.4.1.2 Ordering of variables

This study imposed the Cholesky decomposition, which assumes that shocks or innovations are propagated in the order of loil, lusdzar, lcap, mi (i=1, 2 or 3), llr and lcpi. This is a recursive contemporaneous structural model which gives rise to a Just-identified structural VAR Model.

2.4.1.3 Model using M1

According to the Schwarz information criterion and the Hannan-Quinn information criterion, the appropriate lag will be 1. However, the sequential modified LR test statistic (each test at 5% level) and FPE: Final Prediction Error, other criterion suggests 5 lags while the Akaike information criterion suggests 6 lags. Overall, 1 lag will be the proposed lag at this point following the principle of parsimony. According to Liew, Venus Khim−Sen (2004), the size of the sample usually makes Akaike's information criterion (AIC) and final prediction error (FPE) superior to the other criteria while the frequency of the data may also suggest otherwise. The key issues being the minimizing the chances of under estimation while maximizing the chance of recovering the true lag length. Generally, the AIC is inconsistent and generally overestimates the true lag order with positive probability; but that both Schwarz criterion (SC) and Hannan-Quinn criterion (HQ) are consistent. The SC criterion is generally more conservative in terms of lag length than the AIC, i.e., it selects a shorter lag than the other criteria. Ivanov and Kilian (2005) show that while the choice of information criterion depends on the frequency of the data and type of model, HQ is typically more appropriate for quarterly and monthly data. Generally, information criterion applies perfectly in different scenarios and is usually up to the researcher to select that which best fit the specific study. As for the current study, information criterion (IC) was just one of the ways of finding the right lag for the models to be estimated. IC alone was not sufficient to determine the lags to be used for the models in question as the models were supposed to satisfy other certain diagnostic tests such as normality, serial correlation and the stability tests. Too short a lag length may result in inconsistent estimates, while too many lags can result in imprecise estimates in small and moderate samples. As such, adding more lags improves the fit but reduces the degrees of freedom and increases the danger of over-fitting. An objective way to decide between these competing objectives is to maximise some weighted measure of these two parameters. This is how the AIC, SC and the HQ work. These three statistics are measures of the trade-off of improved fit against loss of degrees of freedom, so that the best lag length should minimise all of these three statistics. (Mumtaz Haroon and Rummel Ole, 2015)

Table 2.3 below shows the results of the lag length selection. However, after some Diagnostic Checks on the model, the study settles on a lag length of 3 which satisfies all the diagnostic checks.

Table 2. 3: Optimal lag order selection M1

Lag	LogL	LR	FPE	AIC	SC	HQ
0	336.4300	NA	1.33e-	-10.322	-10.119	-10.242
1	742.751	723.991	1.25e-	-21.898	**-20.4812***	**-21.340***
2	783.476	64.905	1.11e-	-22.046	-19.415	-21.010
3	828.076	62.719	9.16e-	-22.315	-18.469	-20.800
4	862.207	41.596	1.13e-	-22.256	-17.1967	-20.263
5	922.288	**61.959 ***	**6.97e***	-23.009	-16.735	-20.53
6	964.715	35.797	8.91e	-23.210*	-15.721	-20.2597

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

Source: Author's estimations

Table 2.4 below summarizes the diagnostic checks results for the model using M1 for money supply.

Table 2.4: Residual Tests M1

	Serial Correlation	**Normality Test**	**Stability Test**	**Conclusion**
VAR (3)	There is no serial Correlation	Normally distributed	VAR satisfies the stability condition	VAR (3) Satisfies all the diagnostic checks.

Source: Author's estimations

The various diagnostic tests results are presented below.

Table 2.5: Residual Serial Correlation LM Test M1

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
3	34.19196	36	0.5548	0.947264	(36, 165.2)	0.5599

Source: Author's estimations

Table 2.6: Residual Normality Test M1

Component	Jarque-Bera	df	Prob.
Joint	14.70552	12	0.2579

Source: Author's estimations

The stability tests results shown in Appendix 1B show that no root lies outside the unit circle therefore the VAR satisfies the stability condition.

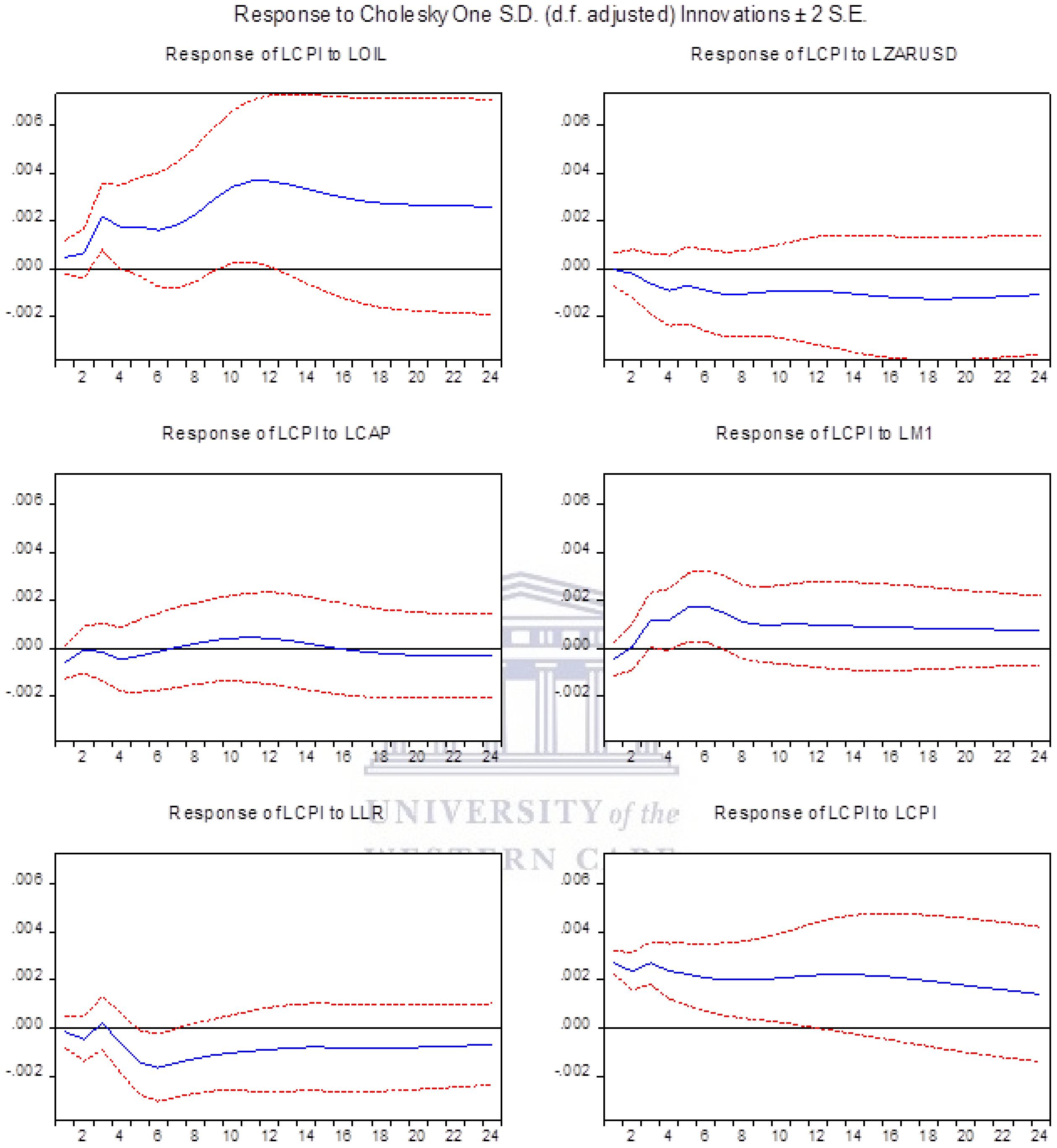
The researcher ran a VAR (1) as suggested by the Information criterion in Table 2.3 and then proceeded to do some diagnostic checks on that model. The results indicated that the model was not stable. This followed some iterative process of running different VAR(p) with different lags and then checking them for serial correlation, normality test and also stability test. Overall, for the model that employed M1 as a proxy for money supply, a lag length of 3 was used as this satisfied all the diagnostic tests that are necessary to run.

For the 3 estimated Structural VAR Models using M1, M2 and M3, the detailed output is provided under Appendix 1C.

Impulse response functions

Impulse Response functions were run for each model. Below are extracts of impulse response functions for the effects of the independent variables' shocks to the CPI. The IRF's will help in analysing both the immediate and the long run response of CPI to shocks on the independent variables.

Figure 2.1: Impulse response functions M1



Source: Author's estimations

According to Figure 2.1, the impulse response functions output detail above, in response to a positive one-standard deviation structural shock to international oil price (Loil), income (lcap), and money supply (M1) responds positively, though insignificant during the first few periods (in the loil and lM1 variables). However, the impact of the loil shock is positive and significant during the third, fourth and fifth month and between the 9th and the 12th period. The USD/ZAR exchange rate (lzarusd) shock has a negative effect on CPI that is insignificant during the entire period. A shock on the income (lcap) has an insignificant impact on inflation both in the short and long term. A shock on money supply (lm1) has no significant effect during the first three periods. However, money supply (lm1) affects inflation (lcpi) positively and significantly between the 4^{th} and the 6^{th} period. After the sixth period, the impact of money supply on inflation becomes insignificant. A shock to the lending rates (llr) does not contemporaneously trigger changes in inflation. The response of inflation from a shock on lending rates is largely insignificant and negative during the period of study. An analysis of the effects of all the independent shocks except lcap shocks on the CPI show that the response to CPI to the shocks on the variables form new equilibriums and this shows that these changes are permanent in the long run. Lcap shocks, however, seem to go back to their initial equilibrium point, thus revealing that the shocks are of a temporary nature.

Forecast error variance decomposition

Table 2.7 shows that the percentage of variation explained by Oil price (loil) gradually increases from 4.8% to 45.5% at period 10 and to 60.3% at period 24. Loil explains the greater portion of inflation as time goes on. The portion of inflation explained by USD/ZAR exchange rate increases from 0% to 4% during the first 10 periods while income explains inflation less as time goes on. On the other hand, the percentage of variance explained by money supply (M1) increases from around 2% in the first period to some 8.5% in period 10 and eventually decreases to 4.8% at 24 lags. Finally, even after 10 periods, inflation still explains the majority (36.7%) of its own variation. Overall, of all the independent variables, international oil price and money supply explained the variation of inflation more than the other variables during the first 10 period. In fact, oil price explained about 60% of the inflation variation at period 24 while inflation itself explained about 25%, USD/ZAR exchange rate explained 6.5%, money supply 5%, lending rate 2% and income 0.6%.

Table 2.7:Variance decomposition for LCPI M1

Period	S.E.	LOIL	LUSDZAR	LCAP	LM1	LLR	LCPI
1	0.054	4.849	0.027	3.032	2.048	0.001	90.044
6	0.122	34.208	2.371	0.403	10.745	4.751	47.522
12	0.133	52.626	3.780	0.552	7.025	3.910	32.107
18	0.139	58.902	4.932	0.405	5.260	2.706	27.795
24	0.141	60.332	6.460	0.640	4.805	2.443	25.318

Cholesky Ordering: LOIL LUSDZAR LCAP LM1 LLR LCPI

Source: Author's estimations

2.4.1.4 Model using M2

According to the Schwarz information criterion and the Hannan-Quinn information criterion, the appropriate lag will be 1 as shown in table 2.8 below. However, the Akaike information criterion, sequential modified LR test statistic (each test at 5% level) and FPE: Final Prediction Error, other criterion suggests 6 lags. Overall, 1 lag will be the proposed lag at this point, following the principle of parsimony. However, after some Diagnostic Checks on the model, the study settles on a lag length of 2 which satisfies all the diagnostic checks.

Table 2.8: Optimal lag order selection M2

Lag	LogL	LR	FPE	AIC	SC	HQ
0	348.397	NA	9.08e	-10.670	-10.498	-10.620
1	770.049	751.068	5.33e-	-22.752	**-21.335***	**22.193***
2	808.878	61.885	5.02e-	-22.840	-20.209	-21.803
3	849.091	56.550	4.75e	-22.972	-19.126	-21.457
4	888.094	47.534	5.04e	-23.065	-18.006	-21.072
5	936.890	50.321	4.42e	-23.465	-17.191	20.994
6	998.271	**51.790***	**3.12e**	**-24.258***	-16.770	-21.308

* Indicates lag order selected by the criterion. Note: LR: sequential modified LR test statistic, FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Source: Author's estimations

Table 2.9 below summarizes the diagnostic checks results for the model using M2 for money supply.

Table 2.9: Residual tests M2

	Autocorrelation	**Normality Test**	**Stability Test**	**Conclusion**
VAR (2)	There is no serial Correlation	Normally distributed	VAR satisfies the stability condition	VAR (2) Satisfies all the diagnostic checks.

Source: Author's estimations

The residual test results are presented below.

Table 2.10: Residual Serial Correlation LM Test M2

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
2	47.34998	36	0.0976	1.355379	(36, 196.0)	0.0998

Source: Author's estimations

Table 2.11: Residual Normality Test M2

Component	Jarque-Bera	df	Prob.
Joint	20.73829	12	0.0543

Source: Author's estimations

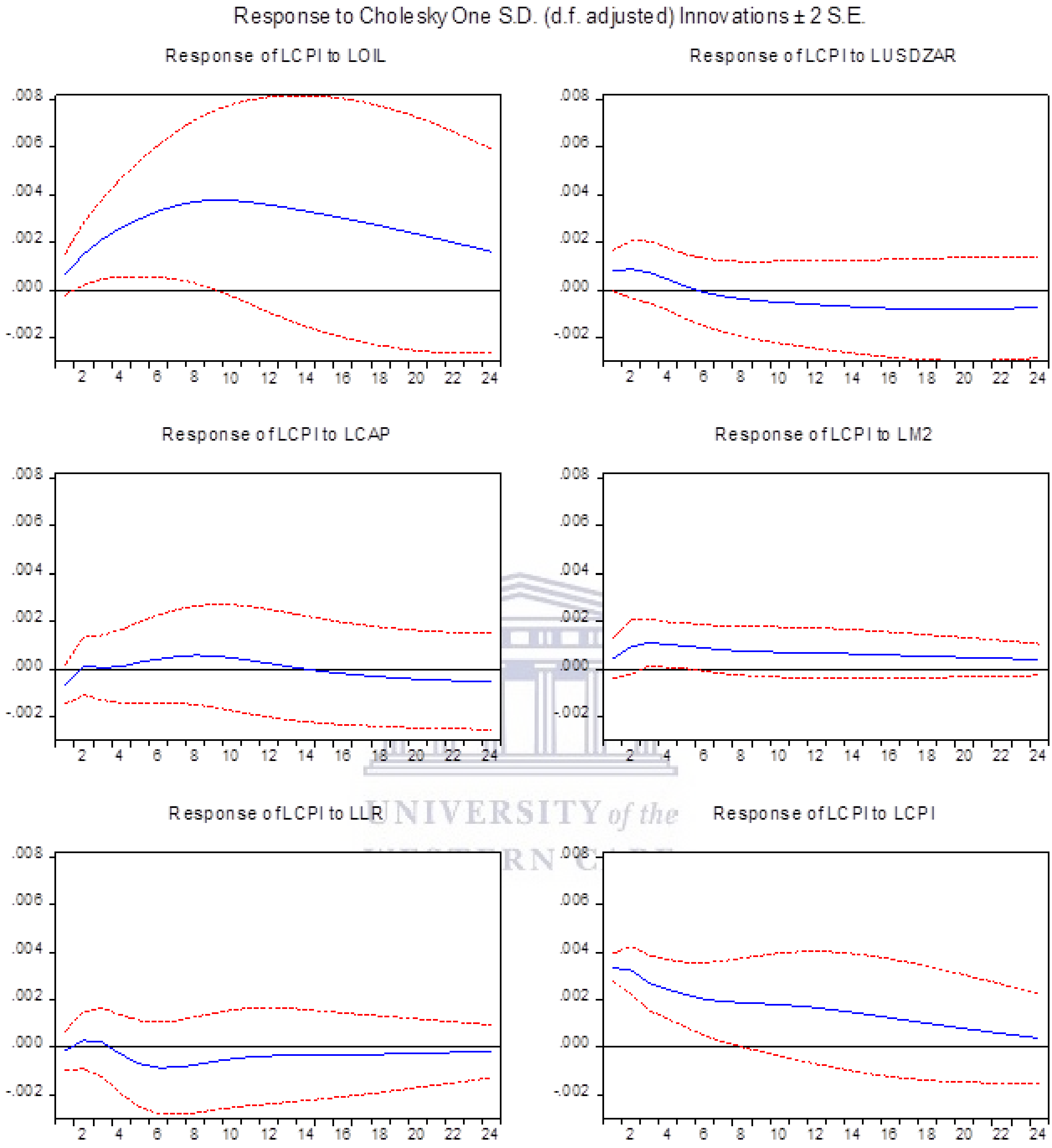
From the stability test results presented in Appendix 1B, it is shown that no root lies outside the unit circle therefore the VAR satisfies the stability condition.

A VAR (1) was run as suggested by the information criterion in Table 2.8. Diagnostic checks on the model were then conducted. The results indicated that the model was not stable. This followed some iterative process of running different VAR(p) with different lags and then the checking for serial correlation, normality test and also stability test. Eventually a lag length of 2 is the one that satisfied all the diagnostic tests hence an SVAR (2) for the model was run under this section.

Impulse response function

In response to a positive one-standard deviation structural shock to international oil price, inflation responds positively during the entire period. However, it is only significant between the 2nd period and the 9th period. Though positive, from period 11, there is a gradual insignificant decrease into the long run. The response of inflation to shocks on the exchange rate, lending rate and income are insignificant. In other words, the three variables do not contemporaneously trigger changes to inflation. A positive one standard deviation structural shock to money supply significantly and positively affects inflation rate between the 2nd and 4th period only. From then onwards, there is a gradual positive decline towards zero into the long run. In light of that, there is a positive response of CPI to shocks in the money supply both in the short run and the long run. Money supply has a lagged effect on inflation. For the model using M2, the effects of the shocks to the CPI from shocks of lusdzar and loil seem to be of a permanent nature as new equilibriums are formed. However, effects from all the other variables seem to be of a temporary nature as no new equilibrium is formed because they tend to go back to their initial equilibrium levels in the long run.

Figure 2.2: Impulse response functions M2



Source: Author's estimation

Forecast error variance decomposition

The fraction of the variance of inflation one-period-ahead explained by the international price shock (loil) is 3.5% at a 1 period lag; the USD/ZAR exchange rate shock is 5.2%; income shock (lcap) is 3.2%; money supply shock (lm2) is 1.4%; lending rate shock (llr) is 0.1%; and the inflation rate shock (lcpi) is 87%. As time goes on, at lag 20 oil prices become the major determinant at 64%, followed by the lags of CPI at 26%, income variable (lcap) being the least determinant at 0.9%. Of interest is money supply which explains 3.8% of inflation in the long run. However, money supply comes third after inflation (explaining 24%) and international oil price (65%) at period 24.

Table 2.12: Variance decomposition for LCPI M2

Period	S.E.	LOIL	LUSDZAR	LCAP	LM2	LLR	LCPI
1	0.054	3.522	5.168	3.199	1.410	0.113	86.588
6	0.112	39.141	2.590	0.797	5.793	1.609	50.070
12	0.122	58.970	1.811	1.035	4.192	1.780	32.212
18	0.125	64.146	2.494	0.837	3.836	1.503	27.184
24	0.125	65.397	3.343	1.164	3.799	1.419	24.880

Cholesky Ordering: LOIL LUSDZAR LCAP LM2 LLR LCPI

Source: Author's estimation

2.4.1.5 Model using M3

According to the Schwarz information criterion and the Hannan-Quinn information criterion, the appropriate lag for the model that uses M3 for money supply will be 1. However, the Akaike information criterion suggests 6 lags while sequential modified LR test statistic (each test at 5% level) and FPE: Final Prediction Error criterion suggests 5 lags. The results of the lag length selection are shown in Table 2.13 below. Overall, 1 lag will be proposed at this point, following the principle of parsimony. However, after some Diagnostic Checks on the model, the study settles on a lag length of 3 which satisfies all the diagnostic checks.

Table 2.13: Optimal lag order selection M3

Lag	LogL	LR	FPE	AIC	SC	HQ
0	347.610	NA	9.31e	-10.6753	-10.4723	-10.596
1	783.402	776.254	3.51e-	-23.169	**-21.752***	**-22.611***
2	821.081	60.052	3.43e	-23.221	-20.590	-22.185
3	859.701	54.310	3.41e	-23.303	-19.458	-21.788
4	897.270	45.787	3.78e	-23.352	-18.292	-21.359
5	954.121	**58.627***	**2.58e ***	- 24.004	-17.730	-21.532
6	1000.821	39.403	2.88e	**-24.338***	-16.8450	-21.388

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

Source: Author's estimations

Table 2.14 below summarizes the diagnostic checks results for the model using M3 for money supply.

Table 2.14: Residual tests M3

	Serial Correlation	**Normality Test**	**Stability Test**	**Conclusion**
VAR (3)	There is no serial Correlation	Residuals are Normally distributed	VAR satisfies the stability condition	VAR (3) Satisfies all the diagnostic checks.

Source: Author's estimations

The residual test results are presented below.

Table 2.15: Residual Serial Correlation LM Test M3

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
3	33.48677	36	0.5887	0.925879	(36, 165.2)	0.5936

Source: Author's estimations

Table 2.16: Residual Normality Test M3

Component	Jarque-Bera	df	Prob.
Joint	19.55165	12	0.0761

Source: Author's estimations

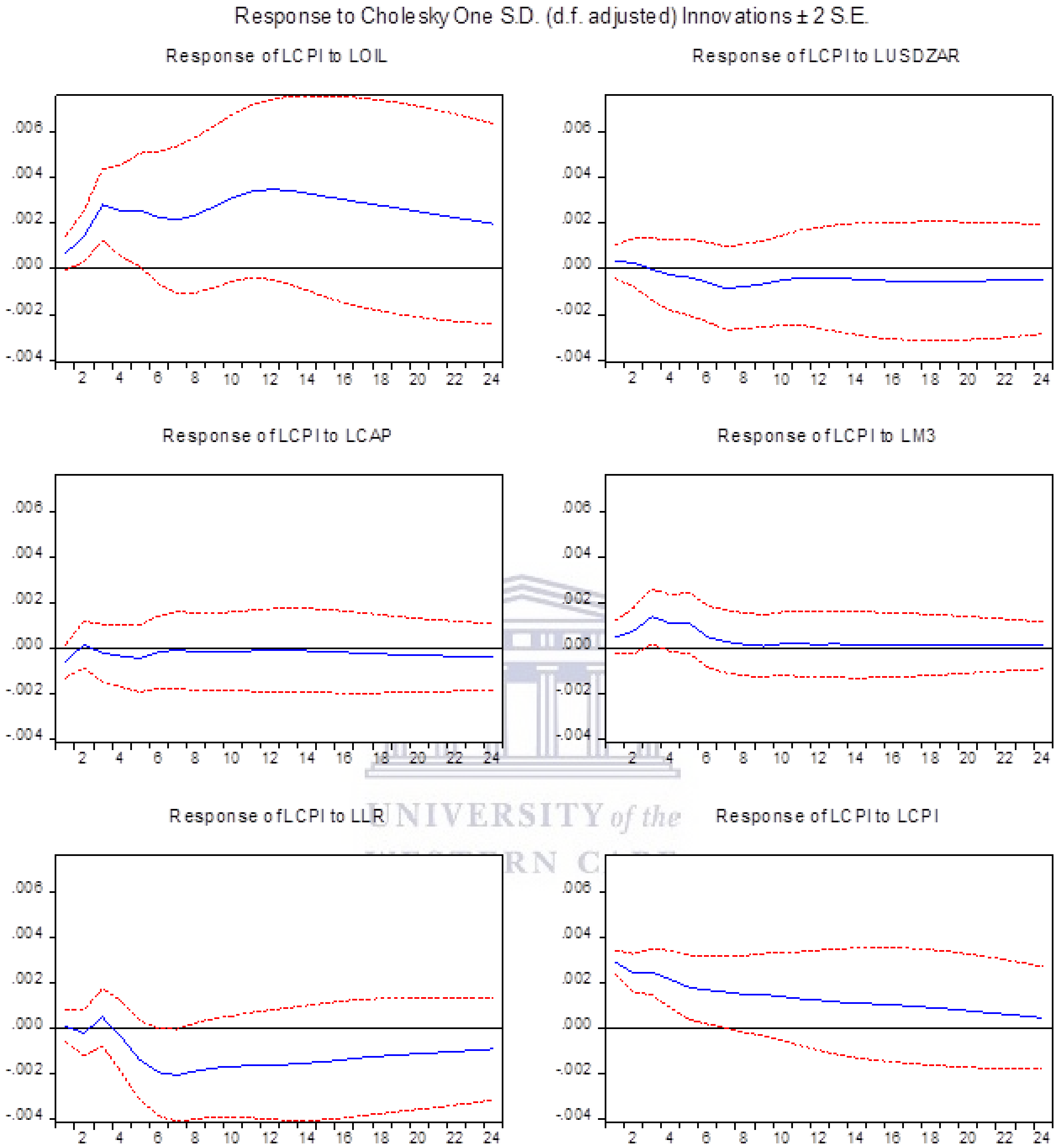
From the results of the stability tests shown in Appendix 1B, it is clear that no root lies outside the unit circle therefore the VAR satisfies the stability condition.

The detailed output of the model is provided in Appendix 1A.

Impulse response function

Impulse response functions for the model that uses M3 shows that lusdzar and lcap did not have contemporaneous effects on inflation and the two were negative for the greater part of the study period and were insignificant in all time periods. Inflation responded positively and significantly to one standard deviation shock on oil price during the second to the fifth period only. As for a shock to the money supply, money supply was significant during the second and third period only. Lcap shocks tend to be temporary, while all the other shocks seem to move along a new equilibrium level, hence being permanent in nature.

Figure 2.3: Impulse response functions M3



Source: Author's estimations

Forecast error variance decomposition

The proportions of inflation explained by the independent variables in this model are almost like the model that uses M1 and M2. The proportion explained by the international price shock (loil) increases from 4.9% one period ahead to 44.8% 10 periods ahead, the USD/ZAR exchange rate shock (lusdzar) also increases from 1.1% to 2.2%; income shock (lcap) declines from 3.1% to 0.6%; money supply shock (Lm3) (2.6% to 4.7%); lending rate shock (llr) (0.1% to 15.6%) and the inflation rate shock (lcpi) (88.1% to 32.1). Of interest is the fact that money supply explains a maximum of 4.7% of inflation after 10 periods. However, money supply comes fourth after inflation (explaining 32%), international oil price (44%) and lending rate (15%) at period 10. In the long run, the statistics are almost the same as in the short run with money supply becoming the 4th major determinant of CPI explaining 2.23% after oil (60.8%), interest rates (15%) and CPI (19%) .

Table 2.17: Variance decomposition for LCPI M3

Period	S.E.	LOIL	LUSDZAR	LCAP	LM3	LLR	LCPI
1	0.055	4.895	1.117	3.131	2.633	0.103	88.121
6	0.116	39.209	1.023	0.924	7.733	8.304	42.807
12	0.123	50.595	1.955	0.470	3.760	15.681	27.538
18	0.126	58.445	1.939	0.371	2.587	15.486	21.172
24	0.126	60.849	2.186	0.523	2.238	15.362	18.842

Cholesky Ordering: LOIL LUSDZAR LCAP LM3 LLR LCPI

Source: Author's estimations

2.4.2 Empirical analysis: 2014:12 to 2019: 02

2.4.2.1 Stationarity test

For running stationarity tests, the Augmented Dickey Fuller (ADF) and the Phillips Perron (PP) tests were employed in this study. The results of ADF tests and the PP tests for all the variables in the study are summarized in Table 2.18 below:

Table 2.18: Stationarity tests (2nd Period)

	Augmented Dickey Fuller Results			**Phillips Perron Results**		
Variable	**Level**	**First difference**	**Conclusion**	**Level**	**First difference**	**Conclusion**
LM1	-2.451	-6.670***	I (1)	-3.337*	-6.671***	I (0)
LM2	-2.206	-5.277***	I (1)	-2.283	-5.252***	I (1)
LM3	-2.174	-5.465***	I (1)	-2.411	-5.465***	I (1)
LOIL	-2.179	-6.231***	I (1)	-2.606	-6.227***	I (1)
LCAP	-2.153	-5.499***	I (1)	-1.834	-5.417***	I (1)
LUSDZAR	-2.450	-5.131***	I (1)	-2.0634	-5.073***	I (1)
LCPI	1.637	-3.867**	I (1)	2.224	-3.904**	I (1)
LLR	-4.213**	-3.529**	I (0)	-1.880	-5.834***	I (1)

Source: Author's estimations

*Note: *, **,*** means the null hypothesis of non-stationarity was rejected at 10%, 5%, 1% respectively.*

According to Table 2.18 above, with regards to both stationarity tests, most of the variables are not stationary at level, only becoming stationary after first differencing. Stationarity test results are not that necessary when running SVAR models as explained in the prior sections.

2.4.2.2 Ordering of variable

This study imposed the Cholesky decomposition, which assumes that shocks or innovations are propagated in the order of loil, lusdzar, lcap, mi (i=1, 2 or 3), llr and lcpi. This is a recursive contemporaneous structural model which gives rise to a just-identified structural VAR Model.

2.4.2.3 Model using M1

The first step towards the estimation of the unrestricted VAR with the appropriate lag length was to estimate a VAR (2) model encompassing all the variables, using the ordering proposed in earlier subsections where p is an arbitrary lag length.

According to the Schwarz information criterion (SC), the appropriate lag will be 1; the Hannan-Quinn (HQ) and the sequential modified LR test statistic (LR), information criterion suggests a p which is equal to 2 while the Final Prediction Error (FPE) and Akaike Information Criterion (AIC) suggest a lag length equal to 4. Overall, 1 lag suggested by the SC will be the proposed lag at this point, following the principle of parsimony. The results of the optimal lag order selection are presented in the table below:

Table 2.19: Optimal lag order selection M1 (2nd Period)

Lag	LogL	LR	FPE	AIC	SC	HQ
	168.856	NA	3.94e	-6.930	-6.694	-6.841
1	485.201	38.459	2.63e	-18.860	**-17.206***	-18.237
2	537.255	**75.313***	1.43e	-19.543	-16.472	**-18.387***
3	573.602	43.307	1.73e	-19.558	-15.070	-17.869
4	624.700	47.837	1.41e*	**-20.200***	-14.295	-7.978

* Indicates lag order selected by the criterion. Note: LR: sequential modified LR test statistic (each test at 5% level), FPE: Final Prediction Error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Source: Author's estimations

Table 2.20 summarises the diagnostic checks results for the model using M1 for money supply.

Table 2.20: Residual tests M1 (2nd Period)

	Serial Correlation	Normality Test	Stability Test	Conclusion
VAR (1) With a time trend component.	There is serial correlation (evidence of serial correlation at some lags)	Not Normally distributed	VAR satisfies the stability condition	Stable model

Source: Author's estimations

The residual tests results are presented below.

Table 2.21:Residual Serial Correlation LM Test M1(2nd Period)

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	60.96122	36	0.0058	1.841881	(36, 143.3)	0.0063

Source: Author's estimations

Table 2.22: Residual Normality Test M1 (2nd Period)

Component	Jarque-Bera	df	Prob.
Joint	233.8120	12	0.0000

Source: Author's estimations

Concerning the stability test conducted (Appendix 1B) , the results show that no root lies outside the unit circle therefore the VAR satisfies the stability condition.

After some iterative checks, the VARs continued to defy the normality of residual test and remain unstable as lags increase. In order to correct the issue of stability, a time trend was added to the model VAR (1) and it became stable. Overall, for the model that employs M1 as a proxy for money supply, a lag length of 1 with an added time trend was used as this was the only one that satisfied the stability diagnostic tests. A model with one lag was also suggested by SC criterion before. It is critical to note that it is difficult to find a VAR that eliminates residual correlation at all lag lengths. The model that was finally selected for analysis has some lags which satisfy the no residual correlation assumption. Although normality is not a necessary condition for the validity of many statistical procedures related to VAR or SVAR, deviations from the normality assumption may nevertheless indicate that improvements to the model are possible (Rummel and Ole 2015). Considering the purpose of this study, it is ideal to let the data speak, thus satisfying the stability condition alone would suffice to run a Structural VAR (p) model. This is supported by Rummel and Ole (p 4., 2015) "*.....For forecasting purposes, we must avoid potential spurious regressions that may result in spurious forecasts; for the purpose of identifying shocks (such as monetary policy shocks) we have to be careful about the stability of the VAR (whether it can be inverted to yield a corresponding vector moving average representation), the reliability of our impulse response functions and the statistical properties of the residuals. ………*

………Moreover, maximum likelihood estimation procedures may be applied to a VAR fitted to the levels even if the variables have unit roots; hence, possible cointegration restrictions are ignored. This is frequently done in (S) VAR modelling to avoid imposing too many restrictions, and we follow this approach here."

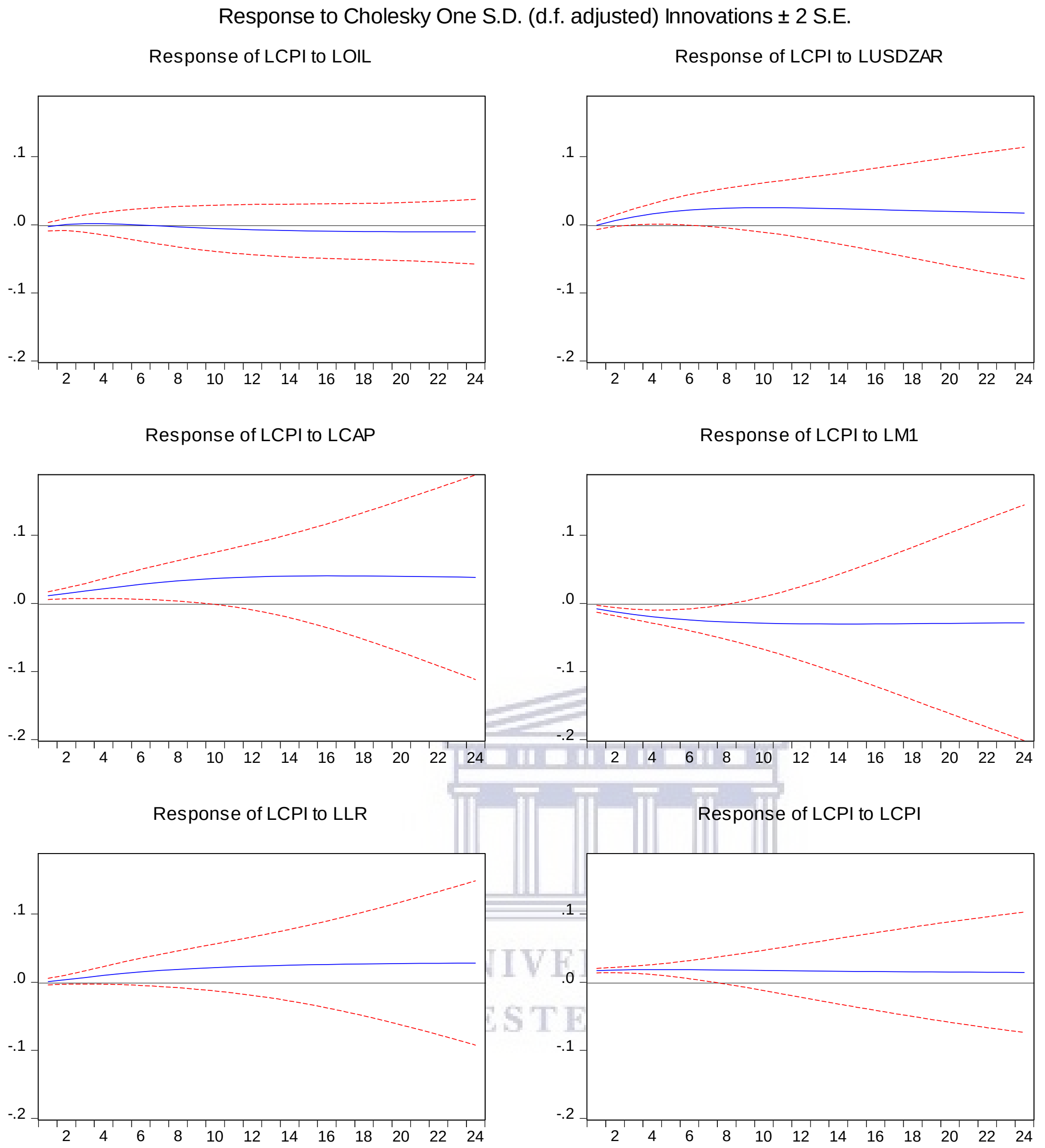
All the three models employed about 51 restrictions on the A-B Matrices to make the resultant SVAR model just identified. Restrictions are equal to $(3n^2 - n)/2$, where n is number of variables.

For the 3 estimated Structural VAR Models, the detailed output is provided under Appendix 1C.

Impulse response functions

According to the impulse response functions output detailed below, the response of inflation (lcpi) to positive one-standard deviation structural shocks of international oil price (Loil) and lending rates (llr) are insignificant for all the periods. A shock on the income (lcap) has a contemporaneous effect on inflation and the impact is significant and positive for the first 9 periods, thereafter it is insignificant. On the other end, lcpi responds negatively and significantly to money supply (lm1) during the first 8 periods and then stays stagnant in the long run though in the negative. The shocks of the independent variables all appear to form a parallel line to the initial equilibrium line both in the short and the long run.

Figure 2.4: Impulse response functions: model using M1 (2nd Period)



Source: Author's estimations

Forecast error variance decomposition

The percentage of variation explained by Oil price (loil) remained less than 2% during the entire 24 periods. USD/Rand exchange rate explanatory power increased from 0.1% at period 1 to a peak of 17.3 at period 10 and gradually decreased to 13.3% at period 24. Income explained 26% of inflation variation at period 1 and the explanatory power of income increased gradually to 38% by period 24. Money supply explained 12.9% of inflation variation at period 1 and the explanatory power of money supply increased gradually to 22.8% by period 24. Lending rate (llr) explained 0.1% of inflation variation at period 1 and the explanatory power of lending rate increased gradually to 15.4% by period 24. Contrary to the trends that were mentioned earlier, the explanatory power of lagged variables of inflation decreased from a high of 59.2% at period one to a low of 8.6% at period 24. Overall, inflation was explained better by its lagged variables during the first periods, followed by income and money supply. However, with the passage of time, inflation was explained much by income, followed by money supply.

Table 2.23: Variance decomposition for LCPI M1 (2nd Period)

Period	S.E.	LOIL	LUSDZAR	LCAP	LM1	LLR	LCPI
1	0.085	1.766	0.148	25.863	12.891	0.122	59.211
6	0.132	0.178	15.301	30.598	23.582	6.651	23.690
12	0.174	0.577	16.973	34.967	23.596	10.842	13.046
18	0.206	1.256	15.032	37.349	23.091	13.366	9.906
24	0.227	1.705	13.258	38.234	22.788	15.394	8.621
Cholesky Ordering: LOIL LUSDZAR LCAP LM1 LLR LCPI							

Source: Author's estimations

2.4.2.4 Model using M2

According to the SC and the HQ information criterion the appropriate lag will be 1. However, the LR and FPE criterion suggest 2 lags while the AIC criterion suggests 4 lags. Overall, 1 lag is the proposed lag at this point, following the principle of parsimony.

Table 2.24: Optimal lag order selection M2 (2nd Period)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	187.3911	NA	1.79e	-7.719	-7.483	-7.630
1	502.166	535.787	1.28e	-19.582	**-17.928***	**-18.959***
2	549.270	**68.150***	**8.60e***	-20.054	-16.984	-18.899
3	586.192	43.993	1.01e	-20.093	-15.606	-18.405
4	635.645	46.2956	8.86e	**-20.666***	-14.76	-18.444

* indicates lag order selected by the criterion

Note: LR: sequential modified LR test statistic (each test at 5% level), FPE: Final Prediction Error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion. *Source: Author's estimations*

However, after some diagnostic checks on the model, the study settles on a lag length of 1 with a time trend and constant which gives a stable model. This is because on all the suggested lag lengths, none satisfied any diagnostic tests as what happened in the model which used M1. Table 2.25 summarises the diagnostic checks results for the model using M2 for money supply.

Table 2.25: Residual tests M2 (2nd Period)

	Autocorrelation	Normality Test	Stability Test	Conclusion
VAR (1) With a time trend component.	There is serial correlation (evidence of serial correlation at some lags)	Not Normally distributed	VAR satisfies the stability condition	This is a better model as it satisfies the stability condition.

Source: Author's estimations

The residual tests results are presented below.

Table 2.26: Residual Serial Correlation LM Test M2 (2nd Period)

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	61.48088	36	0.0051	1.860787	(36, 143.3)	0.0056

Source: Author's estimations

Table 2.27: Residual Normality Test M2 (2nd Period)

Component	Jarque-Bera	df	Prob.
Joint	222.0839	12	0.0000

Source: Author's estimations

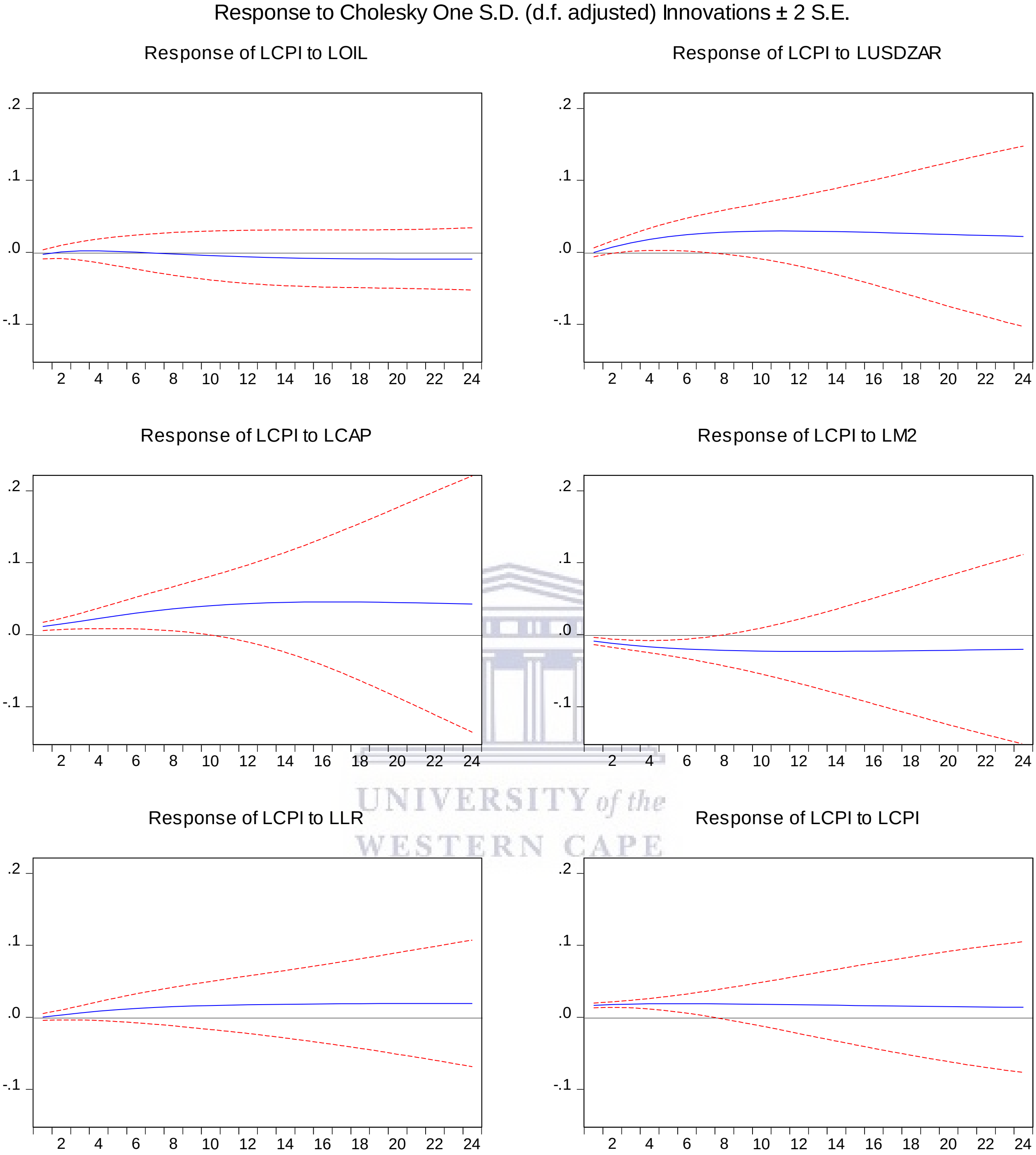
The stability test results shown in appendix 1B show that no root lies outside the unit circle therefore the VAR satisfies the stability condition.

For the model using M2, diagnostic tests for serial correlation, normality and stability suggested an unrestricted VAR with a lag of 1 with a constant and time trend component. The estimated VAR (1) with a trend for model using M2 is provided in Appendix 1A.

Impulse response function

In response to a positive one-standard deviation structural shock to international oil price and lending rates to inflation respond insignificantly. The shocks to exchange rate on the inflation rate were significant between period 2 and 7 only though positive throughout the entire period. The positive response of Zimbabwean inflation to the USD/ZAR exchange rate was consistent with expectations because South Africa has been the major trading partner for Zimbabwe (Zimbabwe imports most of its goods from South Africa) and Zimbabwe is on the receiving end of imported inflation. A positive one standard deviation structural shock to income significantly and positively affects inflation rate from the first period up until the 10th period only, then becomes insignificant in the long run. A positive one standard deviation structural shock to money supply significantly and negatively affects inflation rate between the 1st and 8th period only. The results largely indicate non-applicability of the Quantity theory of Money during the period under study.

Figure 2.5: Impulse response functions: model using M2 (2nd Period)



Source: Author's estimations

Forecast error variance decomposition

The proportion of variation of inflation explained by the international price shock (Loil) decreases from 1.7% one period ahead to 0.3% 10 periods ahead and thereafter increases to levels around 1,4% (at period 24); the USD/ZAR exchange rate shock(lusdzar) also increases from 0.004% to a high of 22.7% at period 11 and thereafter drops to around 19.6% at period

24; income shock (lcap) increases from 26% to a high of 39% at period 10. The variable of concern, money supply, explained 15.8% of variation of inflation one period ahead and its explanatory power increased to a high of 18.4% at period 3. On the other end, lending rate shock (llr) explained 0.04% one period ahead and the inflation rate shock (lcpi) explained 56% at period 1 and the explanatory power declined gradually to around 9.2% towards period 24. Of interest also is the fact that income (lcap), money supply (lm3) and the exchange rate (lusdzar) explained more of inflation as time went on.

Table 2.28: Variance decomposition for LCPI M2 (2nd Period)

Period	S.E.	LOIL	LUSDZAR	LCAP	LM2	LLR	LCPI
1	0.085	1.722	0.004	26.450	15.790	0.036	55.997
6	0.134	0.218	19.570	33.871	17.512	4.706	24.123
12	0.178	0.445	22.658	41.233	15.367	6.572	13.724
18	0.210	1.015	21.175	45.610	14.273	7.424	10.503
24	0.229	1.417	19.595	47.898	13.697	8.236	9.156
Cholesky Ordering: LOIL LUSDZAR LCAP LM2 LLR LCPI							

Source: Author's estimations

2.4.2.5 Model using M3

According to the SC and the HQ information criterions the appropriate lag for the model that uses M3 for money supply is 1. However, LR and FPE suggest 2 lags while the AIC suggest 4 lags. Overall, 1 lag is the proposed lag at this point following the principle of parsimony.

Table 2.29: Optimal lag order selection M3 (2nd Period)

Lag	LogL	LR	FPE	AIC	SC	HQ
0	190.055	NA	1.88e-	-7.669	-7.435	-7.581
1	514.517	554.287	1.15e-	-19.688	**-18.051***	**-19.070***
2	559.783	**66.013***	**8.38e-***	-20.074	-17.034	-18.925
3	597.462	45.529	9.46e-	-20.144	-15.700	-18.465
4	645.655	46.185	8.53e-	**-20.652***	-14.805	-18.443

* indicates lag order selected by the criterion

Note: LR: sequential modified LR test statistic (each test at 5% level), FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

Source: Author's estimations

However, after some diagnostic checks on the model, the study settles on a lag length of 1 with the inclusion of a trend which satisfies the stability check. Table 2.30 below summarises some of the diagnostic checks results for the model using M3 for money supply.

Table 2.30:Residual tests M3 (2nd Period)

	Serial Correlation	**Normality Test**	**Stability Test**	**Conclusion**
VAR (1) With a time trend component.	There is serial correlation (evidence of serial correlation at some lags)	Not Normally distributed	VAR satisfies the stability condition	This is a better model as it satisfies the stability condition.

Source: Author's estimations

The residual tests results are presented below.

Table 2.31: Residual Serial Correlation LM Test M3 (2nd Period)

Lag	LRE* stat	Df	Prob.	Rao F-stat	df	Prob.
1	60.21267	36	0.0069	1.814755	(36, 143.3)	0.0075

Source: Author's estimations

Table 2.32: Residual Normality Test M3 (2nd Period)

Null Hypothesis: Residuals are multivariate normal

Component	Jarque-Bera	df	Prob.
Joint	223.9956	12	0.0000

Source: Author's estimations

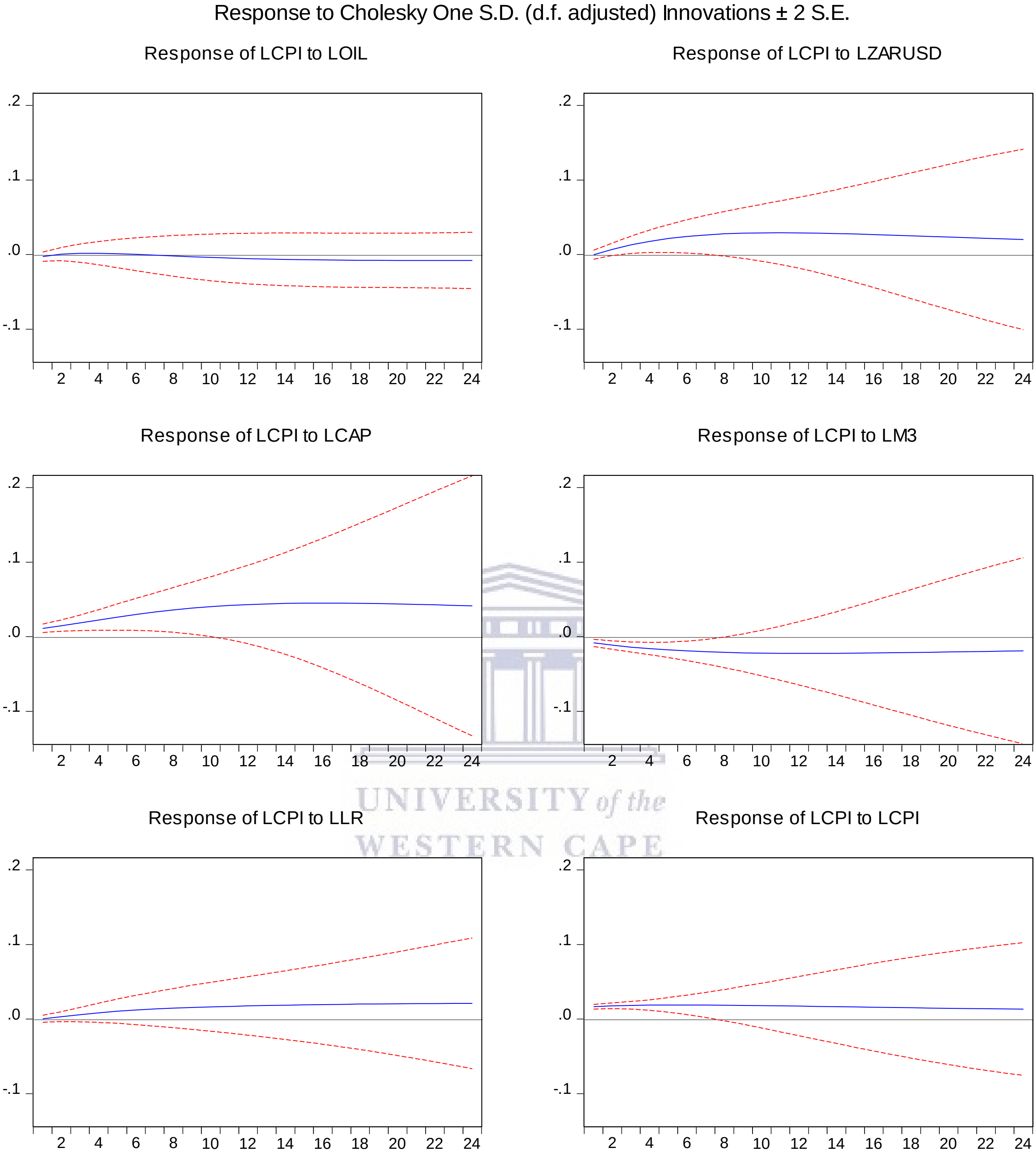
The stability tests shown in Appendix 1B show that no root lies outside the unit circle therefore the VAR satisfies the stability condition.

Following diagnostic tests for serial correlation, normality, and stability, a VAR of I with a trend was suggested for the model using M3. The estimated VAR (1) with a trend for model using M3 is provided in Appendix 1A

Impulse response functions

Both in the short run and the long run, shocks to the international oil price have an insignificant effect on the price levels. However, shocks to the interest rates, though their shocks had a positive effect on lcpi, were insignificant. Inflation responded positively and significantly to one standard deviation shock on income (lcap) between the 1st and 10th period. Money supply shock triggered a significant but negative response on inflation during the first nine periods only. Overall, income (lcap) and money supply (m3) contemporaneously fed into inflation during the period under review. The effects of all the shocks under study on CPI using the M3 model exhibit the same trends just as the ones seen in the M2 model.

Figure 2.6: Impulse response functions: model using M3 (2nd period)



Source: Author's estimations

Forecast error variance decompositions

The fraction of the variance of inflation one-period-ahead explained by the international price shock (Loil) is 1.7%; the Rand/USD exchange rate shock (randusd) is 0.005%; income shock (lcap) is 27%; money supply shock (Lm1) is 14.2%; Lending rate shock (llr) is 0.04%; and the Inflation rate shock (lcpi) is 57%. Of interest is money supply which explains a maximum of

16.9% of inflation. However, the explanatory power of money supply comes fourth after income (explaining 38%); lzar/usd (23%) and inflation itself (16%) at period 10. In the long run, income explained a total of 59% followed by the exchange rate at 19%. Money supply is on average the 3rd major determinant of the CPI in the long run though the weight is very insignificant.

Table 2.33: Variance decomposition for LCPI M3 92nd Period)

Period	S.E.	LOIL	LUSDZAR	LCAP	LM3	LLR	LCPI
1	0.085	1.697	0.005	26.731	14.165	0.044	57.359
6	0.134	0.233	19.723	34.378	16.257	4.728	24.681
12	0.178	0.388	22.733	41.870	14.382	6.634	13.993
18	0.209	0.907	21.133	46.320	13.368	7.586	10.686
24	0.226	1.285	19.464	48.635	12.806	8.501	9.308
Cholesky Ordering: LOIL LUSDZAR LCAP LM3 LLR LCPI							

Source: Author's estimations

2.4.3 Discussion of results

This section highlighted the empirical findings and analysis of the study. The results of the periods that were studied were shown. The first period was when the Zimbabwean economy was solely using foreign currencies as their legal tender and the country's monetary authorities had no autonomy over money supply issues in the economy. The second period represents that era when the country had its own pseudo money in the currency basket that was in circulation.

The results from the first period clearly reveal that in a foreign multicurrency economy, the tenets of the Transactional Quantity Theory of money do not hold sway. Considering the impulse response functions discussed during this period, the response of inflation to shocks in money supply (M1, M2 and M3) were largely in the positive though insignificant for most of the time lags. This shows that there is a positive relationship between the monetary aggregates and the dependent variable though not very significant. Shocks to the international oil prices however seem to be a bit more significant as compared to shocks to all the other independent variables in the study. Looking at the variance decomposition in the short run, CPI was mainly influenced by its own lags. In the M1 model CPI was influenced by its own lags to a 90%, M2 87% and M3 88% point) at its maximum. International oil prices become the 2nd major determinant in all three models in explaining CPI. Money supply in the short run was the 3rd strongest determinant though the extent was quite insignificant with the highest weights recorded in the M1 model at 11%.

In the long run, looking at the 24-lag point, the international oil prices explained changes in the CPI much better than any other variable in the models (M1:60%, M2: 65% and M3: 61%). CPI explained itself better than money supply which came in 3rd in the M2 model and 4th in the M1 and M3 model when ranking the variables. Income seems to be the most exogenous among the variables of study as its shocks explained the least changes in the CPI. From that we can conclude that the theory did not hold sway during the first period. However, money supply explained variations of inflation better after several periods. There is a lagged relationship between the two variables (money supply and the CPI) as supported by most empirics.

During the first period of study, changes in the shocks to money supply proved not to significantly affect the changes in the price levels. It is however important to know that, during some time periods though very few, the shocks to the monetary aggregates were found to significantly influence changes in the CPI. In the short run, it was proven that the past lags of inflation affected the current inflation rate mostly followed by the prices in the international commodity, oil. In the long run, during the last few years of the first period, monetary aggregates are ranked between the third and fourth determinant (depending on the model in use) of changes in the price levels with the highest aggregate affecting CPI at lag 24 being only 4.8% in the M1 model. The results are in line with the results found by Sunge and Makamba (2020), Pindiriri (2012) and Kavilla and LeRoux (2012) who established that during the period that there was no local currency in circulation, changes in money supply did not proportionately lead to changes in the price levels.

The effects of independent variables in the long run are not much different from those noted in the short run. In this period, international oil prices affected CPI the most, with the highest weight recorded being 65% in the M2 model having not much difference from the M1 model with 60% and M3 model with 61% effect. This shows that regardless of the monetary aggregate used, the effects of the international oil price are quite significant in determining the price levels. Money supply in the long run also did not have much bearing in determining the changes in the price levels and was ranked on average, the 4th strongest determinant of changes in the price levels behind the lags of CPI with the highest closing weight at period 24 being only 4.8% in the M1 model. Income and the interest rates were not incredibly significant in determining changes in the price levels.

Analysing the second period in which the local authorities now had a control of the total money supply in circulation, the results are a bit different from a solely foreign multicurrency economy especially when it comes to the significance of the shocks of the independent variables in determining changes to the price levels. Considering impulse response functions discussed in the second period analysis, the response of inflation to shocks in money supply were largely insignificant, only being significant during the first few lags, otherwise, all the three models gave negative responses. This is however different to the positive effects recorded during the first period. Therefore, we can conclude that there was not enough evidence to support the holding of QTM during the second period when Zimbabwe used a multicurrency system with a pseudo currency in the currency basket. This is so because the tenets of the QTM suggest a positive relationship between money supply and the inflation rates. Shocks to international oil prices during this period also differed from the first period becoming insignificant and negative during the period under study. This result is thus different from that of Sunge and Makamba (2020) who found the tenets of the Quantity Theory of Money to show a bit of applicability after the introduction of the Bond currency. The negative relationship between money supply and the inflation rates are in tandem with Cao (2015) who also discovered such a relation in several countries (USA, Britain, Japan, Germany, Euro area, BRICKs, and some members of ASEAN). His reasoning was that when a country's general income increases (as was the case in Zimbabwe during the period), inflation does not become a monetary phenomenon but becomes a wealth allocation phenomenon due to the excess money being put to wealth creation uses and functions.

Now, looking at the variance decompositions of inflation, the percentage of variance explained by money supply using the three proxies M1, M2 and M3 at period 1 was 13 %: 16% and 14%, respectively ending at 15%, 14% and 13% at lag 24. On average M1 explained changes in CPI, the most in the long run as compared to the other monetary aggregates.

Overall, in the short run, money supply did not significantly affect the changes in the price levels and the effects were not as expected. In the short run, changes in the income levels had a great bearing on the changes in the price levels and the relationship was positive. This alludes that as the output in the economy increases, national income also increases which to a certain extent will increase disposable income of the general populace. This will in turn increase the demand for goods and service in the short run which will in turn lead to increased prices since suppliers would have not yet adjusted to the increased demand. As time goes on, the results then differ from model to model. Of interest is the model which used M1 as the monetary aggregate. In this model, in the long run (at lag 24) money supply contributed on average of 15% to changes in the price levels, making it the second highest contributor, and in M2 and M3 variable it was the 3rd highest contributor. The significance of the exchange rate variable makes economic sense in that South Africa is Zimbabwe's major trading partner both in exports and imports. This then makes price levels in Zimbabwe susceptible to the relative changes in the value of the SA Rand.

Results from the study then go on to exhibit that the choice of the monetary aggregate in analyzing the Quantity Theory of Money may be pivotal as it strongly affects the results outcome. However, in all the time periods, it is important to know that the effects are very insignificant to claim applicability of the QTM. Thus, it is safe to conclude that in a multicurrency economy, the tenets of the Quantity Theory of Money are inapplicable since growths in the shocks of money supply did not cause equal increases in the inflation rates. This result resonates with Sunge and Makamba (2020) who also observed that while using the M3 variable in their second regression, there was weak evidence for QTM. The results however are at odds with the results obtained from Mundonde (2020) who while using M3 as the monetary aggregate claimed that the tenets of the QTM were at play in the economy during the entire two periods of study. The results from this study however seem to concur with Telesetal (2015) who found weak evidence of the QTM particularly for countries with low inflation rates of around less than 12%.

The findings from this study that clearly reveal the inapplicability of the QTM are not surprising, mainly for one reason. The adoption and the use of the multiple currency system meant that the monetary authorities had no control over the money supply determination in the country. Even with the introduction of the pseudo currency (bond notes and coins), still the authorities could not influence much money supply determination. Still, other currencies were at play and with the pseudo currency also pegged equally against the US Dollar, manipulation of the money supply proved to be difficult.

2.5 Conclusion

Literature is still scanty on the study of the effects of money supply in a solely foreign multicurrency economy. Most of the available literature on money supply and inflation is mostly concentrated on economies using their own mono currencies as legal tender. For those economies which are dollarised, the situation is such that there will only be one foreign currency in circulation that would be used as legal tender. The Zimbabwean case is a very peculiar one. During period in which it was using multi-currencies, Zimbabwe initially did not have its own currency in the currency basket but with the passage of time, it included its own version of pseudo currency into the currency basket (Maune et al., 2020). This then makes the study of the whole period all at once difficult. To fully analyse the objectives of this study, it was then prudent to divide the study period into two in order to analyse the objectives fully and objectively.

Most previous studies which looked at money supply and the price levels during the multicurrency era only anchored on a limited time in which the economy solely had foreign currencies in the currency basket, save for the study by Sunge and Makamba (2020) which included some of the periods in which the Bond notes and coins were now part of the currency basket. Like the majority of studies which study the same relationship between money supply and the inflation rate, this study based its analysis on the Transactions Quantity Theory of money which states that a proportional change in the money supply should result in the same proportional change in the price levels.

In all of these studies, none attempted to make use of the Structural Vector Auto Regression modelling technique. This therefore means that this study had no main point of reference in analysing its objectives. This study however adapted its methodology to almost similar studies that had been conducted elsewhere. The variables of the study were modelled to correctly fit the objectives that were being analysed (money supply, CPI, income, exchange rate, interest rate and international oil prices). Foreign variables were included so as to capture the effects of international shocks since Zimbabwe is a small open economy which is predominantly an import country.

The result of this study basically shows that in a pure foreign multicurrency economy, the Transactions Quantity Theory of Money does not hold sway since there are other factors that were seen to effect changes in the price levels, mainly the international oil prices. In an economy that has some control over the quantity of money in circulation within its borders, it is seen that the effects of the shocks to money supply also do not differ much from the first scenario when looking at the significance of the variables.

Therefore, to answer the research objectives of this study, in a multicurrency economy the pure tenets of the Transactional Quantity Theory of money are inapplicable. Though there is evidence of a long run positive relationship between money supply and the price level (shown by the variance decomposition) in the first period as supported by a-priori assumptions, there is no significant proof of satisfying the QTM's assumption of proportionality that is to say, a percentage increase in money supply should equal to a percentage increase in the price levels. Also, the results have shown that shocks in the money supply aggregates in most cases do not contemporaneously affect changes in the price levels as alluded to by Fisher's version of the QTM. From this study, the shocks to the money supply affected the CPI with a lag, thus in this study, overall using either of the available monetary aggregates, in a multicurrency economy whether with or without a local currency in the currency basket, the tenets of the QTM are not satisfied, thereby rendering it inapplicable. These results mirror a study conducted in Pakistan by Farood *et al* (2015); Sanusi, Eita and Meyer (2021), Addp (2016) where he concluded that though inflation is positively dependant on money supply, the dependence is not proportional to suggest applicability of the QTM.

CHAPTER THREE: MONEY DEMAND AND INFLATION

3.1 Background and problem statement

The different theories that explain the Quantity Theory of Money (QTM) have different ways of showing how money in general affects the price levels. The two most common theories are the Fisher's Transactionary QTM and the Cash Balance Approach Theory also known as the Cambridge approach to the QTM (Chen 2020). Fisher's theory mainly focuses on money supply as the causal variable while the Cash Balance Approach (CBA) analyses the QTM using money demand as a causal variable (McLure, 2013). The preceding Chapter looked at the applicability of the QTM in a multicurrency economy from the transactionary approach. This Chapter, hence, now looks at the other option of looking at the QTM which is the Cash Balance approach.

When Zimbabwe introduced the multicurrency system after a prolonged period of hyperinflation, it was expected that the price levels will drastically decline and eventually stabilize at a particular level (RBZ, 2009). Reduction of the prices was observed immediately after the adoption of the system. However, stability was not observed even as time went on as the inflation rates started to fluctuate at some point even going into the negative then rising up again to the positive (Pasara and Gadzirai, 2020). The positive drift brought about by the introduction of the multicurrency use only lasted a few years as from 2012, macroeconomic variables started to fluctuate some declining, some rising while others became stagnant.

In an equilibrium state economy, money demand is said to be equal to money supply and any changes in either of the two correctly mirrors the changes in the other (Fisher, 1911; Pigou 1917). Due to this assumption, when either of the two (money demand or money supply) is being studied, the most preferred variable is mostly any of the monetary aggregates. The concept of money market equilibrium is however highly contested as most economists argue that in the real world, the money market is never in equilibrium though it is constantly moving towards it (Investopedia, 2020;White, 1981). However, in studies where both money demand and money supply must be included as variables of study, there is need to come up with different proxies of the two variables. The demand for credit has been used as a substitute for money demand in a number of previous studies (Bernanke and Blinder, 1988; (Allessi & Detken, 2018). This has been so because, the economy's demand for credit has been seen as a mirror of how individuals may be demanding money and this is also closely related to the money supply in the economy. Basing his study on the theory of credit, Bernanke and Blinder

(1988) warranted a symmetrical treatment of money and credit, hence the adoption of demand of credit as a proxy for money demand. The use of credit in an economy also provides a method of purchasing goods and services that is an alternative to using money, hence its demand can be equated to the demand for money (credit can be used for transactionary purposes just as M1) (Allessi & Detken, 2018. This study in a bid to look at how the money demand affects the prices levels in order to be able to compare that with how money supply also affects the price levels will make use of the demand for private credit as a proxy for money demand.

Looking at the figures released by the RBZ (2020), just after the introduction of the multicurrency system in February 2009, the demand for private credit began to show an upward trend. From February 2009 up until December 2010, there was a sharp increase in the demand for credit. This may be attributed to the restored confidence and the stability that the abandonment of the local currency had brought into the economy. The same trend could also be seen in the money supply changes which started to rise just after the adoption of the multicurrency system (RBZ, 2010). This period saw a lot of financial institutions becoming comfortable with issuing out loans again as the risk of payment default and ever-increasing inflation had been drastically reduced by the introduction of the use of foreign currency. It is interesting to note that there was a sharp decrease in the demand for credit between December 2010 and January 2011 and the demand for credit began to have a new average. Though the demand for credit was basically stable, there were however minimal fluctuations in the demand from month to month.

Since the introduction of the multicurrency system, there was a conspicuous relationship between CPI and the demand for credit where the two variables exhibited an upward close relationship. However, after the introduction of the Bond notes (fiat currency), the trend took a different turn where an increased gap between the variables was noticed. The CPI now increased at a greater rate as compared to the demand for credit (RBZ, 2020). Some scholars and critiques may attribute the change to the fact that confidence in the performance of the economy began to decline due to the introduction of the local fiat currency. Makochekanwa (2016) conducted a study on the reaction of economic agents after the announcement of the introduction of the Bond notes by the central bank. From his study most economic agents were frightened by the decision by the government to introduce the bond currency. Most agents highlighted the fact that they did not have confidence in the Government and that it would be able to keep the bond currency at par with the USD. Matanda, et al., (2018) then conducted a study that confirmed the earlier results found by Makochekanwa (2016). According to Matanda, et al., (2018) the introduction of the bond currency into the Zimbabwean economy brought with it a loss of confidence in the monetary system in the country. People began to withdraw their money from the banks, banks began to limit the rate at which they issued out loans, prices began to increase amongst other things. It is believed that there was fear that history would repeat itself and the economy would plunge into high inflation as had occurred during the Zimbabwean dollar era. Lenders began to limit credit growth, reducing the growth trend while the rate of inflation continued on an upward trend (Matanda, et al., 2018). There is therefore need to study the correlation between money demand and the inflation rates in a bid to answer the overall research question looking at the different principles of the QTM. This will help in analysing whether the QTM in all of its forms was applicable in the Zimbabwean context during the multicurrency era.

The primary goal of this Chapter is therefore to scrutinize the effects of money demand shocks on the price level in a multicurrency economy.

Looking at the main motive behind this whole study, "to study the applicability of the Quantity Theory of Money in a multicurrency economy" it is imperative that all the different contributions to the formulation of the theory be examined. This is done to see if the different formulations of the theory can/ still get to the same conclusion. In this section of the study, the use of the monetary aggregates which are normally used as proxies of money supply are not applicable as they have already been used in the preceding chapter which formed the basis of comparison. Derivation from theory in the use of the monetary aggregates variable as a proxies for money demand is therefore warranted as this essay now brings out the other side of the theory which will be used for comparison purposes.

As advocated for by the proponents of the theory for credit, demand for private credit is seen as a suitable proxy for money demand (Sidd, 2017). The reasoning is that the creation of credit is effected when commercial banks advance loans and purchase securities. Money is lent to businesses and individuals out of the deposits accepted from the public, hence credit is created from the money that will already be in circulation.

Literature for the comparison of the different proponents of the QTM in a multicurrency economy is still missing. There is therefore a need to contribute to the body of knowledge to this effect. This will aid in analysing if truly the tenets of QTM in a multicurrency economy hold sway. Also, this study greatly contributes to the general knowledge of the inflation dynamics in a multicurrency economy as according to this researcher's knowledge, no such study has been conducted where such a proxy for the money demand variable has been put to use.

3.2 Literature review

This section of the Chapter analyses the literature that explores the relationship between money demand and inflation. The theoretical background of this study is given in subsection 3.2.1. Subsection 3.2.2 then lays out the empirical studies that were previously conducted on the topic of money demand and inflation. It is imperative to know that literature on multicurrency economies is still very scanty, thus studies from mono currency use economies will also be analysed. Finally, subsection 3.2.3 provides a conclusion with the revelation of the gaps in literature. This will give a general summary of the available literature as well as identifying the yawning gaps in extant literature.

3.2.1 Theoretical literature review

Keynes (1936) postulates that there are three main purposes which affect individuals craving to hold money as opposed to other financial assets. These three are the transactions, precautions and the speculative drives for holding money. The transactions motive is premised on the fact that individuals require liquid money on a consistent basis in order to pay for different bills and also to fund their different consumption needs (Davidson, 1990). The Corporate Finance Institute (2020) stated that the overall conditions of the economy tend to have an impact on the motive why individuals would want to hold money for transactions purposes. The reasoning behind this is that when the economy grows and the macroeconomic conditions improve, idle resources will be put to use which lowers unemployment and eventually leads to increased salaries, this ultimately leads to increased spending in the economy. This increased spending thus increases the demand for money to finance the purchase of goods and services.

The precautionary motive holds its premise on the fact that individuals would want to hold some money in order to be able to meet an unexpected need that can often arise. This motive is usually motivated also by the level of economic activity taking place. The level of precautionary holding of money in consumers usually increases when an economy experience increases in the GDP as well when general economic activity rises. However, in rising inflation, consumers tend to decrease their holdings of precautionary balances. Of importance is to note that the precautionary motive for holding money is greatly influenced by the availability of credit (Corporate Finance Institute, 2020). *Ceteris paribus*, when credit is hardly available in an economy and the interest rates are also high, the precautionary motive for holding money balances is likely to decline and the opposite is true. Also, the spending patterns of an individual or an economy, closely mirrors the individual balances one holds for precautionary reasons (Davidson, 1990).

Lastly, the speculative motive for holding money is based on the reasoning that when the value of money is expected to increase versus other asset classes holdings of such money tend to increase.

Cash-Balance Approach to the Quantity Theory of Money (Cambridge approach)

Money basically serves four major function and these are store of value, unit of account, the medium of exchange as well as a source of deferred payments. Generally, money demand is basically the demand for real balances according to the functions stated above. There are several money demand theories which have evolved over time from classical theories to the modern ones. This subsection, however, places its main focus on the Cash Balance Approach to the QTM, a part of the classical theories of money demand as it forms the basis of this study.

The Cash Balance Approach (CBA) was propounded by a number of Economists from the Cambridge University. The main proponents of this approach include among others A.C Pigou and Alfred Marshall. This theory scrutinized the determination of the price levels from the perspective of money demand and money supply (Handa, 2009). In the transactional approach to the QTM explained in the previous Chapter, Fisher (1911) in his analysis mainly focused on the utilitarian details of the payment mechanism while on the other hand, the theorists of the Cash Balance Approach focussed more on the intentions that motivated individuals to hold money. The Cambridge Economists' explanation of the determination of the value of money was derived or is determined by the determination of value in general. This explanation is premised on the understanding that the value of any commodity is derived from both the demand and the supply of that particular commodity, and thus likewise, the value of money (its purchasing power, the prices) is also derived from its demand and supply (McLure, 2013) .

The Cambridge approach came as an alternative paradigm to the QTM as it relates the quantity of money to nominal income and stresses the role and importance of money demand in determining the effect of money supply on the price levels. Just like Fisher, Pigou defined currency as a legal tender, but his interest relied on what he called "the titles to legal tender" (Pigou,1917). According to Pigou, these titles consist of currency (notes and coins) and demand deposits in the bank. These titles are what is now referred to as M1. Pigou highlighted that individuals needed these titles in order to perform transactions as well as for their security against unexpected demand due to sudden need (Pigou, 1917). Furthermore, the convenience that money brings when one needs to transact to meet his obligations and the security that these titles bring in unexpected situations become the motives for holding such tittles. The actual demand for currency is said to be governed by the quantity of an individual's assets that he chooses to keep as currency. However, this decision is strongly influenced by the convenience of holding such, gives the avoided risk of holding such titles, the income loss had these titles been used for production of future commodities and the utility of consuming these titles in the present.

This assertion was strongly supported by the Cash in balance proponents who emphasized the importance of the store of value function of money which is contrary to Fisher's assertion of the transactional approach to demand for money as a medium of exchange. Three differences from Fisher's version of the QTM can be noted from the cash balance approach. Firstly, in the cash balance approach, the emphasis is on individual choice rather than on market equilibria. The CBA looks at an individual agent's motive of holding an amount of money he does. This is motivated by the desire one has to conduct transactions which makes money holding attractive at all. This is different to Fisher's view who concentrated on the determinants of the quantity of money an entire economy requires to perform a given volume of transactions (McLure, 2013).

Secondly, the CBA theory argues that money does not just serve the role of a medium of exchange, but it also acts as a store of value. Lastly, the CBA also suggest that wealth and the interest rates play a role in the determination of the demand for money. According to Pigou's assertions, in the short run, there is a correlation among one's level of wealth, his/her income levels as well as their volume of transactions. All other things being constant, the demand for money in nominal terms is proportional to the nominal level of income for each individual and hence for the aggregate economy as a whole (Alter 2002).

The Cambridge approach introduced its version of the Quantity Theory as a theory of demand, supply and then equilibrium in the money market and goes on to put it in a long run general equilibrium approach to the economy. According to the CBA, the value of money depends on the demand for money; but the demand for money arises on account of its function as a store of value. The theory sought to answer two principal questions:

1. How much high-powered money (M1) do people currently wish to hold rather than being spent or invested? And

2. What therefore, is the ration of cash balances to the total money value of all transactions in the economy?

According to the CBA theory, individuals prefer to keep a portion of their money for the convenience and security of having cash on hand rather than using it all for transactional purposes. The theory states that halving of purchasing power of money leads to the doubling up of the demand for money and vice-versa. To fully explain the Cash Balance Approach in this study, emphasis is given on Pigou's work and his derivation of the Quantity Equation as derived from Handa (2009). Pigou was the first Economist from Cambridge to explain the CBA in the form of an equation. Pigou stated that the demand for money is not what usually interest people, rather, they are interested in the money's relation to their total assets which can be equated to the form of income. Pigou states that, the ratio of money demand to resources that one has, is a function of its services, the internal rate of return on investments and of the marginal satisfaction foregone from less consumption (Pigou, 1917). Taking the derivations of the equation from Handa (2009), assuming r is used to denote the internal real rate of investment on investment, the ratio of money demanded M^d to nominal expenditure (Y) is given as:

$$\frac{M^d}{Y} = k(r) \text{ ....} (3.1)$$

Where k is a functional symbol.

M^d is the number of actual units of legal tender.

Y is the resources an individual has (income).

$K'(r)$ <0 therefore the demand for money balances will be represented as:

$$M^d = k(r)Y \text{..............................} (3.2)$$

Now taking the assumption of the long run equilibrium, it means that money demand will be equal to money supply thus, money supply $M^s = M^{d.}$ This therefore makes

$$M^s = k(r)Y \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.3)$$

Now substituting Y with Py (P being the price level and y as the real amount of goods) thus Py becomes the total expenditure.

$$M^s = k(r)Py \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.4)$$

Taking the assumption that y, the output is at full employment level y^f in equilibrium $y = y^f$, giving us:

$$M^s = k(r)Py^f \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.5)$$

Pigou assumed that the rate of return (r), in equilibrium (r^*) was determined by the marginal productivity of capital (MPK) which was also assumed to be independent of the money supply and the price level so that $\partial r^*/_{\partial P} = 0$ and $\partial r^*/_{\partial M} = 0$

Thus, in equilibrium:

$$M^s = k(r^*)Py^f \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.6)$$

Making P the subject of the formula we now get:

$$P = M^s/[k(r^*) * y^f] \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.7)$$

Now assuming that r^* and y^f are invariable, the price index (P) will in comparative equilibria vary proportionately with the money supply thus making equation 3.7 Pigou's version of the Quantity Equation. The CBA invention of the QTM provides a further acceptable description of monetary equilibria within the classical model of the QTM by concentrating on the society's demand for money, especially the demand for real money balances as the most crucial aspect in determining the equilibrium price level consistent with a given quantity of money (Sriram, 1999).

Keynes Liquidity Trap Theory

Considering the unstable monetary situation that was evident in Zimbabwe during the time under study it is also important to discuss the liquidity preference theory that also emerged form Keynes works in his contradiction of the QTM as put out by the Cambridge Economists.

In his formulation of the Liquidity Preference Theory, Keynes argued that due to what he called "Time Preferences", a person makes a choice of whether to consume all his income in one period or to reserve some for future consumption. He argues that, once a person makes this decision, another decision follows; how to keep the money he has reserved for future consumption. Does one prefer to have liquid command or does one prefer to invest the money and leave his fate to the future market conditions to determine his fortunes, hence the term liquidity preference (Keynes , 1936). Keynes thus divides money into two distinct categories i.e., idle and active balances.

Keynes defined the rate of interest as the "the inverse proportion between a sum of money and what can be obtained for parting with control over the money in exchange for a debt for a stated period of time." (Keynes, 1936, p 167). According to Keynes, the rate of interest is the reward for parting with one's liquidity for a given period of time, thus interest can be viewed as the return on investments. According to him, the rate of interest is determined by the demand for and supply of money.

According to Keynes (1936), given an economy's level of wealth, when the interest rate is low, the amount of money the economy would seek to hold will exceed the money supply in that economy and when the opposite is true, there would be a surplus of the cash which no one in the economy would want to hold. Therefore, according to him, the liquidity preference together with the quantity of money are the determinants of the interest rates. Therefore, the liquidity preference then shows/determines the amount of money that people can demand given a particular rate of interest.

According to Keynes (1931), given the three distinct motives for holding money, the transactionary and the precautionary motives (he referred to as M_1) are not sensitive to interest rates hence are not affected by any changes in the interest rates, However, the demand to hold money for the speculative motive(M_2) is sensitive to the interest rates. Basically, he defined the speculative motive for holding money as relating to the desire to hold one's wealth in liquid form so as to benefit from the future changes in the interest rates or bond prices. Keynes went to further argue that the demand for money in order to satisfy the precautionary as well as the transactionary motives rely mostly on level of economic activity and the level of income one holds. However, the demand for the speculative money mainly relies on the economic system.

Algebraically, Keynes assertion of the Liquidity preference for the speculative purposes can be illustrated as below:

If r represents the rate of interest, M_2 being the quantity of money demanded for speculative purposed and L_2 represents the function of the liquidity preference we can then have

$$M_2 = L_2(r) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.8$$

The equation above therefore shows how the quantity of money demanded enters into the liquidity preference theory.

Now so as to show the liquidity preference of all the total liquid money algebraically:

M denotes the total liquid money ($M_1 + M_2$)

As earlier implied $M_1 = L_1 (Y)$ where Y represents income

Were L_1 is the liquidity preference for M_1.

The total liquidity preference (L) function can therefore be expressed as :

$$M = L\ (Y, r) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.9$$

According to Keynes, as the rate of interest falls the quantity of the money desired to be held as cash must increase and he attributes this to the following reasons:

Ceteris paribus, when the interest rates fall, more money will be absorbed by the transactionary liquidity preference motive. His reasoning was that; "For if the fall in the rate of interest increases the national income, the amount of money which it is convenient to keep for transactions will be increased more or less proportionately to the increase in income; whilst, at the same time, the cost of the convenience of plenty of ready cash in terms of loss of interest will be diminished" (Keynes 1936, p. 171).

Secondly, when the rates of interest rates fall, some individuals within the economy who hold different views from those of the market regarding the future of the interest rates may wish to increase the quantity of money that they hold.

Keynes went on to further explain that changes in the interest rates have the highest capabilities of affecting the quantity of money that is demanded in the economy. This is however superior to other factors such as changes in circumstances or changes in the individual expectations (Keynes 1936, p. 198). Keynes attributed the determination of interest rates to the quantity of money supply in an economy. He went on further to argue that when the monetary authorities in a bid to try and stimulate the economy reduce the interest rates, there might occur a situation where people would prefer to hold on to money rather than investing it in bonds thus the demand for money actually increases. Keynes explained that, in a recession monetary authorities may try to boost demand by increasing the money supply, however there is a situation where interest rates will not be moved and this might lead to what he termed the "Liquidity Trap". Keynes stated that a liquidity trap happens when an expansionary monetary policy is effected but there will not be any effect on either prices or output. The theory suggests that when it is not possible to make lower nominal interest rate than zero, further monetary stimulation of aggregate demand is ineffective (Brycz, 2012). These traps usually occur during periods of recessions and a gloomy economic outlook. Consumers, firms and banks are pessimistic about the future, so they look to increase their precautionary savings and it is difficult to get them to spend (Brycz, 2012).

Keynes further insinuated that, in a recession in an underemployed economy, increase in money supply merely helps the unemployed resources to get utilised in the general economy. There, in such an economy, the increase in the quantity of money in circulation is unlikely to cause inflation but rather will promote the public to hold more money rather than investing it hence increasing the demand for money.

The Morden Quantity Theory of Money.

In his criticism or what I can rather say "missing's" of both the traditional and the Cambridge approach to the QTM, Milton Friedman in his paper "The Quantity Theory of Money—A Restatement" published in 1956 argued that the quantity theory of money, was not in essence a theory of money income and neither was it a theory of output or price levels. He argued that the QTM was rather a theory of the demand for money (Friedman, 1956). Friedman basing his study on the Cash Balance Approach made some improvements on the Keynes Liquidity preference theory by regarding money as any other asset (held for speculative purposes) but however ignored Keynes classifications of motives for holding money. He argued that money generally takes two functions, it can either be an asset or a capital good

According to Friedman, the demand for money by wealth holders can be expected to be a function of a number of things, namely:

i. Total wealth: this is the total amount of wealth one possesses, that must be divided among various forms of assets the wealth holder can opt to hold. Here Friedman suggests that income may serve as a measure of wealth.

ii. The division of wealth between human and non-human forms: Friedman argues that the most important asset of most wealth holders is their personal earning capacity. He argues that there is need for wealth holders to be able to use their human wealth in order to turn them into non-human wealth and vice versa.

iii. The expected rate of returns on money and other assets: these are the returns the wealth holders get from either holding money or other assets.

iv. Other variables determining the utility attached to the services rendered by money relative to those rendered by other assets: this refers to other variables other than income that affect utility attached to the services of money which determine liquidity proper besides liquidity .

In order to explain his theory, Friedman (1956) divided income into two categories i.e., permanent income and the nominal income. He defined permanent income as that income that a wealth holder can consume while maintaining his wealth intact. On the other hand, nominal income is measured in the prevailing units of currency and it depends on both prices and quantities of goods traded.

Friedman went on to explain that individual's wealth can be held in five different forms which are :

i. Money- this is inclusive of notes and coins in circulation , time deposits and demand deposits. He argued deposits yields interest thus making money a luxury good. He went on to further explain that money yields real returns which can be realised as security, convenience etc and this can be measured in terms of the general price levels/

ii. Bonds – these can be defined as claim to a time stream of payments that are fixed to a nominal unit.

iii. Equities -claim stream to a time stream of money that are fixed to a real unit.

iv. Physical goods or non-human goods are inventories of producer and consumer durable.

v. Human capital- the productive capacity of human beings.

The above forms of wealth show that each has its own characteristics and each can have its own kind of yield, different to the other. Friedman however showed that wealth is like capitalised income when he expressed the present discounted value of these expected income flows. He presented this as

$$W = {}^{y}/_{r} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.10$$

W represents the current value of wealth; y is the total flow of expected income from the five above mentioned forms of wealth and r stands for the interest rate.

He concluded that economic agents (individuals, businesses etc.) are interested in holding real money balances as opposed to just nominal money balances. In essence what the theory suggests is that, if nominal balances held by the economic agents are increased due to increase in the price levels, these agents will demand more nominal balances in order to keep their real money balances constant.

According to Freidman these real money balances are a function of permanent income, relative expected return on bonds, stock versus money and expected inflation (Friedman, 1956).

Friedman's analysis of the demand for money can therefore be expressed as

$$M/P = f(y, w, R_m, R_b, R_e, gp, u) \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3.11$$

Were M refers to the quantity of money demanded

P is the price index

Y is the income

W refers to the fraction of wealth in non-human form

R_m - expected return on money

R_b – is the expected nominal rate of return on fixed-value securities, including expected changes in their prices

R_e expected nominal rate of return on physical assets, including expected changes in their prices

Gp- e expected rate of change of prices of goods and hence the expected nominal rate of return on physical assets and

u represents other variables affecting the utility attached to the services of money. (Friedman 1982)

From the equation above, Friedman shows that a rise in the expected yields on the different financial assets reduced the quantity of money demanded by the wealth holders as they are likely to benefit more from having their wealth tied up in assets. Also, an increase in wealth causes an increase in the demand for money.

Now, in reinstating the quantity theory of money, Friedman considers the supply for money to be independent to the demand for money as the supply for money is governed by the monetary authorities hence it is unstable. On the contrary, he sees the demand for money as stable as he argues that the quantity of money that people wish to hold either in cash or in bank deposits is related in a fixed way to their permanent income (Wang, 2016)

To illustrate how the changes in the price levels come about, Friedman explained that when monetary authorities purchase securities from individuals, this has then effect of increasing the money supply in the economy. This increase in the money supply will lead to a raised nominal income for the people who would have sold their securities to the monetary authorities. Their increased nominal income would have increased in relation to their permanent income. This will lead to the increased spending on assets and also on consumer goods and services (Wang, 2016) .

By spending the money acquired from the security sales, the individual's money balances will be reduced and concurrently this will also raise nominal income. The opposite is true also when the central bank sells securities. This has the effect of reducing the buyer's money balances holdings in relation to their permanent income. In a bid to increase their money holdings, individuals will then sell off some of their assets as well as reduce their consumption levels of goods and services and this tends to reduce the nominal income. It is then evident that on both counts, the demand for money remains stable.

Friedman postulates that a change in the money supply causes a proportionate change in the price levels or income or in both. He argues that it is possible to predict the effects of the changes in the supply of money on total expenditure and income when looking at the demand for money.

Friedman's argument was that, in an economy operating at less than full employment levels, in the short run when money supply is increased, its effect on the economy is that it raises output and employment with the rise in total expenditure. His reasoning was that money supply is perfectly inelastic and when income increases, the demand for money also increase. And, since money supply is perfectly inelastic to income, changes in income will not affect it. However, when the monetary authorities increase the money supply in the economy this shifts the money supply outwards and raises the income and ultimately the price levels (Friedman, 1956).

3.2.2 Empirical literature review

There are different theories of money demand inclusive of the transactions, speculative, precautionary and utility considerations and they address a variety of hypothesis. Though these theories usually share more or less the same variables, they differ on the specific roles that these variables are assigned to (Boorman, 1976). Rightfully so given the equilibrium assumption in most monetary theories, most studies that have empirically studied money demand, have mainly used monetary aggregates as proxies of the demand for money variable. Nevertheless, those studies that have sought to move a step further in analysing money demand separate from the money supply have also made use of the demand for private credit as a proxy for money demand. Sriram (1999) highlighted that it is also very common for empirical studies to make use of the demand distinct elements of the monetary aggregates (types of assets and type of holders) as the variables for money demand (Goldfield 1973, Lim 1993, Jansen 1996). Bernanke and Blinder (1988) also warranted a symmetrical treatment of money and credit where he studied the relationship between money, bank credit and aggregate demand. The demand for money and demand for credit were analysed to see their effects on aggregate demand, hence the conclusion. Rather, the message of this paper was that a more symmetric treatment of money and credit is feasible and appears warranted.

The use of the demand for credit as a proxy for the demand for money can be backed by the credit theories of money which show the relationship between money and credit as exact things (Wang, et al., 2017). This theory posits that, from the origins of money, money was a system for accounting debts, with monetary units in these systems representing debts and not inherent value (Sidd, 2017). Proponents of the theory advocate for the idea that money originated as a unit of account for debt, and the position that money creation_involves the simultaneous creation of debt hence the two are equally the same thing. They argue that money equates to credit only in a system based on fiat money, where they argue that all forms of money including cash can be considered as forms of credit money (Andrew, 1905). On the other hand, the other strand argue that money is best understood as debt even in systems often understood as using commodity money.

Andrew (1905) in his contributions to the credit theory of money highlighted that, in as much as the value of money is determined by the demand and supply of money, the same happens for the value of credit as it is also determined by the demand and supply of it. However , he went on to explain that the supply of money is not determined only by the quantity of money but rather, also by that of all its possible substitutes as well. Andrew (1905) further went on to explain that credit also qualifies and contributes to the inclusion of devices that are called money as it also offers the same use as that of the other devices such as coins, Government notes, bank notes, and bank deposits hence credit is freely acceptable without endorsement or any particular scrutiny. According to him, credit also contributes other instruments, equally capable of representing and transferring purchasing power and of mediating exchanges, which are not usually designated as money. Andrew's theory of the value of money and credit also goes ahead to distinguish between fixed and circulating credit , the former being that which do not circulate and the latter referring to real means of payment (money).

From Andrew's analysis of the value of money vis a vis the value of credit, he then concluded that in the long run, the quantity of banking credit is governed by the quantity of money, and each permanent addition to the monetary supply tends in the end towards an increase of credit. Therefore, since the value of money in the long run depends most importantly upon its quantity which in turn affects prices not alone when money enters the circulation, but also when money is gathered in the bank reserves, because the amount of the only kind of credit which serves effectively as a substitute for money depends primarily upon the extent of these reserves.

The concept of viewing money as a debt is supported by modern economist as they argue that since President Nixon severed the tying of the value of all government paper currencies to gold there is no scarce commodity backing our money, only debt from governments and banks (Sidd, 2017). The reason being that, when any government spends money, it is either spending tax money its citizens gave it, money it earned from selling services or collecting fines, or money created by its central bank in exchange for debt the government promises to repay. This is equated to when the government sells as much debt as they want to the central bank and get printed currency in return.

The same can also be said when the bank lends out money, it will also be creating debt-based money. When one then spends the money from the bank one would then use it as any other piece of currency though they will be owing the bank the money which will be returned to at a later date.

This study makes use of the demand for private credit as a proxy for money demand as it seeks to clearly make a distinction between the demand and the supply of money. The monetary aggregates or variables of interest vary among studies, based on the study's intentions as well as other variables of interest in the study. Literature on studies that have used both monetary aggregates as well as private credit is analysed in this section.

Sakib (2020) analysed the assumption that money demand, inflation and the interest rates are all cointegrated. The study made use of the real M1 money balances as well as the bond yields. Both variables were taken as the proxies for money demand. From the study, it was recommended that both the variables be used to model the monetary policy as they proved to have an almost similar effect on the inflation rate. Wang, Wright and Liu (2020) also recently developed a theory of money and credit as competing payment instruments. The study derived closed-form solutions for money demand and showed how to simultaneously account for the price-change facts, cash–credit shares in micro data, and money-interest correlations in macro data. The study results, for both fixed and variable transaction costs, and for different assumptions about the way households sample prices, the model delivers the exact money demand functions resembling classic results in the literature. These functions can match macro data, and at least the variable-cost model can match the money–credit shares in micro data making the use of either of the two in place of the other practical (Wang, et al., 2020).

In a study that has used both money supply and money demand proxies in the same study, long run cointegration was seen to exist between both the money supply and money demand variables and the inflation rate. Tang (2001) analysed the patterns between inflation and bank lending in Malaysia using the unrestricted Error-Correction Model (UECM) for the period 1973 to 1997. Using the Bounds test for cointegration, the study revealed that there existed a long-run equilibrium relationship between inflation and its determinants, namely import price, money supply (M3), bank credit (a proxy for money demand) and real income. Khan, Bukhari and Ahmed (2007) also incorporated both money supply and money demand variables in a single study to examine their effects on the inflation rate and the result was almost similar to that of Tang (2001). Khan, Bukhari and Ahmed (2007) analysed the inflation dynamics in Pakistan between 1972 and 2006 using the ordinary least squares method for analysis. The study made use of both the demand and supply side variables in the determination of inflation in the country. The variables in the study comprised of private sector borrowing as a ratio of real gross national product, government sector borrowing as a ratio of real gross national product, government taxes relative to the nominal value added to the product, exchange rate, import prices real demand relative to real supply, government taxes relative to nominal value-added in manufacturing sector GDP, adaptive expectations, wheat support/procurement price and the consumer prices (CPI). Looking at the monetary policy variables, money supply (M2) and credit policy (private sector credit) representing the money demand, results revealed that both variables were significant causes of inflation in Pakistan. Government sector borrowing was also a statistically significant variable.

Empirics have shown that an expansion of the credit in an economy can have adverse effects on the state of the economy. An imbalance can arise between credit growth and economic expansion, generating inflationary pressures on the prices of several assets. Moreover, increased indebtedness of households and businesses, in the long term can generate a financial crisis with negative repercussions on the rest of the economy (Allessi & Detken, 2018). Using broad credit as the proxy for the demand of credit, Alessi & Detken (2018) analysed the effects of increased bank credit on the economies of 28 EU countries from 1970 to 2012. The analysis from the study revealed that having increased credit in the economy increases the disposable income of both firms and individuals hence it increases money supply in the economy which if left uncontrolled can lead to increased inflation (Allessi & Detken, 2018)

Albulescu & Pepin (2018) tested the long run correlation between inflation rate and the money demand in Hungary, Poland and the Czech Republic. The study ran two models for both the closed and the open economy (which considers a currency-substitution effect). In the two estimated models, long-run money-demand parameters with the FMOLS method of Phillips were run and a cointegration test with Hansen's parameter instability test was also estimated. Money demand was proxied with the broad money (M3) monetary aggregate. The reasoning for the running of the two models enabled the researchers to see whether the consideration of a currency-substitution effect makes the money demand more stable in the long run. The results from the study showed that for the Czech Republic there was a long run correlation between money demand and the inflation rate as compared to the other two countries. This was attributed to the fact that in the Czech Republic bank deposits showed a higher proportion of domestic currency denominated deposits as compared to Hungary and Poland. This then supported or affirmed the assumption that in countries where the confidence in domestic currency is higher, the effect of currency substitution for monetary stabilization diminishes (Albulescu & Pepin, 2018). The same results were also in sync with the results of Kurniawan (2020) for the Jordanian economy. Using an ARDL approach the study reported that in both the short run and the long run, there is a positive and significant relationship between money demand as proxied by M2 and the inflation rate.

Awdwen (2016) investigated the factors that promoted private credit growth in Lebanon between the years 2000 and 2005. The study made use of both internal and external variables that could affect the demand for credit. The internal variables included bank size, capitalisation level, profitability, growth rate of customer deposits and riskiness while external variables were GDP growth, inflation rate, public debt, and financial inflows. The study used panel data analysis. The results of the study revealed that increases in the bank credit to the resident private sector was mainly influenced by the money supply, inflation, deposit growth as well as the GDP growth. Contrarywise, loan growth decrease was mainly caused by the other remaining variables. Katusiime (2018) also suggested a positive relationship between the demand for credit and the inflation rate. Katusiime conducted a study in Uganda which investigated the relationship that exist and the effect one has with the other of the growth in private sector credit and inflation volatility. The period of the study was 1995 to 2017 using monthly data. Using the OLS estimation technique, it was shown from the study that there was a one period lag relationship between the private sector credit growth rate and the inflation volatility. Also, private sector credit growth was significantly influenced by the one lagged variables of the private sector credit growth itself, nominal exchange rate, and inflation, while financial innovation (the ratio of M2 to M1), interest rates, and GDP growth appeared not to be important determinants of private sector credit growth.

A statistically significant relationship was also found in Reinhold (2014) used the SVAR modelling technique to the test the statistically significance empirical evidence of monetary policy effects on economic and financial activity in Namibia. According to the results of the study, shocks on the credit shock led to a considerable increase in the rate of inflation. However, the shocks on the credit shock did not significantly influence the commodity price inflation in the model (Reinhold, 2014).

Looking at the money demand function in a dollarised economy. Oomes and Ohnsorge (2005) analysed the correlation that existed between inflation and money demand in a dollarised Russia from 1996-2003. The rationale for the study was based on the fact that in a dollarised economy, the demand for money often appears to be highly unstable. This makes it exceedingly difficult to forecast and control inflation. The study employed two of the major theories of inflation i.e., the Mark-up theory of inflation and the Monetary Theory of inflation as the basis of the study. For the long run inflation model, the variables of the study were inclusive of the CPI index, exchange rate, unit labour cost index, price index for paid services. For the money demand model, the variables of the study were 12-month nominal ruble deposit rate, 12-month nominal ruble, U.S. dollar depreciation rate and the money demand proxied by broad money. In a bid to determine the monetary aggregate that provided the most stable money demand function, five different aggregates were used to estimate the money demand function. The monetary aggregates used were the ruble currency in circulation, ruble narrow money, ruble broad money, broad money and effective broad money. The long run inflation and money demand equations were combined in an equilibrium correction model to study the short run inflation dynamics. Results revealed that foreign cash holdings need to be considered when determining the inflation dynamics in a dollarised economy. A stable money demand function for Russia was found for “effective broad money,” which included an estimate of foreign cash holdings. Also, an excess supply of effective broad money was found to be inflationary, while other excess money measures were not, and that effective broad money growth had the strongest and most persistent effect on short-run inflation

On the contrary Korkmaz (2015) studied the effect of bank credit on inflation and economic growth in 10 European countries between 2006 and 2012. The study analysed whether bank credit had any impact on the macroeconomic variables, inflation and economic growth. The variables of the study included domestic credit provided by banking sector exclusive of credit to the central government, GDP and inflation. The study used panel data analysis. The results of study indicated that domestic credits created by the banking sector for the 10 European countries had no effect on the inflation level but rather on economic growth. Bavuile (2021) also found that there was no significant relationship between demand for credit , inflation and economic growth in Brazil, Russia, India, China and South Africa (BRICS) countries. Using an ARDL modelling approach, the study examined the linear co-integration and Non-linear Autoregressive Distributed Lag (NARDL) for the non-linear empirical analysis of the relationship between inflation, credit markets and economic growth in BRICS countries. Using the domestic credit to private sector as the credit proxy the results of the study showed that credit did not have a significant impact on growth even under different inflation thresholds. The results proved the non-applicability of the QTM as the bidirectional causality assumption could not be met. The overall findings of the study suggested that although inflation exerts various effects on growth, it does not have a significant impact on credit for all the countries except for China whereby credit in general is conducive to economic growth and Brazil where growth is enhanced when credit is declining (Bavuliye, 2021).

Now coming to the Zimbabwean economy, the studies that have analysed the relationship between money demand and the inflation rate seem to be in sync with each other. Jenkins (1999) studied the money demand and stabilisation in Zimbabwe between the years 1970 and 1995. The variables of the study were inclusive of real money demand, inflation rate, interest rate, wealth variable proxied by gross domestic income, availability of bureaucratically rationed credit and/or foreign exchange, as well as the availability of comparatively liquid alternatives to financial assets. Quarterly data was used for the analysis. The study used the Vector Auto Regressive modelling technique for analysis. Results showed a positive correlation between the demand for money and the inflation rates in Zimbabwe. The same result was also found by Muñoz (2006) who studied the supressed inflation and money demand in Zimbabwe.

The noticeable decrease in the velocity coupled with the increases in the real money balances in the year 2004 did not tally with the inflation that was being recorded during that time which was closely tracking the growth rates of monetary aggregates in the past. The study's variables included, real money balances (M3), the three-month time deposit interest rate, real GDP, price level, expected rates of change in interest rates and consumer price index and the parallel exchange rate. Monthly data from 1998:1 up to 2004:12 was used to analyse the variables using the Johanesen procedure. Results of the study revealed a stable money demand function, increases in the money demand (monetary aggregates) had a positive relationship with inflation rates. Empirical results indicated that, a stable demand for money as a function of parallel market exchange rate, inflation, and real output could be found in Zimbabwe during the period of study.

Mcindoe-Calder (2017) analysed money demand under the hyperinflation period looking at the period 1980 up until 2008. The study employed the use of the ARDL model for analysis. The exogenous dummy variables included in the study were the climate (drought), political (post-independence boom, civil war, judicial crisis) and economic (exchange rate appreciation and exchange rate auction). The endogenous variables were consumer price index (CPI), real money balances (M1), three-month time deposit rate, parallel market exchange rate (CER) data, government budget, overseas development assistance data (ODA), stock market returns, imports and trade-partner exports to Zimbabwe. Results revealed that there existed cointegration and long run relationship between the dependent and the independent variables, real money balances were cointegrated with the inflation rate.

3.2.3 Literature gap

Many studies that have tried to analyse the applicability of the QTM have mainly looked at Fisher's version of the QTM (Sanusi, et al., 2021: Sunge and Makamba, 2020; Maune, et al., 2020; Farooq, et al., 2015; Shafie, et al., 2022). The Cash Balance Approach to the QTM has been mainly used as a theory of money demand and has been mainly linked to the Quantity Theory of Money while using almost the same variables as those used in the transactions approach to the QTM. This section of the study explores the other arm of the QTM clearly distinguishing it from the transactions approach of the QTM.

Literature on money demand in post multicurrency era in Zimbabwe is still very scarce. Most of the previous studies that have tried to study and analyse money demand in the country have usually proxied the money demand variable with the monetary aggregates (M2 or M3) basing on the assumption that in an equilibrium state, money demand will be equal to the money supply. However, most studies that have tried to analyse both money supply and money demand, in the same study have made use of private demand of credit as a proxy for money demand and monetary aggregates as the proxy for money supply. This then makes this case study of great significance as there is still very limited studies that have aimed at studying the money demand dynamics in Zimbabwe not using the monetary aggregates as its variable but rather using private credit. In both the pre and post multicurrency era there is still very limited literature that has sought to analyse the research problems of this nature.

Most studies outlined above mainly made use of the error correction modelling technique as well as the Johansen cointegration modelling technique in order to bring out the analysis of their research. There is need to study the effects that macroeconomic shocks can cause to both the variable of interest as well as other macroeconomic variables. These shocks are the ones that also largely determine the movement in most economic variable. The use of the Structural Vector Autoregressive modelling (SVAR) technique is also still very limited in studying the money demand's role in causing inflation. Hence, this study attempts to address this yawning gap by employing the SVAR technique in exploring the relationship between money demand and inflation. The effects of the shocks to money demand and all the other variables of interest are studied to establish if they have any effect on the inflation rate. This will bring out a new dimension to the subject matter.

3.3 Research methods

Having reviewed the literature available on money demand and the price levels, this Chapter now proceeds to discuss the research methodology that it employed. The majority of studies that have explored the relationship between money demand and the inflation rate have mostly used the Error Correction Models (ECM) and the Johansen cointegration method of analysis. This study however employs the Structural Vector Autoregressive (SVAR) model as it studies the effects of money demand shocks and other variables of interest to the inflation rate. From the literature available, there has not been any study conducted in Zimbabwe in both the pre and post dollarization era that has examined the effect of shocks of the variables in this study to the inflation rate.

3.3.1 Analytical framework

After the adoption of the multicurrency system in Zimbabwe in 2009, for some period (2009-2014) the country solely used foreign currency as a medium of exchange and for all business and personal transactions. However, with the passage of time, authorities deemed it prudent to introduce a surrogate currency into the currency basket in November 2014 (RBZ, 2014). This currency was initially at par with the USD as authorities insisted that this was not a currency but rather just a fiat money which was aimed at easing business operations. However, in early 2019, the monetary authorities announced that the fiat money would no longer be at par with the USD but rather, was now becoming Zimbabwe's local currency which was now going to be rated against all other currencies (RBZ, 2019).

Because of this, the study period is therefore divided into two periods. The first period, 2009:02 up until 2014:11 is where the country was strictly using foreign currency as legal tender and 2014:12 up until 2019:02 when the country now had its own fiat currency (pegged at par with the USD) in the basket of currencies that were in circulation and the fiat money was not seen as a currency but just as a transaction enabler. This is done so as to separately analyse the impact of the monetary aggregates both in periods of sole use foreign currency as well as in periods when there was a local currency (fiat money) in the currency basket.

3.3.1.1 Unit root tests

Unit root tests were run before the estimation of the SVAR model. This is because macro variables are usually known for their non-stationarity. Unit roots tests were thus performed to check for stationarity. The Augmented Dickey Fuller (ADF) and the Phillips- Perron (PP) tests were used to test for the existence of unit root.

3.3.1.2 Diagnostics tests

A number of diagnostic tests and iterations were run ensure that the data fits econometrics standards in order to produce prudent results. Tests for the stability of the model were conducted by analysing the root of the characteristic polynomial in which all the roots lied within the unit circle. The optimal lag length was also estimated using the information criterion and also the use of the principle of parsimony.

Residual tests were conducted which included the Autocorrelation LM tests and the normality test. This was to ensure that before the SVAR was run, the model residuals characters and the model's assumption were consistent with each other. To enable the estimation of the SVAR model and the obtaining of the impulse response function and the variance decomposition it became necessary to use the structural shocks rather than the forecast errors.

3.3.1.3 Structural vector autoregressive models (SVAR)

Structural Vector Autoregression (SVARs) are a regression model which has a multivariate, linear representation of a vector of observables on its own lags (Kratzig, 2004). The SVAR models combine the basic structure of the VAR approach with a number of widely accepted restrictions derived from economic theories used on traditional macroeconomic modelling (Systematic Risk and Systematic Value, 2017). In this modelling technique, the regression must be based on certain economic theories, thus making use of the SVAR a perfect model to use in this study to examine the applicability of these economic theories in today's economies. In this model the analysis of the effect the contemporaneous variables have on the CPI variable was analysed since in SVAR, mathematical statements about how a set of observable endogenous variables are related to another set of observable explanatory variables is made.

From the general VAR model, the dynamic movements of endogenous variables are described by their own past values as:

$$x_{t} = k + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \ldots\ldots + \beta_p x_{t-p} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots \text{(3.8)}$$

Where: x_t is a vector of endogenous variables at time *t*, k is a vector of constants, β's are matrices of coefficients, p is the number of lags included in the system and μ_t is a vector of residuals. The above equation above can also be expressed as:

$$x_{t\,=}\;k+\beta(L)x_{\;t}+\mu_t \text{…………………..} \quad (3.9)$$

Where L is the lag operator.

The above VAR is a generalised model, which imposes no restrictions on the form of B (L) which is the dynamic relationship between the variables (Kratzig, 2004) .

The SVAR model taken from the VAR model can then be identified as:

$$A_0X_t = A(L)X_{t-1} + \varepsilon_t \text{…………………………} \quad (3.10)$$

X_t is a vector of endogenous variables and the matrix A_0 is of order *n x n* and it describes the contemporaneous relationships between the variables.

A (L) is a non-singular matrix of coefficients and L represents the Lag operator.

ε_t Is the vector of structural shocks of order *N x 1*.

Note: It is important to know that exogenous variables can also be added into the model as is in this study as contemporaneous variables.

The equation above is in the structural form, thus OLS estimation is not possible. The equation must then be changed into its reduced form by multiplying it with an inverse matrix A_0^{-1} (Kotze, 2019). Putting the equation in the reduced form is necessary as equation 3.8 is not directly observable and the structural shocks cannot be correctly identified. This therefore results in the following equation:

$$X_t = A_0^{-1}\,A(L)X_{t-1} + e_t \quad \text{…………………………} \quad (3.11)$$

e_t is an *n x 1* vector of serially uncorrelated structural disturbances of the model. The vector is obtained as:

$$A_0e_t = \;\varepsilon_t \; or \; e_t = A_0^{-1}\varepsilon_t \text{ ……………………} \quad (3.12)$$

One of the assumptions of the SVAR methodology is that there is no correlation between shocks as it assumes that shocks come from distinct independent sources. However, there is correlation in the error-series reduced form VARs (Killian,2011). One way to view these correlations is that the reduced-form errors are combinations of a set of statistically independent structural errors. The most popular SVAR method of identification is the recursive identification method. This method (used in the original Sims paper) uses simple regression techniques to construct a set of uncorrelated structural shocks directly from the reduced-form shocks (Whelan, 2016).

Method of identification: The recursive identification system (Cholesky decomposition)

In the recursive identification method, certain restrictions are put on the model and the model identification tests conducted. Sufficient restrictions were imposed to get the system to be just identified. This was done so that all the structural innovations from the reduced for VAR could be recovered. For the SVAR model to become identified, a certain number of restrictions which must equal to k(k-1)/2 were imposed, where *k* was the number of variables in the model (Whelan, 2016).

In order for the ordering of the variables and the imposition of restrictions to make economic sense, it should be supported by economic theory and or economic rationale. A restriction may be imposed based on the tenets of a certain economic model or an encompassing model that includes various alternatives to structural models (Kotze, 2019). Often times, economic theories may not provide the prerequisite information for use to the dynamic specification of the relationship between variables in a model, this is where economic rationale as well as prior empirical use comes into play. There can be also other factors that can also influence restrictions such as information delays, physical constraints, institutional knowledge and market structure (Killian, 2011).

In this study, the recursive identification system, based on the Cholesky decomposition is used to identify the model. Recursive identification assumes that the error terms in the model are not constructed to be correlated with each other but are allowed to be correlated with the repressors in the set of linear equations (Whelan, 2016). The ordering of the variables is such that a variable that is placed on top is to the most exogenous (it is only affected by a shock to itself at time *t*) variable in the study and the one that is placed on the bottom must be the most endogenous variable i.e., the dependent variable of the study (Whelan, 2016). Each variable contemporaneously affects all the variables ordered afterwards, but it is affected by a delay in them. According to Whelan (2016), the ordering of the variables in the SVAR identification should be influenced by theory and or empirics.

The recursive structure of the VAR was used for the model identification. This showed how individual variables in the study affected the other variables, especially the CPI. Following literature (Raidi (2011), Ayutuc (2013) and Mariyama (2008)), international oil prices is treated as the most exogenous variable in the study. Due to its nature of being a foreign variable, it is assumed that all the variables in the study are affected by the oil prices but these variables cannot affect it in return. The foreign exchange rate (USD/ZAR) is also treated as the second most exogenous variable. Due to the nature of the economy during the multicurrency era, the exchange rate is being imposed on the local market since there is no local currency being used in the economy. All the domestic variables will not have an effect on the exchange rate, but however, this exchange rate will be affected by the international oil price, hence it was ordered second. The rationale behind this is that changes in the international oil prices tend to have effects on the major currencies in the world, and also South Africa being an importer of oil, changes to its prices will have an effect on its currency.

The shocks on the nation's income usually tend to affect all other variables in the economy. In this study, these shocks however do not have any effect on the exogenous variables i.e., the international oil prices as well as the ZAR/USD exchange rate but rather tend to affect all the other endogenous variables (variables that are particular to the Zimbabwean economy). When the government increases its expenditure, it stimulates the nation's aggregate demand and this in turn increases the national output/income (Keynes, 1936). Increased national income will have a direct positive effect on the population's spending habits and money demand will thus increase. When people's level of income increases, they prefer to hold more money to support their increased spending on transactions, this then leads to increases in the money demand.

Interest rates are also affected by the exogenous variables as well as the income variable. When the people's income increases, *ceteris paribus*, it means that people will have more disposable income and their savings rate will thus be also affected by the variations in national income. Changes in the savings behaviour of the nation will therefore have an effect on the savings interest rates that will exist in the country. El-Seoud (2014) supported that in the short run, increases in the national income have positive effect on national saving. According to the life cycle hypothesis, a person's consumption and savings pattern in a particular life period is determined by their expectations about lifetime income. The theory alludes to the fact that people tend to be save a lot during their productive years and then consume those savings during the retirement period. Given that, growth of per capita income will result in an increase of aggregate savings rate, because it increases the lifetime earnings and savings of younger age groups relative to older age groups. Therefore, it is expected that economies that have a higher

GDP growth rate and so higher per capita growth rate are expected to have higher savings ratios than countries with lower growth rates and the opposite is true. (El-Seoud (2014).

According to the Cash Balance Approach, the demand for money depends on income and also the interest rates. The theory asserts that an individual inspires one's spending habits and thus, the number of transactions one conducts (Wang, 2016). It will also determine how much a person can spare his savings. However, this decision to save or to consume will also be determined/ influenced by the opportunity cost of holding that money as real cash as opposed to investing it and then earn an interest from it. This analysis therefore influenced the ordering of this variable in the fifth place. In this study, the money demand variable was influenced by the international variables as well as the income and the interest rate variables as explained above.

Lastly the objectives of this study determined where the CPI would be placed in the ordering rank. CPI is placed last due to the fact that this study scrutinizes how the shocks of all the above-mentioned variables affect the CPI. This therefore means that CPI is deemed not to affect all the earlier placed variables simultaneously, but rather with a lag. Inflation is posited to be affected by changes in the oil prices, money demand, foreign exchange rate changes, interest rates and aggregate demand shocks.

This ordering of the variables implies that A_0 is given by:

$$A_0X_t = \begin{bmatrix} 1 & 0 & 0 & 0 & 0 & 0 \\ A_{21} & 1 & 0 & 0 & 0 & 0 \\ A_{31} & A_{32} & 1 & 0 & 0 & 0 \\ A_{41} & A_{42} & A_{43} & 1 & 0 & 0 \\ A_{51} & A_{52} & A_{53} & A_{54} & 1 & 0 \\ A_{61} & A_{62} & A_{63} & A_{64} & A_{65} & 1 \end{bmatrix} \begin{bmatrix} loil_t \\ lzarusd_t \\ lcap_t \\ lmd_t \\ llr_t \\ lcpi_t \end{bmatrix} \ldots\ldots\ldots\ldots (3.13)$$

From the matrix above, it can be observed that the ordering of the variables is not unique hence, the study relying on economic theories to justify the identification scheme.

3.3.1.4 Impulse response function

After running the SVAR regression, in order to examine the effects of the shocks of each variable to the other variables, the impulse response function (IRF) was run. These functions basically show/ track the impact of any variables/ shocks to that variable on others in the model system (Kilian and Lutkepohl, 2017). The IRF is used in studying the empirical causal relationships as well as the policy effective analysis. The IRF function describes the progression of the variable of interest along a specified time horizon after a shock in a given moment (Lin 2006). In this study, the IRF shows how the dependant variable (CPI), responds to the shocks of the independent variables shocks (international oil prices, money demand, exchange rate, interest rate and income). However, in this study, greater emphasis is made on the effect of a shock on the money demand variable to the CPI as that is the overall objective of this study.

In order for the IRF to produce the correct results, the ordering of the variables in the SVAR analysis should be done appropriately. This is so because the IRF is generally affected by this ordering. The results of the IRF differ when the ordering is changed, hence ordering of variables is of paramount importance in an SVAR model. In the model outlined above, the lower triangular matrix chosen's interpretation is that an impulse/shock in the first variable can have an instantaneous impact on all other variables as well, whereas an impulse in the second variable can also have an instantaneous effect on the third to last variables but not on the first one, and so on (Lütkepohl, 2010).

3.3.1.5 Forecast error variance decomposition

After the running of the IRF, the forecast variance decomposition was then run. This showed how much each variable caused variations in the dependant variable i.e., the CPI. The variance decomposition analysis illustrates the comparative significance of each of the variables in the study (Kilian and Lutkepohl, 2017). The variance decomposition shows the importance of each variable in the model (inclusive of the dependant variable, CPI) in explaining the variations in the dependent variable (CPI). This is shown by the allocation of percentages to each variable attributable to innovations in all the variables included in the system (Sugiarto 2015). In the analysis, in each lag, each variable has a percentage that shows how much it contributes to the changes in the dependant variable. The total of all these figures should equal to a hundred and the variable with the highest value is the variable that explains variations in the dependant variable the most during that lag. An analysis was made using all the lags to analyse the variables that determine the variations in the dependant variable the most over time. The effects may differ from period to period and this may be explained by the different events that will be occurring in the economy, and some of these effects may have some economic stimuli behind them.

3.3.2 Data sources and characteristics

Data that was used in this study was obtained from the Reserve Bank of Zimbabwe (RBZ) website, the International Monetary Fund (IMF) website and the South African Reserve Bank. The study used monthly data from 2009:02 up until 2019:02. Though the main goal of this Chapter is to analyse the effects of the money demand shocks on inflation. There are also other variables other than money demand which also affect the price levels in economies, hence the inclusion of other independent variables as outlined below. The variables to be studied for the main objective of this Chapter are:

Consumer Price Index (CPI): The study made use of the Zimbabwean CPI for the period under review. Consumer Price Index was used as a measurement for the inflation rate. Just like in the previous chapter, CPI has been defined as comprehensive measure used for estimation of price changes in a basket of goods and services representative of consumption expenditure in an economy (Oxford, 2013).

In Zimbabwe, the calculation of the inflation rate is based on the different weights that are put of different baskets of goods/services. The data for compiling the inflation rates weights and basket was taken from the Poverty Income Consumption and Expenditure Surveys conducted by Zimbabwe National Statistics Agency (ZIMSTAT) which is the only official statistics agency Zimbabwe. The weights assigned to the commodities reflect the commodities relative importance to households' expenditures.

In compiling the Consumer Price Index, the ZIMSTAT uses the United Nations guidelines and manuals to make sure that their calculations comply with universal standards. They make use of the Modified Laspeyres method which the United Nations strongly recommends. This method compares the current commodity prices to prices in the previous periods. The use of the geometric mean in calculating averages is used instead of the arithmetic mean. The structure of the CPI basket is based on the internationally agreed Classification of Individual Consumption according to Purpose (COICOP) (The Herald, 2018). The baskets consist of 12 divisions, 41 groups, 83 classes and 117 sub-classes in total.

Money demand: the demand for money can be defined as a representation of the desire by an individual or household to hold his assets in a from that can easily be changed for goods and or services (Sakib and Nazmuz, 2021). Demand for private credit was used as proxy for the demand of money. The use of the monetary aggregates which are normally used as proxies is not applicable as they have already been used in the preceding Chapter. Demand for private credit is seen as a suitable proxy for money demand. The creation of credit is effected when commercial banks advance loans and purchase securities. Money is lent to businesses and individuals out of the deposits accepted from the public, hence credit is created from the money that will already be in circulation. For example, in the United Kingdom Cash, (notes and coins) accounts for only 3% of the money in circulation, whilst the remaining 97% of the money in circulation comprises of credit money that has been created by banks (Maurice, 2018). Bank deposits account for approximately 97% of the money supply in the United Kingdom economy. Bank deposits are sometimes referred to as 'credit money' because the majority of bank deposits were originally created by banks issuing new loans.

The analysis from the study revealed that having increased credit in the economy increases the disposable income of both firms and individuals hence it increases money supply in the economy which if left uncontrolled can lead to increased inflation (Allessi & Detken, 2018). Also in Zimbabwe, it has been proven argued and shown that the majority of the loans issued out by banks and the micro finance institutions has been mostly for consumption purposes and not for productive purposes hence a positive relationship between the two variables is warranted (Sunge and Makamba, 2020). In simplistic terms of relation, when more individuals and entities are able to borrow more money from banks and other lenders, this results in consumers having enough money to go on their businesses (spending), this spending causes an economic growth and as such, so does inflation. Money demand is expected to have a positive relationship with inflation, *ceteris paribus* (Sakib and Nazmuz, 2021).

Income (GDP): Grand market capitalisation is used to represent the income variable in this study, in line with what was done by Sunge and Makamba (2020). This is done due to the fact that the monthly GDP figures which are usually used as proxies for national income are not readily available. For stock market investors, growth in GPD is important. The performance of the stock exchange closely mirrors the performance of the GDP in the country. As the grand market capitalisation increases, income will also be increasing, hence increases in the GDP. Empirics usually favour between the manufacturing price index (Masiyandima, et al., 2018) and the industrial price index as proxies for the GDP. However, no consensus has been made as to which of the two is the better proxy. In the Zimbabwean case, both indices are included in the grand market capitalisation figure, thus this study deemed it fit to take it as a proxy for the GDP.

The main contributors to economic activity in Zimbabwe are the mining sector, agriculture sector and the manufacturing sector. These three main sectors are largely represented on the Zimbabwe Stock exchange and make up the indices together with other counters from other economic sectors of the economy. In that regard, the ZSE Market Capitalization figure may be seen to mirror to a large extent, the economic activity of a nation, especially Zimbabwe. However, there could be incidences where the aforementioned proposition might not be observable, especially when the stock market performance is driven by sentiments or speculative activity. However, speculation and sentimental effects of investors are usually short termed as the baseline performance fundamentals of the stocks usually help to correct the situation. Nevertheless, the main driver of the stock exchange remains largely the performance of the baseline real economic sectors from which the counters operate from. In addition to the aforementioned, during the period of study, the country largely used the USD, a stable currency, subject to less manipulation and thus there was minimal speculative activity linked to the performance of the Market Capitalization. Therefore, a positive relationship between the income variable and the inflation rate is thus expected given the tenets of the Keynesian economics of the relationship between national income and the inflation rate. When the government increases its expenditure, it stimulates the nation's aggregate demand and this in turn increases the national output/income. Increased national income will have a direct positive effect on the population's spending habits and money demand will thus increase. When people's level of income increases, they prefer to hold more money to support their increased spending on transactions, this then leads to increases in the money demand.

International Oil prices: This is the international price of crude oil in US Dollar per barrel. Zimbabwe as a small open economy which is import dependant is prone to international macroeconomic shocks. Zimbabwe relies heavily on oil for most of its productive sectors. This is due to the fact that oil is a major substitute of electricity in the country. This means that shifts in the international oil prices have an impact on the general price levels of goods and services in Zimbabwe via the cost push inflation, thus prompting the inclusion of the variable. Due to these increases in the price levels, the economy's nominal demand for money hence tends to increase so as to cater for the increases in the price levels. All other things unchanged, the higher the price level, the greater the demand for money which ultimately leads to an increase in the inflation rates. Thus, the expected sign of the international oil price is a positive one.

Exchange Rate: Like previously defined, the exchange rate is the the rate at which a country's currency can be changed for the currency of another country (Oxford, 2013). In this section of the study, the exchange rates represent the rate at which the South African Rand was exchanged for the US Dollar. Zimbabwe's trade statistics show that Zimbabwe's biggest trading partner both in exports and exports is South Africa. Due to the nature of Zimbabwe being more of an importer rather than an exporter, this makes it vulnerable to shocks on the currencies of its trading partners. South Therefore, movements in the value of the Rand against the USD are expected to have an effect on the price levels in Zimbabwe as evidenced by the studies of Pindirii (2012), Kavilla and LeRoux (2016), Maune, et., al (2020) .

Interest rates: This study makes use of the average lending rate as its proxy for the interest rate. Average lending rates were sourced from Reserve Bank of Zimbabwe which consolidated monthly returns from all the specific banks' lending rates to both individuals and corporates. The average captures all economywide attributes of the lending rates and were collated by the Zimbabwean Reserve Bank on a monthly basis from banks' monthly returns. Generally, interest rates are a cost to borrowing and in that regard an increase in lending rates, ceteris paribus, will likely stall inflation as that discourages supply of money in the economy. High interest rates are often a key ingredient in inflation stabilisation programs especially in nations that have suffered high inflation. Policy makers usually resort to tight interest rate policy even though exchange rate may be used as a nominal anchor (Ruch, 2021). The use of tight interest rate policy usually slash liquidity in the market and thus control inflation. This has been useful in Israel (July 1985) and in Argentina there were also stabilisation plans such as Austral (1985), Primavera (August 1988) and Bunge Born (July 1989) which were all successfully supported by interest rate. (Calvo & Végh, 1995)

3.4 Results, interpretations and analysis

This section of the Chapter brings to light the procedures that were followed to arrive at the objectives that this study sought to achieve. Results interpretation as well as their analysis is also provided. The complete period of study was distributed into two periods so as to properly capture the behaviour of the variables of interest given what was occurring in the economy during the entire period of study. The first period of the study is from 2009:02 up until 2014:11. During this period, Zimbabwe was using a multicurrency system and only foreign currencies were used for all financial transactions. The USD and the ZAR were the major currencies used amongst the other currencies. The second period covers the period from 2014:12 up until 2019: 02. During this period, the authorities had introduced own surrogate local (Zimbabwean) currency into the currency basket. This currency was put at par with the USD during this time of study. Broadly, the results are structured in such a way that there are pre-modelling checks, the modelling of the Structural VAR, post modelling checks and interpretation thereof.

It is also critical to note that the variables in the study are international oil price, Rand/US$ exchange rate, income, money demand, interest rate and inflation denoted by loil, lzarusd, lcap, lmd, llr and lcpi, respectively.

3.4.1 Empirical analysis: 2009: 02 to 2014: 11

3.4.1.1 Stationarity tests

Stationarity test results are not that necessary when running SVAR models. As demonstrated by Sims et al. (1990), consistent estimates of VAR coefficients are obtained even when unit roots are present. In light of the results in Sims et al. (1990), potential non-stationarity in the VAR under investigation should not affect the model selection process. Moreover, maximum likelihood estimation procedures may be applied to a VAR fitted to the levels even if the variables have unit roots; hence, possible cointegration restrictions are ignored. This is frequently done in SVAR modelling to avoid imposing too many restrictions, and this approach is followed in this study.

3.4.1.2 Ordering of variables

The study imposed the Cholesky decomposition, which assumes that shocks or innovations are propagated in the order of loil, lzarusd, lcap, llr, lmd and lcpi. This is a recursive contemporaneous structural model which gives rise to a Just-identified Structural VAR Model.

3.4.1.3 Estimation of an unrestricted VAR with appropriate Lag Length

The first step towards the estimation of the unrestricted VAR (p) with the appropriate lag length was to estimate a VAR (2) model encompassing all the variables, using the ordering proposed above where *p* is an arbitrary lag length.

In this study, the information criterion was employed to determine the correct lag length to use. Results of the information criterion are shown in Appendix 2B. According to the Final Prediction Error, Schwarz information criterion and also the Hannan-Quinn information criterion, the appropriate lag for use in this study was 1. However, the sequential modified LR test statistic (each test at 5% level) suggests 3 lags while the Akaike information criterion suggests 6 lags. Overall, 1 lag was the proposed lag at this point following the principle of parsimony. The proposed VAR (1) model had to undergo some diagnostic checks to ascertain suitability. A summary of the diagnostic checks is provided in Table 3.1 below.

Table 3.1: Residual Tests

	Serial Correlation	**Normality Test**	**Stability Test**	**Conclusion**
VAR (4)	There is no Serial Correlation	Normally distributed	VAR satisfies the stability condition	VAR (4) satisfies the two critical diagnostic checks

Source: Author's Estimations

The actual diagnostic tests results are presented below.

Table 3.2: Residual Serial Correlation LM Test

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
4	43.07921	36	0.1942	1.228805	(36, 134.5)	0.2005

Source: Author's Estimations

Table 3.3: Residual Normality Test

Component	Jarque-Bera	df	Prob.
Joint	11.07691	12	0.5223

Source: Author's Estimations

Stability Test

According to the stability tests results shown in appendix 2B, no root lies outside the unit circle therefore the VAR satisfies the stability condition.

A VAR (1) was run as suggested by the information criterion and then some diagnostic checks on the model were done. The results indicated that the model was not stable. This followed some iterative process of running different VAR(p) with different lags and then checking them for serial correlation, normality test and also stability test. Overall, a lag length of 4 was used as this satisfied all the diagnostic tests that were necessary to run a Structural VAR(p) model. Other lags, from Var (1) to Var (3,) suffered from residual serial correlation and non-normality.

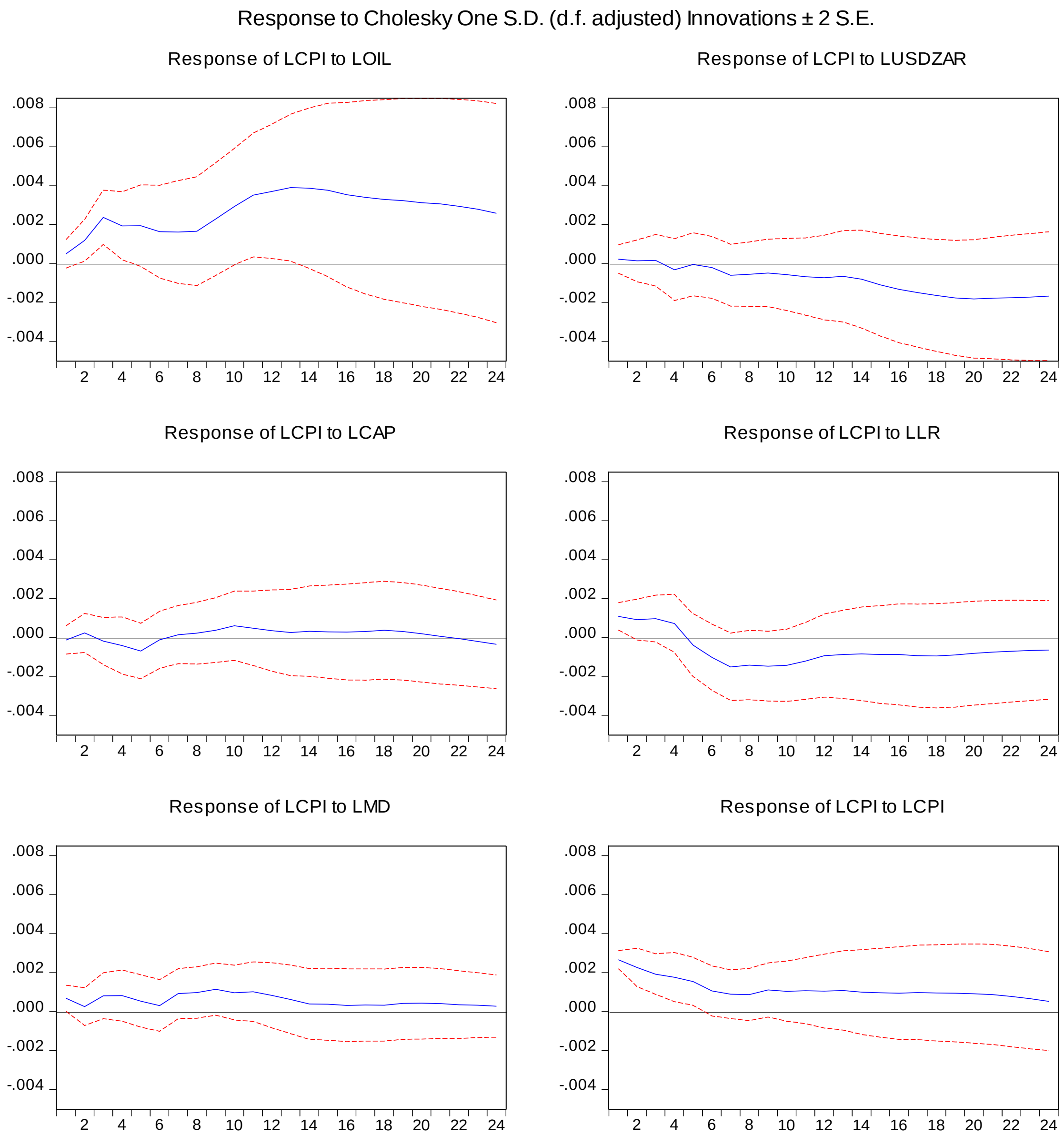
3.4.1.4 Estimation of the unrestricted SVAR

Having done some diagnostic tests for normality, stability and serial correlation, an unrestricted VAR with 4 lag was suggested and the detailed output of the VAR (4) is provided in Appendix 2A. After this, an SVAR model was then run which employed about 51 restrictions on the A-B Matrices in order to make the resultant SVAR model just identified. Restrictions are equal to $(3n^2 - n)/_2$, where *n* is number of variables.

Impulse response functions

According to the impulse response functions output detailed below, in response to a positive one-standard deviation structural shock to international oil price (Loil) and income (Lcap) responds positively, with oil being insignificant during the first few periods and income insignificant in all lags. The response of inflation to oil price (loil) shock is positive and significant between the second period and the 4th period. The estimated results do not show any significant response of CPI to shocks on Income and the Rand/USD exchange rate (lusdzar). Inflation responded contemporaneously and positively to lending rate shocks, however, the response is only significant in the first 3 periods. A shock on money demand (lmd) caused a positive response that was insignificant on inflation during the entire period. Money demand did not contemporaneously affect inflation. Lagged variables of inflation had a contemporaneous effect on current inflation. The relationship was positive and significant during the first 5 periods. Most effects of the shocks tend to be permanent as new equilibriums are created due to these shocks (loil, lusdzar, llr lcpi, lmd). Shocks to lcap seem to be of a temporary nature as the effects tend to go back to the initial position after the first shock.

Figure 3.1: Impulse response function



Source: Author's Estimations

Forecast error variance decomposition

The percentage of variation explained by Oil price (loil) exponentially increases from 2.8% to 52.7% at period 12 and then gradually increases to 65.1% at period 24. Oil price's explanatory power increases as time goes on and explains the greater portion of inflation in the long run. This is expected as Zimbabwe is a net importer of oil and prices respond with a lag. The portion of inflation explained by Rand/USD exchange rate, income, money demand and lending rates was largely less than 14% during the entire 24 periods. Of particular interest is the money demand variable (Lmd) which at lag one came third in terms of explaining inflation. In fact, money demand explains about 5% of CPI on period 1, showing that the explanatory power was weak. CPI explains 78% of its own variation. Overall, at the beginning of the period, Lending rate and CPI had more explanatory power when it comes to determining inflation while at the end of the 24 lags oil and CPI were the two highest contributors of changes in the CPI respectively while money demand was ranked fourth after the USD/ZAR exchange rate.

Table 3.4: Variance decomposition for LCPI

Period	S.E.	LOIL	LUSDZAR	LCAP	LLR	LMD	LCPI
1	0.051	2.757	0.569	0.178	13.022	5.141	78.332
6	0.106	36.506	0.506	1.630	9.740	4.664	46.953
12	0.121	52.704	2.051	1.429	13.050	6.731	24.036
18	0.125	64.717	5.200	1.032	9.248	4.106	15.697
24	0.127	65.146	9.985	0.861	7.923	3.291	12.794
Cholesky Ordering: LOIL LUSDZAR LCAP LLR LMD LCPI							

Source: Author's Estimations

3.4.2 Empirical analysis: 2014:12 to 2019: 02

3.4.2.1 Stationarity tests

Though not a necessity in the SVAR models but just to appreciate the nature of the data used in the study, for the purpose of running stationarity tests, the Augmented Dickey Fuller (ADF) and the Phillips Peron (PP) tests were used in this research. The results from the tests however showed that some variables were only stationary after first differencing with some stationary at level. It remains imperative to note that stationarity test results are not that necessary when running Structural VAR models.

3.4.2.2 Ordering of variables

The study imposed the Cholesky decomposition, which assumes that shocks or innovations are propagated in the order of loil, lzarusd, lcap, llr, lmd and lcpi. This is a recursive contemporaneous structural model which gives rise to a Just-identified Structural VAR Model.

3.4.2.3 Estimation of an unrestricted VAR with appropriate lag length

The first step towards the estimation of the unrestricted VAR (p) with the appropriate lag length was to estimate a VAR (2) model encompassing all the variables, using the ordering proposed above where *p* is an arbitrary lag length. The output for the unrestricted VAR (*p*) is given under the Appendix 2A.

The Information criterion was employed to determine the correct lag length to use in the study. The results of the information criterion are shown in Appendix 2B. According to the Schwarz information criterion and the Hannan-Quinn information criterion, the appropriate lag for use in this study was 1. However, the Final Prediction Error (FPE) and the sequential modified LR test statistic (each test at 5% level) criteria suggest 2 lags while the Akaike Information Criterion (AIC) suggests 4 lags. Overall, 1 lag was the proposed lag following the principle of parsimony. The proposed Var (1) model underwent some diagnostic checks to ascertain suitability. If a model failed to satisfy the checks, a model with a higher lag was chosen to undergo the same checks and at times a trend had to be added to stabilize the model. A summary of the diagnostic checks is provided in Table 3.5. Detailed diagnostic tests are given under Appendix 2B.

Table 3.5: Residual Tests (2nd Period)

	Serial Correlation	**Normality Test**	**Stability Test**	**Conclusion**
VAR (1) With a time trend component.	There is no Serial Correlation	Normally distributed	VAR satisfies the stability condition	VAR (1) with a trend satisfies the critical diagnostic checks

Source: Author's Estimations

The actual diagnostic tests results are presented below.

Table 3.6: Residual Serial Correlation LM Test (2nd Period)

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	59.67265	36	0.0078	1.795264	(36, 143.3)	0.0085

Source: Author's Estimations

Table 3.7: Residual Normality Test (2nd Period)

Component	Jarque-Bera	df	Prob.
Joint	304.9176	12	0.0000

Source: Author's Estimations

Stability Test

According to the stability test results shown in Appendix 2B no root lies outside the unit circle therefore the VAR satisfies the stability condition.

After some iterative checks, the VAR (p)'s continued to defy the stability test and remained unstable as lags increase. In order to correct the issue of stability, a time trend was added to the model VAR (1) and it became stable. Overall, a lag length of 1 with a trend was used as this satisfied the critical diagnostic tests that were necessary to run a Structural VAR (p) model.

3.4.2.4 Estimation of unrestricted SVAR

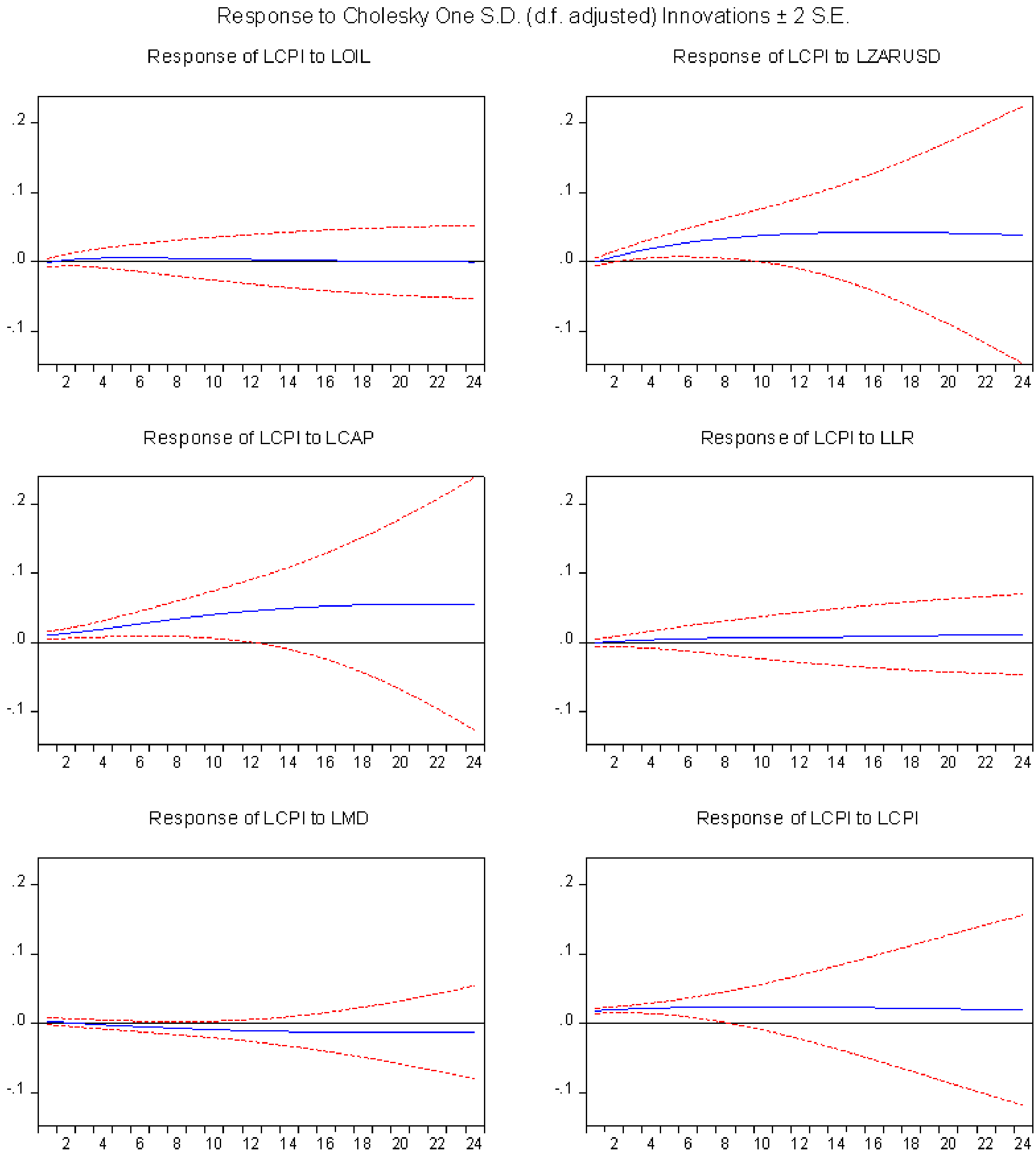
Having done some diagnostic tests for serial correlation, normality and stability, an unrestricted VAR suggested with a lag of 1 and a time trend component was suggested and the detailed output of the VAR (1) with a trend is provided in Appendix 2A.

The SVAR (1) model employed about 51 restrictions on the A-B Matrices in order to make the resultant SVAR model just identified. Restrictions are equal to $(3n^2 - n)/2$, where n is number of variables.

Impulse response functions interpretation

The impulse response functions output detailed in Figure 3.2 below show that in response to a positive one-standard deviation structural shock to international oil price (loil), lending rates and money demand does not significantly affect inflation (lcpi). However, a positive one-standard deviation structural shock to income impacts inflation (lcpi) positively and significantly during the first 12 periods. Results show that income is contemporaneously impacting on inflation. The Rand/USD exchange rate (lzarusd) shock has a positive effect on CPI that is significant between the 2nd and 8th period. However, the effect is insignificant during the other periods. Shocks to all variables except to international oil prices seem to be of a permanent nature as new equilibriums are formed with the passage of time.

Figure 3.2: Impulse response functions: (2nd Period)



Source: Author's Estimations

Forecast error variance decompositions

The explanatory power of the three variables in explaining inflation is very insignificant. Results also showed that USD/Rand exchange rate has a lagged effect in terms of determining Zimbabwean inflation. In fact, period one explanatory power of the exchange rate is insignificant, and the contribution increases to 5% in period 2 only to surpass 30% at period 7 and thereafter, the variance that was explained by exchange rate averaged 34%. At period one, income (at 24.4%) explained more of inflation variation, besides the inflation variable itself (at 72.6%). Results also showed that USD/Rand exchange rate and income explained more of inflation variation in the long run.

Table 3.8: Variance decomposition for LCPI (2nd Period)

Period	S.E.	LOIL	LUSDZAR	LCAP	LLR	LMD	LCPI
1	0.083	0.582	0.011	24.391	0.015	2.356	72.644
6	0.134	2.264	28.216	31.174	1.349	0.706	36.290
12	0.184	1.162	35.548	39.906	1.629	1.725	20.030
18	0.231	0.619	34.833	46.063	1.764	2.291	14.430
24	0.269	0.405	33.049	50.056	2.069	2.563	11.858

Cholesky Ordering: LOIL LUSDZAR LCAP LLR LMD LCPI

Source: Author's Estimations

3.4.3 Discussion of results

The purpose of study was to ascertain whether the Quantity Theory of Money (QTM) basing on the cash balance approach held sway during the period Zimbabwe was using a multicurrency system. The regression from this section investigated how money demand (dependant variable) being looked at from the view of the QTM relates to the other variables of interest, especially the CPI during the period when Zimbabwe used multi-currencies. In essence, for the QTM to hold, a specified percentage change in the money demand must result in a similar level of inflation or deflation. In other words, the greater proportion of inflation (money demand) should be explained by money demand (inflation). Even shocks to either of the two variables should contemporaneously affect the other.

Considering the impulse response functions for the first period, to answer whether shocks to the money demand had any influence on the CPI, the response of inflation to shocks in money demand were not contemporaneous and were insignificant though there was a slight movement from the initial equilibrium levels. Therefore, it can be concluded that there was not enough evidence to support the holding of QTM during the period when there was no local currency in the currency basket as changes in money demand did not contemporaneously cause changes in inflation levels. Katusiime (2018) also concluded that demand for private credit also affect inflation rates with a lag. The shocks to money demand had a positive impact on the changes in the inflation rates though they were insignificant during all the 24 lags. Korkmaz (2015) and Bavuile (2021)also concluded that increases in the money demand as proxied by increases in bank lending did not have any statistical significance in affecting the domestic inflation rates. Now looking at the variance decompositions of inflation, the percentage of variance explained by money demand was 5% at lag one and more was explained by inflation itself. From that we can ascertain and conclude that the theory did not hold during the first period though changes brought by shocks to the money demand caused changes in the inflation rates though not proportionally. This is so because a given percentage change in the money demand did not result in a corresponding level of inflation or deflation. What is of note is the way international oil prices change from contributing a mere 2.8% to changes in the inflation rates during the first lag to becoming the variable that contributes the most to changes in the CPI at the end of 24 lags.

Now looking at the period when the country had now introduced its own local currency into the currency basket, the IRF show that the response of inflation to shocks in money demand were also largely insignificant. Also, money demand did not contemporaneously trigger changes to inflation. The USD/ZAR exchange rate and the income variables had periods in which changes in these variables positively and significantly caused changes in the inflation levels. The relationship was also noted to be negative during the entire 24 lags. This result concurs with Tinoco-Zermio et al (2011) who also found an inverse relationship between demand for credit (money demand proxy) and the inflation rates. Now looking at the numerical contribution of each variable to changes in the inflation rates, the percentage of variance explained by money demand was insignificant at period one as well as with increases in the time periods. This therefore meant that money demand did not contemporaneously trigger inflation. We can therefore conclude that there was no sufficient evidence to support the holding of the Quantity Theory during the second period of study.

What could be of interest to analyse is the fact that during the period that the country had no local currency in circulation, the effects of shocks on the money demand to inflation rate was positive while looking at the second period, the effects were of a negative nature. Regardless of this difference, during both the time periods, the relationship and effects of the shocks were insignificant to cause changes in the inflation rates. These changes may stem from the fact that since during the first period, there now had been a sort of normalcy that was brought back by dollarization, economic players and even individual citizens now tended to demand more money as economic activity had picked up after the adoption of the multicurrency system. The non-significance of the money demand shocks on the inflation rate was also supported by Korkmaz (2015) and Bavuile (2021) who found that there was no significant relationship between the demand for credit and the inflation rates, the inflation rate.

Cohen (2002) also supports the fact that total dollarization reduces transaction costs by eliminating expenses in currency conversion or transactions in hedging, hence increasing money demand. However, with the introduction of the fiat currency at par with the US Dollar, a lot of uncertainty began to creep up again within the economy. Though there were other currencies at play within the economy, the fact that monetary authorities had brought into play a local currency which they had the power to manipulate made economic players to lose confidence in the system, to a certain extent. This can be supported by the sharp decline in money demand just after the introduction of the fiat money into the economy.

3.5 Conclusion

The overall objective of this study was to investigate the effects of the shocks to changes in money demand to the inflation rate which was proxied by the demand for private credit. This variable was chosen as it strongly resembles how much the economy demands for money. The scrutiny of the relationship between money demand and prices in Zimbabwe has not been fully exhausted especially using the variable used in this study. This study therefore brought to light a different approach to the study of the relationship between money demand and the price levels basing it specifically on the Quantity Theory of Money.

Most studies that have looked at money demand in Zimbabwe have almost always used monetary aggregates as the proxy variable for money demand. In a situation where the analysis of money demand together with money supply is needed, it becomes difficulty to employ the same variable for analysis in both the money demand and money supply equations. This then brought up the need to look at how other previous studies, though not from Zimbabwe had dealt with the issue and the variable, demand for credit was opted on.

In the studies that have looked at the correlation between money demand and the price levels using demand for credit as the proxy variable for money demand, the use of the Structural Vector Autoregressive (SVAR) modelling technique has not been employed as yet. This then exposed a literature gap that this study also sought to address and fill. The variables of the study were modelled to correctly fit the objectives that were being analysed (money demand, CPI, income, USD/ZAR exchange rate, interest rate and international oil prices). Foreign variables were included so as to capture the effects of international shocks since Zimbabwe is a small open economy which is predominantly an import country.

From this study it was revealed that a percentage change brought by changes in the shocks to money demand does not proportionately effect the exact percentage change to the price levels in all the two time periods. During the first period of study, though there was not equal causation between changes in money demand and changes in the price levels. It was noted that the response of inflation to shocks in money demand were also not contemporaneous and insignificant. It was further noted that changes brought about by the shocks slightly changed the equilibrium levels from their initial levels. Therefore, QTM cannot be said to have been holding sway considering the level of explanatory power money demand exhibited compared to the other variables in the study. Also, during the second period, shocks to the money demand did not contemporaneously trigger changes to inflation. Also, looking at the numerical contribution of each variable to changes in the inflation rates, the percentage of variance explained by money demand was insignificant, especially at period one as well as with increases in the time periods. This therefore meant that money demand did not contemporaneously trigger inflation. We can therefore conclude that there was no sufficient evidence to support the holding of the Quantity Theory during the second period of study. Conclusively the effects of the changes in money demand caused by its shocks on the inflation rate differ in the two time periods under review, hence different analysis can be made from them.

CHAPTER FOUR: FOREIGN EXCHANGE RATE AND INFLATION

4.1 Background and problem statement

When the Zimbabwean government introduced the multicurrency system in 2009, it meant that the country extinguished all the rights it had in determining its exchange rate as it did not have its own local currency within the currency basket (Matanda, et al., 2018). The loss of an independent monetary policy deprived the country of monetary and exchange rate instruments to react to asymmetric shocks as well as fluctuations in the business cycle not in line with the anchor country (Kavila and Le Roux, (2016). Multiple currencies were now accepted as legal tender in Zimbabwe though the use of the United States Dollar (USD) and the South African Rand (ZAR) was higher compared to all the other currencies (Pindiriri 2012).

By using multiple currencies in Zimbabwe, the country's economy could easily be affected by the changes in the purchasing power of the other currencies it considered as legal tender. The appreciation or depreciation of such currencies would easily reflect on the local prices that were in the market during such periods (Matanda, et al., 2018). The issue of trade also brings into light the effects of the appreciation or depreciation of foreign currencies had on the local prices in the economy (Munyawiri, 2014). Zimbabwe, being a small open economy was prone to both the appreciation and or depreciation effects of the currencies of those countries that it traded with, be it in exports or imports. These exchange rates of the foreign currencies had a huge bearing on the steadiness of the Zimbabwean economy as these economies had a huge bearing on the price levels mainly via imported inflation (Pasara and Gadzirai, 2020) .

When a large fraction of a country's trade is denominated in foreign currencies as was the case in Zimbabwe, its rate of inflation is more strongly affected by exchange-rate fluctuations (Whitten, 2016). These fluctuations can affect domestic inflation rates indirectly via the exchange rate pass through effect and the indirect effect of currency fluctuations dwarfs the direct effect because of the huge influence it exerts on the economy in both the near term and long term. The pass through of the exchange rates was therefore expected to be high as Zimbabwe is an import dependant country (Matanda, et al., 2018).

Statistics from ZIMTRADE (2021) have shown that South Africa, Zambia, Mozambique, China are among the countries that Zimbabwe mostly traded with during the period under review. This was established while assessing to establish countries that are found in both the top ten of Zimbabwe's imports and exports. In the last decade, in terms of the direction of trade flows, the EU which used to be the top traditional trading partner of Zimbabwe for both imports and exports accounting for two thirds of total trade, during the pre-dollarisation era, has since been overtaken by South Africa and China. South Africa is now Zimbabwe's largest trading partner. China has also increasingly become a significant trading partner of Zimbabwe in recent years (CZI, 2020).

The introduction of the multicurrency system, to a greater extent improved or rather increased the country's trading patterns, both for personal consumption, production, and retail purposes. (Chanakira, 2019). With most of the general populace now earning in mainly USD, this meant that even individuals could now easily import goods for their own personal use (Nkomazana, 2014). This was mainly because during this period, the country was a rather importing country with not much production going on, hence most people ended up opting to import goods from neighboring countries, South Africa, Botswana, Mozambique, and Zambia. The same could also be observed in the production sector where producers and retailers now had the purchasing power to import their raw materials and merchandise and this, to a certain extent also improved the country's exports. Countries like China were also seen to contribute a lot in the amounts of imports that were recorded in the country with imports from China to Zimbabwe totaling USD3,926,204,000.00 between 2009 and 2019. Increases in the country's exports were also recorded during this period (ZIMTRADE, 2020).

The situation of increased spending and importation can be linked to Keynes theory of consumption. With increased incomes, people have more disposable income to spend hence they increase their consumption levels (Keynes, 1936). This also has feed in effects to the industry sector were the demand for goods and service also increases due to an increase in the spending patterns in the economy. Since local industry cannot meet the local demand levels, both consumers and producers hence look at filling this gap by imports.

With Zimbabwe being an open economy as it is, it is then imperative to study how its trading patterns given the then prevailing exchange rates affected the general price levels in the country during the period under scrutiny. Such trading patterns therefore mean that fluctuations in the trading partner countries could also have a spillover effect in the general price levels in Zimbabwe. Given the tenets of the exchange rate pass through theory, it is imperative to know the feed in effects of the changes in the exchange rates of the country's trade partners in order to analyse how much these changes affected the domestic price levels. This trading, coupled with the use of foreign currencies as legal tender, therefore had some sort of a definite effect on the general price levels in the country. It therefore becomes essential to study how the individual exchange rates of the then widely used currencies as well as those of its major trading partners affected the price levels in Zimbabwe, also given that, all the currencies of the countries included in this study were seen as legal tender.

To clearly elaborate on the issue at hand, the major goal of this Chapter is to then investigate the effects of the changes in the foreign exchange rates on the price level in a multicurrency economy. However, the specific objective of the Chapter is to:

> To investigate the effect/impact of the movement/changes in the foreign exchange rates on the price levels in Zimbabwe.

Different scholars have tried to show how exchange rates impact inflation rates and vice versa, if there is an effect on inflation rate that is attributed to the changes in the exchange rate, the degree of the impact and the direction of the effect as well. Different hypotheses have also been developed to ascertain the connection between the price level changes and the exchange rates changes.

Most of these studies are however applicable to mono currency economies, hence their applicability become questionable in an economy that uses a multicurrency system. There is therefore a need to examine the applicability of these inflation/exchange rate theories in the multicurrency Zimbabwean economy. It is prudent to agree that there has been quite a number of studies that have been conducted in the post multicurrency era in Zimbabwe analysing the effect of the exchange rate movements on the local price level (Pindiriri, 2012; Madesha, et al., 2013; Kavilla and LeRoux, 2017; Makena, 2017; Maune, 2020). One similar thing about all these studies is that they all used only one exchange rate variable in analysing the effects exchange rate changes have on the domestic price level. Like earlier mentioned, Zimbabwe had a myriad of currencies that were in use during the study's time period hence the results from these studies only showcase the effects that changes in the currency of only one of the currencies in the currency basket posed on the local price levels. By including more study variables, this study allows for the analysis of the contemporaneous effects of the other exchange rates on the price levels rather than just giving focus and preference to one study variable. According to the researcher's knowledge, no such study has sought to analyse the exchange rates effect in this manner.

It is also important to note that, the studies that have looked at the subject matter only did so for the period up until on average year 2015 with the only exception being Maune (2019) who however combined the pre multicurrency and the multicurrency era into one analysis hence his study results may be diluted from the combining of the two time periods, unlike this study which explicitly focuses on the multicurrency use period. This leaves a yawning gap in the literature that needs to be filled. Proper analysis of the entire multicurrency use era therefore needs to be conducted as a lot of economic events occurred in the country between 2015 and 2019 when the system was finally abolished. The pre 2016 studies however do not cover the period in which the Bond notes were introduced into the system in 2016, increasing the quantity of the surrogate currency that was in circulation in the economy.

By conducting this study, it is hoped that its results will influence policy direction within the Zimbabwean economy. Evidence as to which exchange rate pass through greatly affected the local prices will be presented. As advocated for by the gravity models, this helps the relevant authorities on crafting trade policies that are beneficial to the economy given the country's economic activity (as represented by its exchange rate) (Tanglioni, 2002).

4.2 Literature review

In this section of the Chapter, an analysis of the theories that constitute the gamut of literature on the effect of changes in the foreign exchange rates on inflation is examined. An analysis of previous research conducted on the subject matter is also given in subsection 4.2.2. An analysis of the relationship between the inflation rate and the foreign exchange rates is usually done by comparing the exchange rate between the local currency, a base foreign currency and the inflation rate. However, this study is a peculiar one as the exchange rates being used are of more than two foreign currencies as there was no local currency at play during the period under study. Literature on such scenarios is currently very scarce and scanty. However, empirics that studied almost similar scenarios are analysed together with the traditional, common scenarios in this research.

4.2.1 Theoretical literature

There are a number of theories that endeavour to explain and to shed light on the determination of exchange rate. Some of these theories include the Purchasing Power Parity and Quantity Theory of Exchange Rate, Balance of Payment Theory, the Mundell-Fleming model and the Portfolio Balance model. Though there may be a number of theories as highlighted, this study does not seek to explore how exchange rates are determined. It rather confines its scope to the exploration of how the exchange rates may have an effect on the price levels, thus it is the Purchasing Power Parity (PPP) and the Quantity Theory of the Exchange Rate which best explain the motives of this particular study.

The traditional PPP theory put forward by Cassel (1921) states that two countries' currencies exchange rate is in equilibrium when their purchasing power is the same between the two countries. What this means is that the countries' exchange rates should be equal to the proportion of the two countries' price levels of a similar fixed basket of goods and services. This can be represented by the following equation:

$P_a = E P_b$………………………… (4.1)

Where P_a represents the price of a basket in country A, P_b is the same basket's price in country B and E is the exchange rate of the two countries' currencies.

From the above equation, we therefore can deduce that the exchange rate is determined as the ratio of the two counties price ratio.

$E = P_a / P_b$………………………… (4.2)

What this therefore implies is that when a nation's domestic price of goods and services increases (i.e., when the country is experiencing inflation), that nation’s exchange rate will have to depreciate for it to return to the PPP level (Kallianiotis, 2013). The foundation of the PPP is premised on the “law of one price” which states that in the absence of transportation costs plus any added transactional costs, competitive markets will equalise the price of similar goods or service in the two countries and this occurs when the prices are stated in the same currency.

The key highlight of the PPP theory is that nominal exchange rate is bound to change when the price level change. Just as the Quantity Theory of Money states, price changes are affected by changes in the money supply in an economy (Piersanti, 2012). The same can be said about the nominal exchange rate as it exhibits that it is depended on the money supply and demand in each country as it depends on price levels. This can be explained when a country’s central bank increases its money supply and causes the price levels to increase. It also causes its country’s currency to depreciate as compared to other currencies.

Mankiw (1998) stressed that the Quantity Theory of Exchange rate also sometimes referred to as the Classical Theory of Exchange Rate is the monetary approach to exchange rate. This approach uses the Quantity Theory of Money and strict PPP to arrive at the theory of exchange rate. It is formulated by combining the Theory of Monetary Equilibrium and the exchange rate determination (Achieng, 2009). This theory shows the long run relationship linking money, exchange rates and prices. What this theory states is that the long run equilibrium exchange rate between two countries is determined by the relative supplies of and demands for those national money stocks. This model embodies the Quantity Theory of Money and the Purchasing Power Parity relationships, the former linking money supplies, and demand to prices and the latter linking prices to the exchange rate, the conclusion being that the exchange rates are determined largely by relative money demands and supplies operating through the price levels especially of foreign traded goods (Kallianiotis, 2013).

To understand this Classical Theory of Exchange Rate the starting point is to understand the Quantity Theory of Money as given by the Cash Balance Approach explained in Chapter 3 of this study. To explain the link between PPP and the Quantity Theory of money, the monetary approach to the Exchange rate makes certain assumptions as follows:

- In the long run prices are perfectly flexible though however output can still vary.

- Following the Cambridge approach to the QTM, real money balances depend only on Y i.e.

  $M^d = PkY$……………………………………4.3

  M^d being the demand for money, Y is the income, P is the price level and k is a constant.

  From the above equation we can then get the real money demand equation expressed below:

  $\frac{M^d}{p} = kY$……………………………………….4.4

- The assumption of equilibrium therefore comes to play where it is assumed that money demand is equal to money supply : $M^d = M^s$ giving the following equation:

  $M^s = PkY$……………………………………..4.5

  Which also gives the following equation for real money supply balances as:

  $\frac{M^s}{p} = kY$ … … … … … … … … … … … … … … … … … . .4.6

- The last assumption is that PPP always hold

Now from the above equations, looking at equation 4.1 assuming P_a represents domestic prices and P_b represents foreign prices, solving for the price level in each country, it will then be shown that :

$P_a = M^s{}_a / k_a Y_a$ (Domestic economy) and $P_b = M^s{}_b / k_b Y_b$ (Foreign economy)

The above expressions show that the price level P is determined by the ratio of nominal money supplied M^s to nominal money demanded (kY). Prices rise if there is "more money chasing fewer goods" (James, et al., 2012).

Now from the explanation earlier, recall that PPP shows the relationship between prices and the exchange rates (Equation 4.2). now substituting the prices using the money market equilibrium conditions enables us to get the fundamental equation of the monetary model of the exchange rates which is:

$$E = \frac{P_a}{P_b} = \frac{\left(\frac{M^s{}_a}{k_a Y_a}\right)}{\frac{M^s{}_b}{k_b Y_b}} = \left(\frac{M^s{}_a}{M^s{}_b}\right) / (k_a Y_a / k_b Y_b) \text{ ……………………………4.7}$$

Now from the above equation we can see that if the domestic money supply increases, E, the exchange rate increases which as well shows a depreciation of the currency (James, et al., 2012). Also, if local Y, the income increases, E decreases which shows an appreciation of the local currency. On the other hand, if P_b increases, E will also decrease, showing an appreciation of the local currency.

4.2.2 Empirical literature review

It is generally common knowledge that the levels of inflation in a country usually have an impact on how the currency of that particular country behaves on the world market. When the value of a currency depreciates usually because of inflation, the effects will usually spill over and affect the strength of the currency on the world market. In a fully dollarized or multicurrency system, the system is somewhat different from the normal one. Here, the country does not have autonomy over its monetary policy, thus it cannot put in place measures that may affect the value of its currency. In this case, it is safe to say that the exchange rate of the currencies that the country would have adopted in its currency basket were the ones which had effects on the inflation rates in that country. This is a peculiar case and to find research on an almost similar scenario would be cumbersome. However, a number of studies have been carried out in normal economies to try to evaluate the effects of the exchange rate on domestic prices. Moreover, studies on dollarized economies which have their own local currencies in circulation were also used to try and bring out the expected scenarios.

Sadeghi, et al., (2015) studied the exchange rate pass through and inflation in dollarized economies in the Middle Eastern and Northern African Countries (Bahrain, Egypt, Iran, Jordan, Kuwait, Lebanon, Oman, Saudi Arabia, UAE, and Yemen) over the period 1994 to 2012. The dynamic panel data model was used to estimate the research model of the study using the generalized method of moments. The variables included in the study were the country's domestic inflation rate, inflation index of each country as a proxy for inflation persistence, nominal exchange rate, economic dollarization degree, trade openness degree, growth rate of gross domestic output and growth rate of gross domestic fixed capital formation. Results revealed that the exchange rate had a positive and significant relationship with domestic prices in the mentioned countries and, economic dollarization had a direct relation to inflation rate too. In Southeast Asia dollarised countries, it was also seen that the level of dollarisation also increases the exchange rate pass-through coefficient, and it influences domestic inflation. the direction of the effect however can vary from country to country.

The effect of the exchange rates on the domestic price levels is hence assumed to be the same in almost all dollarised countries just as when Phiakeo (2017) studied the effects of the exchange rate on domestic prices in dollarized economies in Southeast Asia from 2000 to 2015. The study used the dynamic panel model with fixed effects estimation. From the study's results, it was indicated that there is an indirect impact of the exchange rate pass-through in dollarized economies to domestic inflation and economic growth via the interaction term variable between exchange rate depreciation and dollarization degree. However, though the impact was indirect, changes in the exchange rates ultimately affect the inflation rates in the countries included in the study.

Park and Son (2020) also conducted a cross country study which sought to understand the determinants of dollarization as well as to investigate the relationship between exchange rates and inflation rates in countries with differing levels of dollarization. The study's aim was to see whether the degree of dollarization also had an impact on the effect of exchange rate on inflation rate. The study made use of twenty-eight countries with differing levels of dollarization for the period 1995 to 2016. The variables included in the analysis were foreign liabilities over saving deposits (dollarization), inflation rate, growth in foreign exchange rate, real exchange rate, real GDP growth, degree of openness and degree of government effectiveness. The study used the fixed effects model in analyzing the causes of deepening dollarization. Just like in the cross-country dollarised economies studies mentioned above, it was also concluded that high inflation, low flexibility exchange rate, depression of the real economy and a decline in trade openness are the main causes of high degrees of dollarization. Among other reasons, these were also part the causes that led Zimbabwe to a multicurrency use economy (Pindiriri and Nhavira, 2011). As for the analysis of the effect of exchange rate on inflation rate, it was found that the higher the level of dollarization, the greater the penetration effect of the exchange rate pass through to inflation in the economy. Also, the depreciation of the domestic currency had strong negative effects on the inflation rate through the rise in the price of imported goods. Lastly, the external variables related to the foreign exchange markets, such as foreign exchange rate, were found to have significant effects on inflation in dollarized countries.

Srithilat, et al., (2018) however found a bidirectional causality between the exchange rate and the inflation rate in Southeast Asian countries. Using a panel VECM, the study analysed the relationship between inflation, exchange rate and currency substitution in five highly dollarised Asian countries. The study also showed an association between all the variables and that the inflation rate had a positive and significant impact on the currency substitution in the long run meaning that economic uncertainty and economic instability led to the loss of confidence in holding domestic currency in Southeast Asia economies in the long run. Nigeria, a dollarised economy also experienced a high exchange rate pass through as compared to its counterpart South Africa (the two economies are regarded as the highest in Africa) ascertaining the view that exchange rate pass through is higher in dollarised countries as compared to non dollarised economies. Balcilar, et al, (2019) studied the exchange rate pass through in these two countries using the Autoregressive Distributed Lag (ARDL) model. For Nigeria, the pass-through effect was quite visible with the exchange rate variations causing changes in the inflation rate. For South Africa, the result was quite different as prices proved to a bit stickier as compared to Nigeria (Balcilar, et al., 2019).

Safi and Mashal (2020) analyzed the exchange rate pass through in Afghanistan, a highly dollarized economy. The study ran a simple regression model with two variables which are the exchange rate and the inflation rate, estimated using the least squares method. A correlation analysis of the nominal Afghani exchange rate per U.S. Dollar and the inflation rate (CPI inflation) was analyzed. The data used in the analysis was monthly data from March 2018 up to March 2020. Findings from this study revealed that exchange rate influenced the inflation rate by 44%, while the rest of the influence was from the other variables that were excluded from the study. To test for the causal effect between the two variables, Granger causality tests were also run. The results revealed that the exchange rate did cause inflation and was a significant variable in determining the inflation rate. The study hence recommended that the monetary authority in the country intervenes in managing the exchange rate as it was found to influence the exchange rate. Quite on the contrary, Mundaca (2018) in his study on the effects of the central bank innervations in managing the exchange rate in the dollarised Peru however argues the fact that the involvement in the exchange rate matters by the central bank increased Peru's local currency volatility against the US Dollar. However, there has been some improvements on the exchange rate pass through in Peru. Since the Government embarked on a de-dollarisation path in 2002, there has been some significant decrease in the inflation rate and the country has been experiencing low and stable inflation (Rossini et al., (2019).

Sean, et al., (2018) also investigated the relationship between inflation, exchange rate as well as money supply in Cambodia by using a Bayesian VAR approach. Monthly data for the period between October 2009 and April 2018 was used. The paper based its study on the money in utility function as well as the Purchasing Power Parity (PPP) theories as the basis of its study.

The research employed money supply, exchange rate and the inflation rate as study variables. Results of the study revealed that money supply was mainly affected by its previous period. At the same time, the exchange rate illustrated a positive correlation with inflation. Depreciation of the exchange rate resulted in the increased inflation in Cambodia. Kou and Hongsakulvasu (2018) also managed to get a similar result for the Cambodian economy. Using GARCH modelling approach the authors found that dollarization does depreciate the Riel per US dollar and induces the exchange rate volatility which has an effect on the price levels. On top of that, the exchange rate movements brought about by dollarisation also had a negative effect on the inflation rate in the country (Kou & Hongsakulvasu, 2018).

In import dependant countries , the exchange rate pass through as well as the strengths of the domestic currencies in such economies is easily affected by the changes in the foreign currencies that are of much use to the economies just as the situation in dollarised economies. Safi and Mashal (2020) found that for Afghanistan, an import dependent country, the demand of the US Dollar is very high which depreciates the afghani exchange rate and with the depreciation of the domestic currency, the prices of imported products rise. The study revealed a highly correlated relationship between the exchange rate and the inflation rate. However, according to the pair-wise Granger Causality tests it was indicated that the exchange rate does cause inflation (Safi & Mashal, 2020).

The results for the non dollarised economies are a bit conflicted and are not as direct as those for the import dependent and dollarised economies. Lu and Chen (2016) examined the relationship between import prices, inflation, and exchange rate in China. The study sought to explore the effect that exchange rate has on domestic prices in the country between 2003 and 2012. The study's variables included the Chinese CPI, broad money supply, GDP, import price index, producer price index, nominal effective exchange rate, domestic demand, and foreign supply. The study used a VEC model. Granger causality tests were also conducted. Among the six variables of study all the variables were seen to granger cause CPI individually and jointly except the money supply variable. The study revealed that a shock on the imported price has positive impact on the CPI. The results of the study showed that a shock on the nominal effective exchange rate in China had negative effects on that country's consumer price index (CPI) which meant that an appreciation of the RMB caused the CPI to decrease. However, this was contrary to what other empirical studies had found. Jixiang et al, (2011) suggested that RMB appreciation would cause the domestic prices in China to increase. Through a granger causality test they conducted for period 2005-2010, Zhu and Liu (2012) also came to the same conclusion of a positive relationship between RMB appreciation and the domestic inflation, implying that China's domestic inflation fluctuations are a domestic issue rather than imported.

Sen et al, (2019) attempted to establish a long run interrelationship between, inflation, exchange rates and interest rates in the five fragile emerging market economies (South Africa, Brazil, Indonesia, India and Turkey). The study used the Autoregressive Distributed Lag test for threshold cointegration as the method of estimation. The study argued that in an open economy, which most likely depend on imports such as the countries they were studying, it is probable that an appreciation or depreciation in exchange rates could influence the domestic price levels. Results from the study revealed that exchange rate and the inflation rates in the countries under study move along together in the long run. This implies that the depreciation of their currencies creates an inflationary effect on domestic prices through raising the prices of imported goods. The findings make theoretical sense as all the countries in the sample study are import-dependant and have persistent current account deficits.

Using a SVAR modelling approach, Ha, Stocker and Yilmazkuday (2020) studied how exchange rate movements in 34 developed countries affected the countries inflation rates. The study found that the source of the shock on the exchange rate matters in effecting any changes to the inflation rate. Domestic shocks on the exchange rate were seen to be a major cause of variance of inflation and exchange rates in most countries as compared to global shocks. The results of the study affirmed what other researchers allude to that country characteristics, structural factors , monetary policy frameworks as well as the nature of shocks all play an important role in determining the direction and magnitude of the exchange rate effects on the price levels. In Egypt the effect of the exchange rate on the domestic prices was seen to be substantial however slow and incomplete. Changes in the exchange rates were seen to mainly affect the consumer price index (CPI) the most as compared to the other indices (Helmy, et al., 2018). The structural factors in Egypt were seen a factor of how the changes in the exchange rates affected the domestic price levels. Price and import controls were responsible for the way in which the exchange rate pass through affected the different indices in the country.

Coming to the Zimbabwean economy. The country, due to its adoption of a full multicurrency system and its heavy reliance on imports makes it prone to the global shocks that pass through the foreign currencies it had adopted as legal tender. Just like in most developing countries, the monetary policy strongly responded to exchange rate movements because these have relevant effects even on the commercial trade in the country. Pindiriri (2012) analysed the determinants of inflation in a post dollarized Zimbabwe for the period January 2009 up until December 2011. The influence on inflation by factors such as GDP, imports, consumer's expectation about future inflation, interest rates, output, exchange rates and money supply among others was analysed. The study made use of the USD/ZAR exchange rate as these were the major currencies that were being used in the country before the reintroduction of its local currency. Results of the study were more or less similar to some other pre-dollarized studies conducted for the same country. The findings supported the claim that the exchange rate, money supply, consumer's expectations about future inflation and imports were the major determinants of inflation during the period under review.

It was revealed that the variations in inflation and the exchange rate had sharply decreased and taken a nosedive following dollarization, as compared to the pre-dollarization era. Prior to the adoption of the multicurrency era, there existed a long run relationship as well as a bi-directional causality between the exchange rate and the inflation rate and vice versa. This was according to the study of Madesha, Chidoko and Zivanemoyo (2013) who investigated the relationship between the exchange rate and the inflation in Zimbabwe during the period 1980 to 2007. A lot of economic events occurred during the entire period of the study with the inflation rate ranging between 7% and 19% between 1980 and 1990 respectively. However, during the period 1990 to 2000 the inflation rate respectively shot from 20% to 56%. After 2006 the rate then increased from 112, 1% to 1281,11% which indicates that the inflation rate was ever increasing, despite the different exchange rate regimes that were at play during the period. The study used the Granger causality test to investigate its study objectives. The results found by Pindiriri (2012) were also supported by Kavilla and Le Roux (2017) who studied how inflation in a post-dollarized Zimbabwe reacted to macroeconomic shocks using monthly data between the periods 2009:01 and 2012:12.

The study made use of the VECM approach to analyse the objectives of study. The variables used in the study were the inflation rate, ZAR/USD exchange rate, international oil and food prices, money supply and the South African inflation rate. The study revealed that, the inflation rate in Zimbabwe during the period under review was mainly influenced by international oil prices, as well as the ZAR/USD exchange rate. The observed relationship was strong and positive. The studies conducted in Zimbabwe for the multicurrency use era however just looked at the USD/ZAR exchange rate effect on the inflation rate as these were the two major currencies that were in circulation. Makena (2017) also used the same exchange rate and found the same results as to those that were done during the multicurrency era. It is however important to note that there were other currencies that were in use during the multicurrency era in Zimbabwe which meant that the direction the feed in effects from the exchange rates came from different directions.

4.2.3 Literature gap

The literature discussed above exhibit that quite a number of studies have been conducted to explore the relationship between inflation rate and exchange rates. However, it is important to note that of the studies conducted on the subject matter, focus was mainly given to economies that use their own local currency as legal tender as well as those countries that had fully dollarized or partially dollarized. From such studies, the exchange rates used where those of the local currencies against the USD.

However, according to the researcher's knowledge there has not been a single study that sought to address the exact subject matter in the magnitude that was explored in this Chapter, particularly, that of a multicurrency economy. This leaves a yawning gap that needs to be explored. This study therefore studies the relationship that exist between inflation rates and foreign exchange rates in a multicurrency economy, not a mono or dual currency economy. This study also goes a step further to include not just one exchange rate, but three exchange rates in a bid to examine if their effects are just the same as in mono or dual currency economies. Studies that have so far focused on the Zimbabwean multicurrency use economy, have almost always used only the ZAR/USD exchange rates, ignoring the effects of the other currency exchange rates that were in circulation during the multicurrency use era. By doing so, an analysis of the different exchange rates and their possible impact on the domestic inflation rate is made possible.

By addressing this gap, this study contributes significantly to literature on the effects of inflation rates and the exchange rates in multicurrency economies.

4.3.1.3 Estimating an ARDL model

Before estimating an ARDL model, selection of an appropriate lag structure using the information criteria for lag length was done. The lags were supposed to control for serial correlation and (with ARDL) endogeneity and should not have brought out any model specification errors. If there was no specification error, it then became prudent to adopt rather small number of lags. However, where there was a specification error, more lags helped. After the selection of the appropriate lag length the ARDL model was then run to establish the relationship and the significance between the dependent and the independent variables.

4.3 Research methodology

After reviewing empirical literature, this section goes a step further to outline the research methodology employed in this study. In analysing the relationship between inflation rates and the exchange rates, scholars have employed a diverse range of econometric regressions. This study makes use of the Auto Regressive Distributed Lag (ARDL) model as it suits the study's overall objectives. This study seeks to assess the effects of the exchange rates on the inflation rate as well as their long run relationship. The nature of the data available also made the use of the Ordinary Least Squares (OLS) not suitable for use, thus the only way to go would have been to make use of the ARDL modelling technique.

4.3.1 Analytical framework

In 2009 after suffering a ruthless hyperinflation for many years, Zimbabwean authorities decided to adopt a multicurrency system in which a bunch of foreign currencies were now seen as legal tender in the country. From 2009:02 up until 2014:11, the currency basket in the country comprised of only foreign currencies. However, in 2014:12, the government introduced a local surrogate currency, the bond coins which were followed by the bond notes in 2016 which were purportedly at par with the US dollar, which was the major currency in circulation (RBZ, 2014; RBZ, 2016). Their reason was that the introduction of this surrogate money would ease up business operations. In early 2019, the monetary authorities however announced that the Bond currency (local fiat currency) would no longer be at par with the USD but was now going to be rated against all other currencies (RBZ, 2019).

For this reason, this study is going to separate the study into two time periods. The first period is going to be from 2009:02 up until 2014:11 before the introduction of the fiat currency while the second period is from 2014:12 up until 2009:02 where the fiat currency was at par with the USD before the introduction of the legal local currency.

The ARDL model is used to study the effects of foreign exchange rates and the interest rate on the price level. The model was implicitly introduced by Davidson et al. (1978) and later popularised by Pesaran and Shin (1995). The ARDL model is an OLS based model which can be used for both nonstationary and mixed order of integration time series which is an advantage as compared to the VAR model which requires all the variables to be stationary before running the estimation. Differencing the non-stationary data has a tendency of losing the long run relationship information of the variables (Harrell, 2015).

A dynamic Error Correction Model (ECM) can be derived from ARDL through a simple linear transformation. Likewise, the ECM integrates the short-run dynamics with the long-run equilibrium without losing long-run information and avoids problems such as spurious relationship resulting from non-stationary time series data (Shrestha and Bhatta, 2018). The model is also capable of simultaneously displaying both the short run and long run parameters.

The ARDL model can be presented as follows (ARDL p, q):

$$y_t = \alpha + \delta_t + \emptyset_1 y_{+-1} + \ldots + \emptyset_p y_{t-p} + \beta_0 x_t + \ldots + \beta_q x_{t-q} + \epsilon_t \quad \ldots\ldots\ldots\ldots (4.8)$$

In the model above,

Y is the dependant variable, and it depends on p lags of itself.

Y also depends on the current value of the explanatory/ independent variable X as well as q lags of X.

X are the independent variables.

ϵ_t is a random disturbance term

The model assumptions are:

$$\text{Cov}\ (\epsilon_t, \epsilon_s) = 0, \text{for } t \neq s \text{ and } \text{Var}(\epsilon_t) = \sigma^2$$

Now expressing equation 4.1 in error correction form we get:

$$\Delta y_t = \alpha_0 + \sum_{k=1}^{p} \forall_j\, \Delta y_{t-k} + \sum_{k=1}^{q} \partial_j\, \Delta x_{t-k} + \sum_{k=1}^{p} \varepsilon_i\, \Delta z_{t-1} + \lambda_1 y_{t-1} + \lambda_2 x_{t-1} + \lambda_3 z_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4.9)$$

The first part of the equation from α, $\forall$ up until ε represents the short run dynmamics of the model while the second part with the λ represents the long run dynamics of the model.

4.3.1.1 Unit root tests

Unit root tests were run prior to the estimation of the ARDL model. This was influenced by the nature of the data as the decision on whether to include a trend and or constant or both was taken from the general analysis of the nature of the data. This is because macro variables are usually known for their non-stationarity. Unit roots tests were thus performed to check for stationarity. The Augmented Dickey Fuller (ADF) and the Phillips- Perron (PP) tests were used to test for the existence of unit root. The ARDL co-integration technique was preferable when dealing with variables that are integrated of different order, I (0), I (1) or combination of both and robust when there is a single long run relationship between the underlying variables in a small sample size (Wickens, 2011). The unit root tests were therefore important as they showed the order of integration of the variables since I (2) variables were not compatible with this model.

4.3.1.2 Deterministic specification

Selecting an appropriate model to fit the data is both an Art and a Science. There are about five different Data Generation Processes (DGP) specifications according to Peraran et al (2001). Here it is important to highlight that Peraran et al (2001) offers five alternative interpretations of a Conditional Error Correction (CEC) model (derived from an ARDL model), distinguished by whether deterministic terms integrate into the error correction term. Now, of the 5 DGP, the researcher chose one according to the nature and specifications of the data.

4.3.1.4 Residual diagnostic tests

In a bid to further validate the study's data, residual diagnostic tests were conducted. The diagnostic tests that were conducted included the stability test, the serial correlation test as well as the heteroscedasticity test. For the stability test, the CUSUM test for stability was conducted. The blue CUSUM line was expected to be within the red lines for the model to be considered stable.

As for the serial correlation test, the Breusch-Godfrey serial correlation LM test was conducted. The null hypothesis was that the residuals were serially uncorrelated. The result of the F-statistic p-value was expected to be greater than 0.05 in order to fail to reject the null hypothesis that the residuals were serially uncorrelated at 5% level of significance.

Finally, for the Heteroscedasticity test, the Breusch-Pagan-Godfrey test was conducted as well. The null hypothesis was that the residuals were homoscedastic. The F-statistic was expected to be greater than 0.05 in order to indicate that the residuals were homoskedastic at 5% level of significance.

4.3.1.5 Estimating a bounds test for cointegration

After making sure that the model was a good fit, the Bounds test for cointegration was conducted. This test showed whether there was a long run relationship between/ among the variables in the study. In this study, this test exhibited whether there was any long run relationship between the inflation rate and the exchange rates as well as the interest rate. The null hypothesis of the test was that there existed no long run relationship between/ among the variables. To analyse the results, the results of the F statistic were expected to be evidently greater than the 1(1) critical values bound at 5% level of significance (Harrell, 2015). Also, looking at the t-statistic, it was expected to be greater than I (1) at 5% level of significance to enable the rejection of the null hypothesis and conclude that the variables are cointegrated. If there was evidence of cointegration an ECM Model was estimated. If not, then we concluded that there was no long run relationship, and we only commented on the short run relationship results

4.3.1.6 Estimation of an ECM model

After ascertaining that there was cointegration and long run relationship between the independent and the dependent variables, the next step was to run an Error Correction Model (ECM). This is a time series model that is run when variables are evidently cointegrated and it manages to reveal both short-term and long-term effects of one time series on another (Harrell, 2015). From the EC model results, the cointegration equation and the associated coefficient shows the speed at which the dependant variable returns to equilibrium after a change in the other variables.

4.3.2 Data sources and characteristics

Data that was used in this study was obtained from the Zimbabwe Reserve Bank (RBZ), the South African Reserve Bank, World Bank, and the International Monetary Fund. The period of study is from 2009:02 up until 2019:02, hence the study made use of monthly data for its regression analysis. The dependent variable remains the Consumer Price Index (CPI), the independent variables being the foreign exchange rates and the interest rate. The specific variables used are:

Consumer Price Index (CPI): This is the dependent variable in the study. The variable represents the overall change in consumer prices over time based on a representative basket of goods and services. Monthly CPI values will be used to represent the inflation rate.

Interest rates: This study makes use of the average lending rate as its proxy for the interest rate. In Zimbabwe the average lending rates were derived from individual banks' lending rates to both individuals and corporates. The average captures all economywide attributes of the lending rates and were collated by the Zimbabwean Reserve Bank on a monthly basis from banks' monthly returns. Generally, interest rates are a cost to borrowing and in that regard an increase in lending rates, ceteris paribus, will likely stall inflation as that discourages supply of money in the economy. High interest rates are often a key ingredient in inflation stabilisation programs especially in nations that have suffered high inflation. Policy makers usually resort to tight interest rate policy even though exchange rate may be used as a nominal anchor (Ruch, 2021). The use of tight interest rate policy usually slash liquidity in the market and thus control inflation. This has been useful in Israel (July 1985) and in Argentina there were also stabilisation plans such as Austral (1985), Primavera (August 1988) and Bunge Born (July 1989) which were all successfully supported by interest rate. (Calvo & Végh, 1995).

Foreign exchange rates: This is the the rate at which a country's currency can be changed for the currency of another country (Oxford, 2013). In this study, the exchange rates represent the rate at which the currencies of South Africa, Mozambique and China were exchanged for the US Dollar. Since the main thrust of this Chapter is to analyse the relationship and the effects of the foreign exchange rates and the inflation rate foreign exchange rates of the major currencies that were in use during the multicurrency era were included as variable. The major currencies that were in use were the US Dollar and the South African Rand, hence their exchange rates inclusions in the study. The exchange rate of the US Dollar against South African Rand (USD/ZAR) is thus one of the study variables. The other two exchange rates to be included in the study are those of the USD against the Chinese Yuan (USD/CNY) and the Mozambique Metical (USD/MZN). These currencies were included in the variables study because according to ZIMTRADE, apart from South Africa, Mozambique and China were among the top countries that traded with Zimbabwe the most during this period. According to the Exchange rate pass through theory as backed by the law of one price in the PPP Theory, price changes due changes in the exchange rate of a country and also in the currencies of the trading partner currencies can filter through into the domestic price levels. In a normal economy, if a country's currency depreciates imported goods generally become more expensive , and the prices of domestically produced goods may also rise as domestic producers face weaker competition from abroad and the opposite is true (Yotov, et al., 2016). In this study the assumption that the exchange rate movements of the currencies that were in circulation in the country affect the inflation rates in the country is taken. This is done due to the fact those currencies were the legal tender in the country hence their appreciation or depreciation will be noted in the price levels. It is expected that with the depreciation of the mentioned currencies against the USD the prices of both imported products from the countries and also the local prices rise as shown by the studies of Maune, et al., 2020 and Safi and Mashal 2020. A considerable amount of literature has been published on the issue of exchange rate pass-through to domestic prices (Forero and Vega, 2015; Kilic, 2016; Baharumshah et al., 2017; Soon and Baharumshah, 2017; Amoah and Aziakpono, 2018; Kurtović et al., 2020). These studies suggested an incomplete pass-through to inflation. However, the studies point to the fact that there is a nexus between foreign exchange rates with domestic inflation which this current study aims to ascertain. Another point to note was the result that inflation was found to react differently to changes in exchange rate in the short-run and/or the long-run

4.4 Results interpretation and analysis

Using data on Zimbabwe inflation, average lending rates and foreign exchange rates, this section outlines the econometric procedures that were followed to deduce the effects, to inflation, and the general relationship between inflation and the other variables. The period of study was subdivided into two periods such that the first period covers the time when Zimbabwe dollarized and was using multi-currencies, mainly US Dollar and the South African Rand. Other currencies like Botswana Pula, British pound and Chinese Yuan were permissible but were not prominently used as the afore mentioned two. The second period covers the period when Zimbabwe reintroduced its pseudo currency via the introduction of the fiat currency (Bond currency) from 2014:12 up until 2019:02 where the pseudo currency was now termed a legal currency.

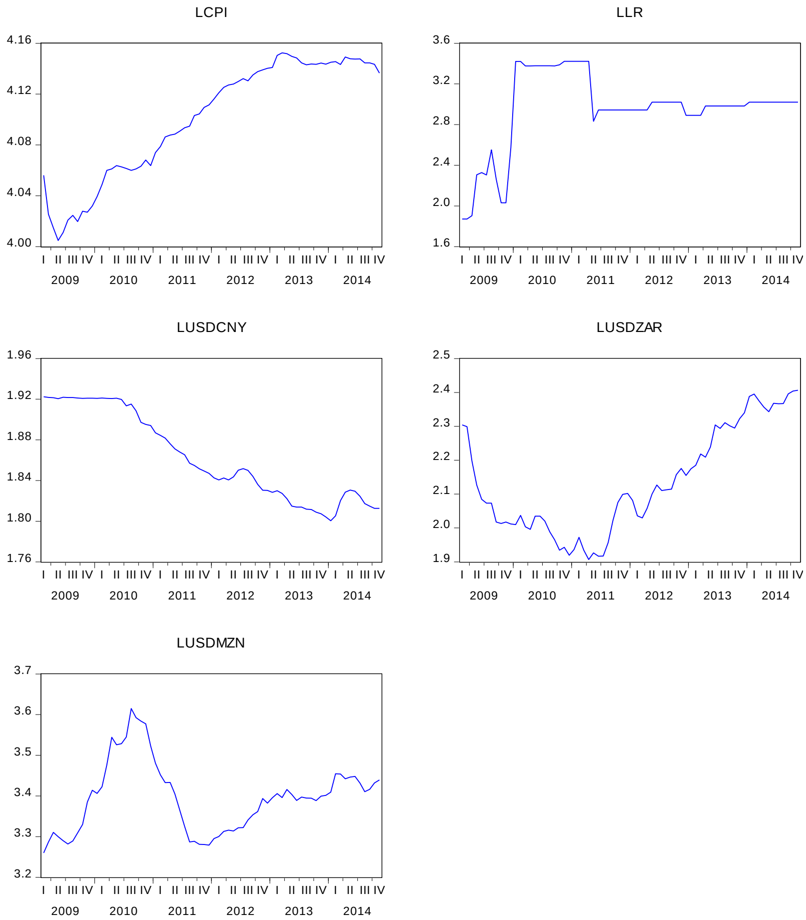
Broadly, the results are structured in such a way that there are pre-modeling checks, the modeling of the ARDL and ECM, post modeling checks and interpretation thereof. It is also critical to note that the variables in the study are Zimbabwe Inflation rates (denoted by LCPI), Zimbabwe average lending rate (LLR), and exchange rates of US Dollar against Chinese Yuan (LUSDCNY), South African Rand (LUSDZAR) and Mozambique Metical (LUSDMZN). The data was converted into log forms first before the estimation.

4.4.1 Empirical analysis: 2009: 02 to 2014: 11

4.4.1.1 Nature of the data

Figure 4.1 below depict the nature of the data used in this study. This aids in choosing the correct regression methods.

Figure 4.1: Nature of data



Source: Author's computations

Figure 4.1 further reveal that the CPI data depict an upward trend and seem to have a constant. The interest rate graph does not show any trend, however during some periods there was a sharp upward increase in the rates. As for the USD/CYN exchange rate, there was generally a downward trend in the rates. The same could be said for the USD/ZAR exchange rates which started off with a downward trend between 2009 and 2011 and thereafter the rate exhibited an upward trend with a few downward movements from time to time. The USD/MZN exchange rate had some sort of a cyclical trend starting off on an upward trend then moving downward from 2010 to 2011, then again going upwards thereafter. This analysis helps in analyzing the appropriate methods to take when running the regression analysis as well as the stationarity tests.

4.4.1.2 Stationarity test

For running stationarity tests, the Augmented Dickey Fuller (ADF) and the Phillips Peron (PP) tests were employed in this study. The results of ADF and the PP tests for all the variables in the study are summarized in Table 4.1 below.

Table 4.1: Stationarity test

ADF TEST				PP Tests		
Variable	**Level**	**First Difference**	**Conclusion**	**Level**	**First Difference**	**Conclusion**
LCPI	-1.267	-8.450**	I (1)	-1.916	-10.219***	I (1)
LLR	-3.221*	-6.595***	I (0)	-2.595	-6.442***	I (1)
LUSDCNY	-2.017	-4.576***	I (1)	-1.542	-4.576***	I (1)
LUSDZAR	-4.365***	-6.022***	I (0)	-3.986**	-6.080***	I (0)
LUSDMZN	-1.874	-5.514**	I (1)	-1.941	-5.475***	I (1)

Source: Author's computations *** H_0 rejected at 1% level of significance, ** H_0 rejected at 5% level of significance, * H_0 rejected at 10% level of significance

According to Table 4.1 above, some variables are stationary at level while others become stationary after first differencing. The most critical issue from the above results is the fact that all the variables are integrated of order I(*d*), where *d* is less than two. To estimate an ARDL Model, all the variables need to be integrated of an order less than 2.

4.4.1.3 Deterministic specifications

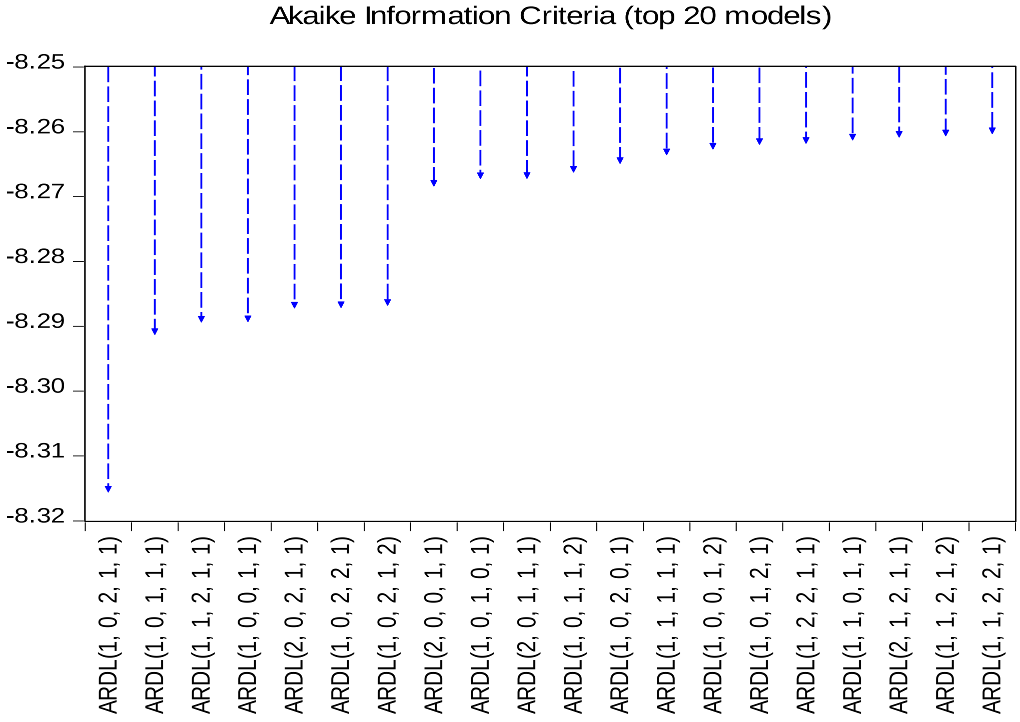
Selecting an appropriate model to fit the data is both an Art and a Science. The series in the study are not centred around zero and seem to exhibit a trend. Therefore, the model that fit well typically require a constant term and a trend. When specifying how deterministics enter the ARDL model for this study, an unrestricted constant and an unrestricted trend (case 5 when using EViews econometric package) was deemed appropriate following the nature of the main variable of concern in the study (inflation) that largely followed a trend and which did not depict a specific constant even using a priori theory. From fig 4.1 having a look at the inflation timeseries graph gave the visual impression that the data exhibit an upward trend. Restricting the two would mean that there is no effect of a time trend in the data generation process of modelling inflation. Same applies to the issue of a constant, inflation is usually influenced by its prior period values and generally builds on those values. Moreover, the study is aimed at deducing whether there are contemporaneous relationships that may support the holding of the QTM and that endeavour can only be realized without putting many restrictions on the data generation process which might then influence the outcomes. (Pesaran, M. H., Shin, Y., and Smith, R. J, 2001).

There are about five different Data Generation Processes (DGP) specifications according to Pesaran et al (2001). Here it is important to highlight that Pesaran et al (2001) offers five alternative interpretations of a Conditional Error Correction (CEC) model (derived from an ARDL model), distinguished by whether deterministic terms integrate into the error correction term. Now, of the 5 DGP the researcher considered the case whereby an Unrestricted Constant and Unrestricted Trend was incorporated in the DGP, and this is case number 5.

4.4.1.4 ARDL lag structure

In this study the Akaike Information Criterion (AIC) was employed to determine the correct lag length to use in the study. A starting point of 2 lags for both the dependant and the independent variables was utilised to allow automatic selection of a proper lag length using the EViews estimation software. The results of the criterion are shown in Fig 4.2. Overall, an ADRL (1,0,2,1,1) was adopted as suggested by the AIC.

Figure 4.2: The Criteria Graph



Source: Author's computations

4.4.1.5 Estimation of ARDL model

After the selection of the appropriate lag length an ARDL regression model was run. This regression shows the short run results of the first period. The results from the regression are shown in Table 4.2 below.

Table 4.2: ARDL estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*	Comment at 5% level
LCPI (-1)	0.834448	0.052403	15.92352	0.0000	Significant
LLR	0.005626	0.002249	2.501665	0.0153	Significant
LUSDCNY	-0.023950	0.150723	-0.158897	0.8743	Insignificant
LUSDCNY (-1)	0.199022	0.241399	0.824450	0.4131	Insignificant
LUSDCNY (-2)	-0.272023	0.153359	-1.773775	0.0814	Insignificant
LUSDMZN	0.032863	0.022969	1.430749	0.1580	Insignificant
LUSDMZN (-1)	-0.047872	0.021954	-2.180534	0.0334	Significant
LUSDZAR	0.029472	0.018221	1.617480	0.1113	Insignificant
LUSDZAR (-1)	-0.050570	0.016953	-2.983006	0.0042	Significant
C	0.932984	0.305270	3.056260	0.0034	Significant
@TREND	0.000209	0.000136	1.535941	0.1301	Insignificant

Source: Author's computations

From the table above, the USD/Chinese Yuan exchange rate is insignificant in all the lags. The USD/MZN and the USD/ZAR exchange rates are also insignificant during the current period, however becoming significant during the first lag. All the significant foreign exchange rates have a negative effect on the CPI meaning that the depreciation of the currencies against the USD causes the inflation rate to increase.

Given the results presented in table 4.2 above, the empirical ARDL estimated equation therefore becomes:

$$LCPI = \beta_1 LCPI(-1) + \beta_2 LLR + \beta_3 LUSDCNY + \beta_4 LUSDCNY(-1) + \beta_5 LUSDCNY(-2) + \beta_6 LUSDMZN + \beta_7 LUSDMZN(-1) + \beta_8 LUSDZAR + \beta_9 LUSDZAR(-1) + \beta_{10} + \beta_{11} @TREND \quad \text{.......} 4.10$$

4.4.1.6 Bound test: Determining the long run relationship between the variables

The F statistic of 4.699 is greater than I (1) of 4.57 at 5% therefore the null hypothesis of no levels relationship is rejected and it is concluded there is long run relationship between inflation, lending rate and foreign exchange rates. Looking at the t-statistic shown in Appendix 3B of 3.159, which is between I (0) ,3.41 and I (1),36 at 5% level of significance (and even at 10% level of significance), it is therefore concluded that the equilibrium relationship of the variables is degenerate in nature or type. There is cointegration between the dependant variable (inflation) and the independent variables (lending rate and the different foreign exchange rates), ECM Model was estimated.

Table 4.3: Bounds test for cointegration

Test Statistic	Value	Signif.	I (0)	I (1)
F-statistic	4.699	10%	3.03	4.06
K	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72

Source: Author's computations

Results from the long run analysis showed that in the long run, interest rates and the South African/USD exchange rate were the only significant variables. A one percent increase in the interest rate spiked inflation rates by 0.03% while a one percent appreciation of the USD/ZAR exchange rates caused a 0.12% decrease in the local inflation rates.

4.1.1.7 Error correction model (ECM)

According to the ECM results shown below as expected, the EC term, here represented as CointEq (-1), is negative with an associated coefficient estimate of -0.166. This implies that about 16.66% of any movements into disequilibrium are corrected for within one period. Moreover, given the exceptionally large t-statistic, namely -5.014, it can also be concluded that the coefficient is highly significant.

Table 4.4: Error correction model (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.933	0.185	5.041	0.000
@TREND	0.000	6.410	3.268	0.002
D(LUSDCNY)	-0.024	0.128	-0.187	0.852
D(LUSDCNY (-1))	0.272	0.131	2.083	0.042
D(LUSDMZN)	0.033	0.020	1.667	0.101
D(LUSDZAR)	0.029	0.017	1.757	0.084
CointEq (-1)*	-0.166	0.033	-5.014	0.000

Source: Author's computations

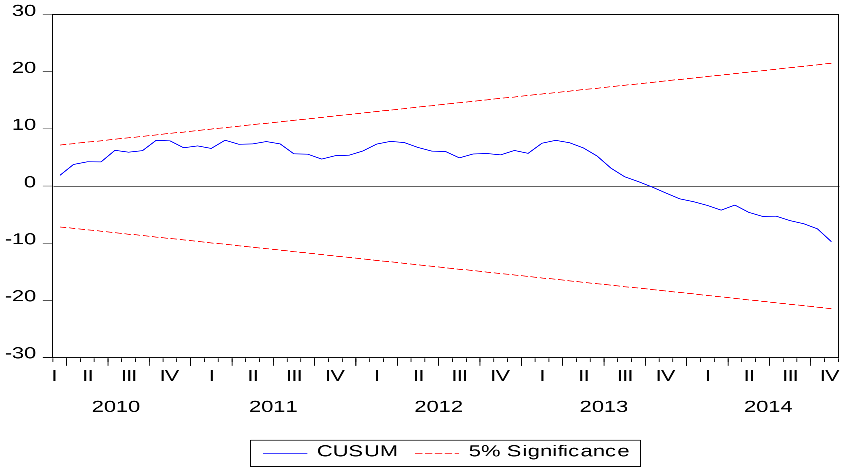
4.4.1.8 Residual diagnostic checks

The diagnostic checks conducted in this study were the stability test, serial correlation test and the heteroscedasticity test. The results are shown below.

Stability Test

The study employed the CUSUM test for stability. The results are given below.

Figure 4.3: Stability Test



Source: Author's computations

Since the blue CUSUM line is within the red lines, the model is stable at 5% level of significance.

Serial Correlation

Table 4.5: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.160	Prob. F (2,55)	0.853
Obs*R-squared	0.393	Prob. Chi-Square (2)	0.822

Source: Author's computations

The F-statistic p-value of 0.0853 is greater than 0.05. This indicates that the null hypothesis that the residuals were serially uncorrelated at 5% level of significance failed to be rejected. It was therefore concluded that there was no problem of residual serial correlation.

Heteroskedasticity

Table 4.6: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	0.783	Prob. F (10,57)	0.645
Obs*R-squared	8.211	Prob. Chi-Square (10)	0.608
Scaled explained SS	7.269	Prob. Chi-Square (10)	0.700

Source: Author's computations

The F-statistic p-value of 0.0645 is greater than 0.05. This indicates that the null hypothesis that the residuals were homoskedastic at 5% level of significance failed to be rejected. Therefore, the conclusion was that there was no problem of heteroskedasticity on the residuals.

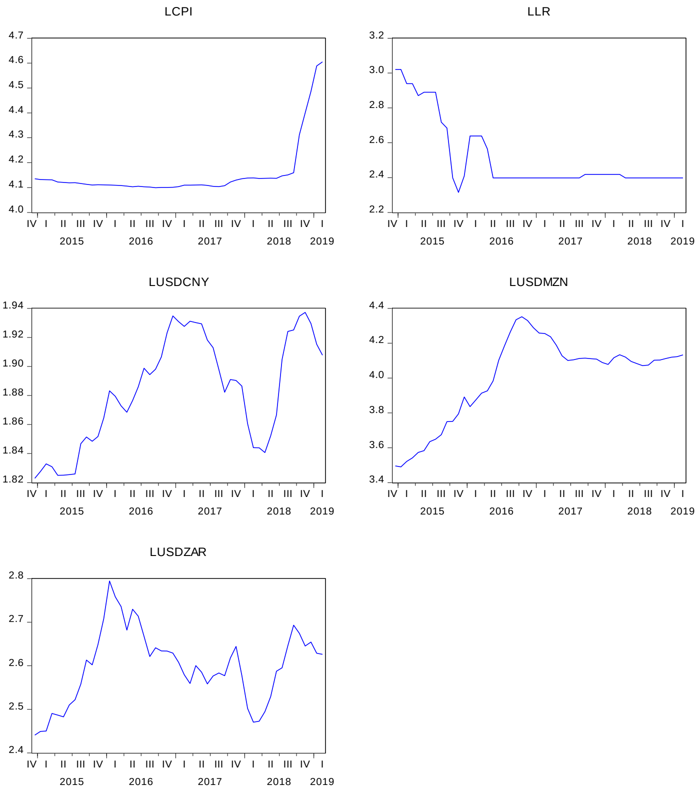
Overall, the diagnostic checks indicate that the model is a good fit.

4.4.2 Empirical analysis: 2014: 12 to 2019: 02

4.4.2.1 Nature of the data

Figure 4.4 below shows the nature of the data used for analysing the second period.

Figure 4.4: Nature of the data (2nd Period)



Source: Author's computations

The CPI data depicts an upward trend and appear to have a constant as it is not oscillating around zero. As for the interest rates graph, there seems to be a downward trend, then the rates tread around a constant rate. The USD/MZN exchange rate depicts an upward trend while the USD/CNY and the USD/ZAR exhibit combined trends which to some extent depicts a cyclical trend.

4.4.2.2 Stationarity test

For running stationarity tests, the Augmented Dickey Fuller and the Phillips Peron tests were employed in this study. The results of ADF and the PP tests for all the variables in the study are summarized in Table 4.7 below.

Table 4.7: Stationarity test (2nd Period)

ADF TEST				PP TEST		
Variable	**Level**	**First Difference**	**Conclusion**	**Level**	**First Difference**	**Conclusion**
LCPI	1.637	-3.867**	I (1)	2.224	-3.904**	I (1)
LLR	-4.213***	-3.529**	I (0)	-1.880	-5.834***	I (1)
LUSDCNY	-2.369	-3.884**	I (1)	-1.848	-3.817**	I (1)
LUSDZAR	-2.448	-5.129***	I (1)	-2.093	-5.076***	I (1)
LUSDMZN	-1.619	-4.457***	I (1)	-1.266	-4.577***	I (1)

*Source: Author's computations. *** H_0 rejected at 1% level of significance ** H_0 rejected at 5% level of significance * H_0 rejected at 10% level of significance*

According to Table 4.7, some variables are stationary at level, while others become stationary after first differencing. All the variables satisfy the ARDL condition.

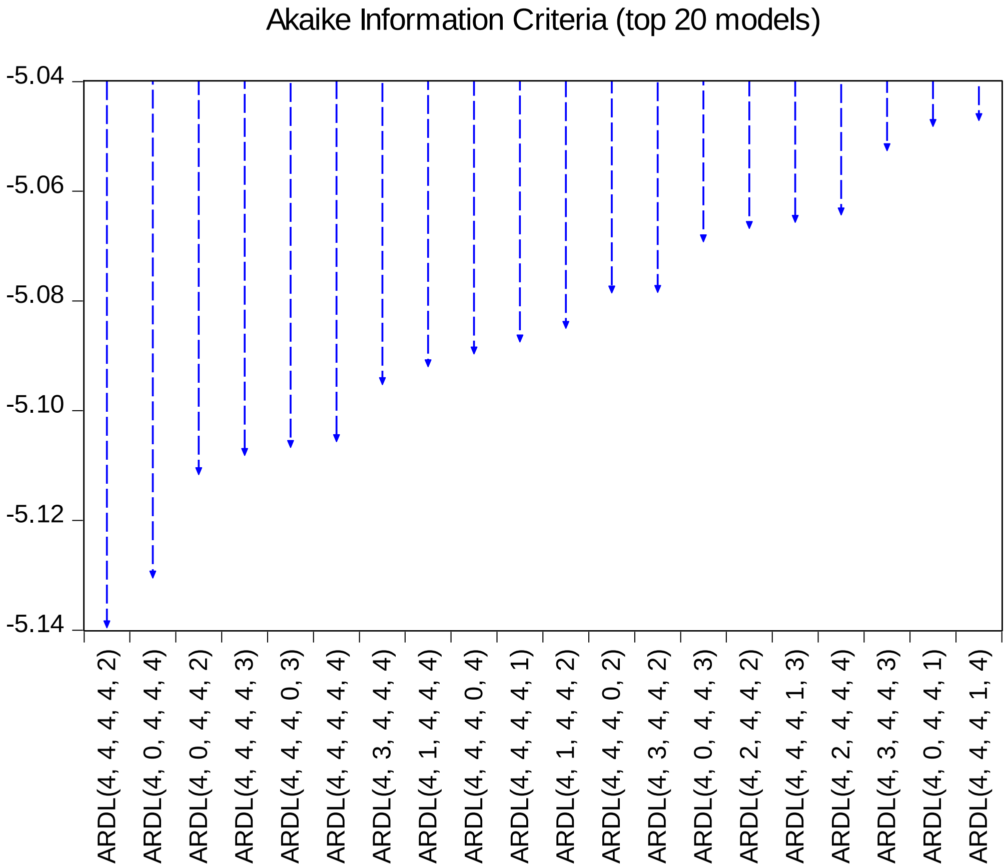
4.4.2.3 Deterministic specification

During the second period, the series in the study are not centered on zero and seem to exhibit a trend. Therefore, the model that fit well typically require a constant term and a trend. The study used the case whereby an Unrestricted Constant and Unrestricted Trend was incorporated in the DGP and this was case number 5 in EViews estimation software.

4.4.2.4 ARDL lag structure

The Akaike Information Criterion (AIC) was employed to determine the correct lag length to use in the study. A starting point of 4 lags for both the dependent and the independent variables was utilised to allow automatic selection of a proper lag length using the EViews estimation software. The results of the criterion are shown in Figure 4.5 below. Overall, an ADRL (4, 4, 4, 4, 2) was adopted as suggested by the AIC. Moreover, there was need to ensure the first period estimation modalities were like those used in the first period so that at the end of the day we compared like for like. All variations were expected to come from the data rather than the estimation methodology.

Figure 4.5: The criteria graph (2nd Period)



Source: Author's computations

4.4.2.5 Estimation of the ARDL model

After the selection of the appropriate lag length an ARDL regression model was run. The results from the regression are shown in Table 4.8 below.

Table 4.8: ARDL estimation (2nd Period)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*	Comment at 5% level
LCPI (-1)	0.995	0.177	5.632	0.000	Significant
LCPI (-2)	0.122	0.236	0.515	0.611	Insignificant
LCPI (-3)	-0.056	0.227	-0.245	0.808	Insignificant
LCPI (-4)	-0.533	0.211	-2.530	0.019	Significant
LLR	0.035	0.055	0.634	0.533	Insignificant
LLR (-1)	0.056	0.082	0.680	0.504	Insignificant
LLR (-2)	-0.016	0.070	-0.233	0.818	Insignificant
LLR (-3)	0.023	0.072	0.316	0.755	Insignificant
LLR (-4)	0.106	0.067	1.585	0.127	Insignificant
LUSDCNY	0.444	0.388	1.145	0.264	Insignificant
LUSDCNY (-1)	-0.867	0.512	-1.694	0.104	Insignificant

LUSDCNY (-2)	0.264	0.594	0.445	0.661	Insignificant
LUSDCNY (-3)	1.792	0.584	3.067	0.006	Significant
LUSDCNY (-4)	-1.121	0.325	-3.449	0.002	Significant
LUSDMZN	-0.100	0.101	-0.989	0.333	Insignificant
LUSDMZN (-1)	0.139	0.138	1.008	0.324	Insignificant
LUSDMZN (-2)	0.009	0.150	0.060	0.952	Insignificant
LUSDMZN (-3)	0.158	0.161	0.985	0.335	Insignificant
LUSDMZN (-4)	-0.258	0.117	-2.212	0.037	Significant
LUSDZAR	-0.026	0.118	-0.221	0.827	Insignificant
LUSDZAR (-1)	0.306	0.132	2.312	0.030	Significant
LUSDZAR (-2)	-0.157	0.104	-1.511	0.144	Insignificant
C	0.259	0.743	0.348	0.731	Insignificant
@TREND	0.004	0.001	5.212	0.000	Significant

Source: Author's computations

From the computations above in the short run, for LCPI variable, the 1st and the 4th lag significantly affect the current value of the CPI in a positive way. The interest rate variable is insignificant in all the time periods. USD/CNY variable is only significant in the 3rd and 4th lag. The USD/MZN variable only becomes negatively significant in the 4th lag while the USD/ZAR exchange rate variable is positively significant in during the 1st lag.

Given the results presented in table 4.8 above, the study's estimated table hence becomes:

$$LCPI = \beta_1 LCPI(-1) + \beta_2 LCPI(-2) + \beta_3 LCPI(-3) + \beta_4 LCPI(-4) + \beta_5 LLR + \beta_6 LLR(-1) + \beta_7 LLR(-2) + \beta_8 LLR(-3) + \beta_9 LLR(-4) + \beta_{10} LUSDCNY + \beta_{11} LUSDCNY(-1) + \beta_{12} LUSDCNY(-2) + \beta_{13} LUSDCNY(-3) + \beta_{14} LUSDCNY(-4) + \beta_{15} LUSDMZN + \beta_{16} LUSDMZN(-1) + \beta_{17} LUSDMZN(-2) + \beta_{18} LUSDMZN(-3) + \beta_{19} LUSDMZN(-4) + \beta_{20} LUSDZAR + \beta_{21} LUSDZAR(-1) + \beta_{22} LUSDZAR(-2) + \beta_{23} + \beta_{24} @TREND \quad \ldots\ldots 4.11$$

4.4.2.6 Bound test: Determining the long run relationship between the variables

The F statistic of 6.024 is above the upper bound I (1) of 4.57 at 5%. Therefore, the null hypothesis of no levels relationship is rejected and it is concluded that there is cointegration. In other words, there is a long run relationship between inflation, lending rate and foreign exchange rates. Now looking at the t-statistic of 3.887303, which is between the upper and lower bounds at various level of significance, it can be concluded that the nature of the long run relationship is degenerate. Since there is cointegration an ECM model is estimated.

Table 4.9: Bounds test for cointegration (2nd period)

Test Statistic	Value	Signif.	I (0)	I (1)
F-statistic	6.024	10%	3.03	4.06
K	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72

Source: Author's computations

According to the long run analysis, only the interest rates had a positive significant relationship with the inflation rates. A one percent increase in the interest rates caused a 0.42 percent increase in the inflation rates.

4.4.2.7 Error correction model (ECM)

From the results given in the table below, as expected, the EC term, here represented as CointEq (-1), is negative with an associated coefficient estimate of -0.471781. The coefficient of the error correction term is also highly significant as indicated by a high *t* statistic of-5.946340. The coefficient of the EC term means that 47.18% of long run deviations are corrected in one period. However, as earlier noted, the long run relationship is degenerate.

Table 4.10: Error correction model (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.259	0.048	5.372	0.000
@TREND	0.004	0.001	6.999	0.000
D(LCPI (-1))	0.467	0.119	3.933	0.001
D(LCPI (-2))	0.589	0.138	4.263	0.000
D(LCPI (-3))	0.533	0.157	3.400	0.003
D(LLR)	0.035	0.046	0.750	0.461
D(LLR (-1))	-0.112	0.045	-2.508	0.020
D(LLR (-2))	-0.128	0.047	-2.757	0.011

D(LLR (-3))	-0.106	0.047	-2.258	0.034
D(LUSDCNY)	0.444	0.283	1.568	0.131
D(LUSDCNY (-1))	-0.936	0.300	-3.120	0.005
D(LUSDCNY (-2))	-0.672	0.336	-2.002	0.057
D(LUSDCNY (-3))	1.121	0.274	4.089	0.001
D(LUSDMZN)	-0.100	0.076	-1.313	0.202
D(LUSDMZN (-1))	0.090	0.078	1.163	0.257
D(LUSDMZN (-2))	0.099	0.090	1.100	0.283
D(LUSDMZN (-3))	0.258	0.090	2.877	0.009
D(LUSDZAR)	-0.026	0.080	-0.323	0.750
D(LUSDZAR (-1))	0.157	0.083	1.899	0.070
CointEq (-1)*	-0.472	0.079	-5.946	0.000

Source: Author's computations

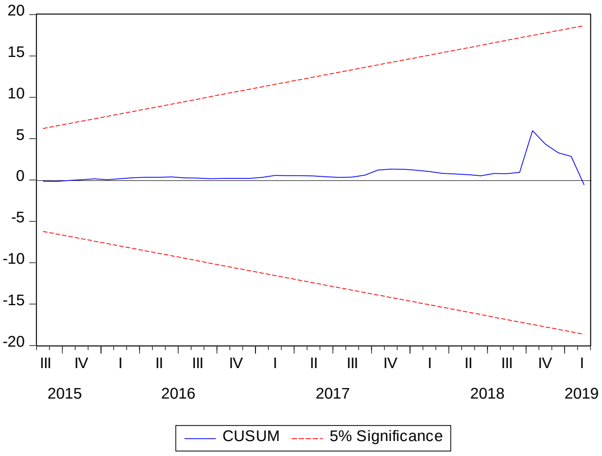
4.4.2.8 Residual diagnostic checks

The diagnostic checks conducted in this study were the stability test, serial corelation test and the heteroscedasticity test. The results are shown below.

Stability Test

The study employs the CUSUM Test for stability. The results are given below.

Figure 4.6: Stability Test (2nd Period)



Source: Author's computations

Since the blue CUSUM line is within the red lines, the model is stable at 5% level of significance.

Serial Correlation

Table 4.11: Breusch-Godfrey Serial Correlation LM Test (2nd period)

F-statistic	0.241	Prob. F (2,21)	0.788
Obs*R-squared	1.055	Prob. Chi-Square (2)	0.590

Source: Author's computations

The F-statistic p-value of 0.788 is greater than 0.05 indicates that the null hypothesis that the residuals were serially uncorrelated at 5% level of significance failed to be rejected. It is therefore concluded that there was no problem of residual serial correlation.

Heteroskedasticity

Table 4.12: Heteroskedasticity Test: Breusch-Pagan-Godfrey (2nd period)

F-statistic	1.347	Prob. F (6,43)	0.240
Obs*R-squared	26.977	Prob. Chi-Square (6)	0.257
Scaled explained SS	16.458	Prob. Chi-Square (6)	0.835

Source: Author's computations

The F-statistic p-value of 0.240 is greater than 0.05 and it indicates that the null hypothesis that the residuals were homoskedastic at 5% level of significance failed to be rejected. It is therefore concluded that there was no problem of heteroskedasticity on the residuals.

Overall, the diagnostic checks indicate that the model is a good fit.

4.4.3 Discussion of results

The preceding section outlined the results of the regression that was run for the two time periods. Table 4.13 below thus shows a summary of the ARDL regression run for the two time periods.

Table 4.13: Summary of results

	LLR		**LUSDCNY**		**LUSDMZN**		**LUSDZAR**	
	First Period	Second Period	First Period	Second Period	First Period	Second Period	First Period	Second Period
ARDL – long run coefficients	**0.006**** (2.502)	0.035 (0.634)	-0.024 (-0.159)	0.444 (1.145)	0.033 (1.431)	-0.100 (-0.989)	0.029 (1.617)	-0.026 (-0.221)
ECM – short run coefficients		0.035 (0.750)	-0.024 (-0.128)	0.444 (1.568)	0.033 (1.667)	-0.100 (-1.313)	**0.029*** (1.757)	-0.026 (-0.323)
ECT	First Period **-0.166**** (-5.014)	Second Period **-0.472**** (-5.946)						

Source: Author's computations. Note: ** and * shows level of significance at 5% and 10% respectively. In parenthesis (--) are the t-statistics.

The purpose of the study was to ascertain the relationship between Zimbabwe Inflation rate (denoted by CPI), Zimbabwe average lending rate (LR), and exchange rates of US Dollar against Chinese Yuan (USD/CNY), South African Rand (USDZAR) and Mozambique Metical (USDMZN) during the multicurrency use era.

It has been shown that during the first period of the study, there was a long run relationship between the aforementioned variables during the dollarized period. As expected, inflation was influenced positively by its lagged variables, LCPI (-1). Current inflation was significantly influenced by inflation of the previous period. The lending rate influenced inflation significantly and positively during the period under review. This meant an increase in lending rate was passed on say as a cost to the production and sell of goods and services immediately, hence increases in the price levels as well. The USD/Chinese Yuan exchange rate affected

Zimbabwean inflation in a negative way though insignificantly in all lags. From the current lag long run estimates presented in table 4.13 above, the USD/MZN and the USD/ZAR exchange rates positively affects inflation however also statistically insignificant. However, in the first lag, with the passage of time, the effect became significant and negative for both variables (USD/MZN and USD/ZAR), as presented in table 4.2. The variables influenced Zimbabwe inflation with a lag. With the passage of time, the results meant that the fall in the exchange rate would mean an increase in Zimbabwe inflation in that regard. The lagged results of the USD/ZAR exchange rate are thus, in line with Pindiriri (2012) results on the study before the introduction of the Pseudo currency though contrary to Kavilla and Le Roux (2017) where a positive relation was established between the USD/ZAR exchange rate and the inflation rate.

Overall, inflation was determined by lagged movements in foreign currency exchange rates during the first period of the study and lending rates also contributed to inflation outturn. Though previous studies which analysed foreign exchange rates and inflation in Zimbabwe during the multicurrency era only used the USD/ZAR exchange rate, the results also align to the other foreign exchange rates (USD/MZN) that were included in this study during the first period of study.

During the second period of the study, it was also shown that there was a long run relationship that was exhibited by the variables during the period Zimbabwe had introduced its fiat currency in the currency basket and it was purportedly deemed to be at par with the USD (between December 2014 and February 2019).

The lagged variables of inflation explained much of the current inflation during the period under review. As expected, inflation was influenced positively and significantly by its lagged variable during the period under review.

The current lag long run estimates showed that USD/MZN and USD/ZAR negatively affects Zimbabwe's inflation, though statistically insignificant. The foreign exchange rates with negative effect on the CPI implies that the depreciation of the currencies against the USD causes the inflation rate to increase. On the contrary, the USD/CNY positively affects inflation but statistical insignificant.

However, during the 4^{th} lag (table 4.8), the effect of the USD/Mozambique Metical exchange rate became significant though still negative. This was a noticed increase in the lags as compared to the first period analysis. The foreign exchange rates with negative effect on the CPI implies that the depreciation of the exchange rates causes the inflation rate to increase. On a different note, the lending rate was largely insignificant when it comes to the explanation of inflation during the period. The phenomenon is justified because lending rates were largely stagnant during the first few years after the introduction of the multicurrency system.

The USD/Rand exchange rate significantly influenced inflation with a lag. In fact, the USD/Rand exchange rate significantly and positively impacted Zimbabwean inflation after one lag. The period saw a reduction in the usage of the South African Rand in Zimbabwe, leaving the US Dollar as the main currency in use in Zimbabwe. Moreover, a pseudo currency called the Bond currency that was introduced in December 2014 operated at par with the US Dollar, thus increasing the US Dollar dominance. This therefore means that the appreciation of the rand against the USD therefore made the inflation rate to increase in the country. Given that South Africa was the country's biggest trading partner, appreciation of the rand meant that the price of imports would increase thereby pushing prices up.

The USD/Chinese Yuan exchange rate affected Zimbabwean inflation significantly during the 3rd and the 4th lags only though the direction of impact depended on the number of lags. This was different from the first period analysis where the exchange rate was insignificant in affecting the inflation rates. At lag 3, the appreciation the Chinese was tantamount to increased inflation in Zimbabwe while after 4 lags it was otherwise. This scenario could be because of a trade imbalance between the two nations with Zimbabwe being the net importer in most instances. Statistics show that China was the second highest country Zimbabwe imported most of its goods from during the period of the study. The result of lag 3 is in tandem with what most literature on dollarised economies state. Sadeghi et al (2005), Sean et al (2018) and Carranza et al (2009) exhibited that there was a positive and significant relationship between exchange rate appreciation and the domestic inflation, and they state this phenomenon is mostly found in highly dollarised economies.

As mentioned in the other sections of this study, literature on the relationship between foreign exchange rates and domestic inflation rate in a multicurrency economy is still scanty, hence the main motive behind this study. Looking at both time periods, it is evident that there was a long run relationship between the dependent variable and foreign exchange rates. However, the significance of most foreign variables changed between the two time periods, especially looking at the lags in which they were shown to be significant. Overall, the results of this study are in line with the research by Park and Son (2020). Just like the Zimbabwean case before the adoption of the multicurrency system, inflation was seen as the common factor for the adoption and or the deepening of dollarization. The study found that there was a relationship between the exchange rate and inflation in dollarised countries and that the depreciation of the domestic currency against the USD had a significant positive effect on the price levels. Madesha, Chidoko and Zivanomoyo (2013) also concluded that there was a long run relationship between the exchange rate and the inflation rates though their study looked at the pre-dollarisation period (1980 to 2007).

Results of this study exhibit reliance on or the applicability of the Quantity Theory of Exchange where the tenets of the Quantity Theory of Money and strict PPP are used to arrive at the Theory of Exchange Rate. Since Zimbabwe had no currency of its own in circulation, it meant that it had to rely on other foreign currencies for all its monetary needs. The demand and supply of these currencies together with their relative exchange rates have been observed as having a hand in the local prices of goods and services during the period of the multicurrency system. Also, Zimbabwe being an open importing country and the foreign exchange rates included in the study were of some of its major trading partners, this meant that fluctuations in the foreign exchange rates would in some way reflect in the local prices. In an open economy which most likely depend on imports such as Zimbabwe, it is probable that an appreciation or depreciation in exchange rates can influence the domestic price levels, hence exchange rate and the inflation rates can move along together in the long run. The result makes theoretical sense as Zimbabwe is import-dependant, and at most times has persistent current account deficits.

4.5 Conclusion

This Chapter focused on the relationship and effects of the exchange rate on the inflation rate. The overall objective was to study the effects of foreign exchange rates on the inflation rate in a multicurrency economy. The variables of the study were the CPI, interest rates as well as the foreign exchange rate of the US Dollar against the South African Rand, Mozambique Metical and the Chinese Yuan. There has not been much literature that has been published with regards to the relationship between foreign exchange rates and the inflation rate in a multicurrency economy, especially one without its own local currency in the currency basket. This study thus, went on to fill this gap by analysing how the variables in question relate and affect each other.

The study made use of the Autoregressive Distributed Lag model (ARDL). This was the best method of estimation given that the relationship, both short run and long run among the variables needed to be studied. The nature of the data also made it prudent to apply the use of the ARDL model. Such a modelling technique has been used before to study almost similar research though a different number of other modelling techniques have also been used. The study period was divided into two separate analyses and similar estimation techniques were applied to the time periods in order to give a clear and fair analysis as well as comparisons.

From the regression analysis conducted, results from the first period showed that all the independent variables in the study except for the USD/CYN were significant in affecting the inflation rate during the period under study. There was also evidence of cointegration among the variables and signs of a long run relationship between inflation rate and the independent variables were observed. The diagnostic tests conducted confirmed that the model was a good fit for the study. Overall, inflation was determined by movement in foreign currency exchange rates during the first period of the study and lending rates also contributed to inflation outturn. This result concurs with other studies such as Pindiriri (2012) and Kavilla and Le Roux (2017) that were previously conducted during the same time period (before the introduction of the pseudo currency) though the other previous studies only used the USD/ZAR exchange rate.

During the second period of study, the interest rates did not significantly affect the inflation rate. All the other variables, however had a significant effect on the inflation rate though normally after some passage of some lag. The bounds test for cointegration revealed that there was evidence of cointegration between the dependant variable CPI and the independent variable hence there was evidence of a long run relationship as well.

Results for the second period however differ slightly from those of the first period. Some of the foreign exchange rates were now significant in affecting the inflation rates though there was no evidence of such during the first period.

Overall, exchange rates influenced inflation rate more during the period that Zimbabwe was solely using a foreign multicurrency economy as compared to the period where it has introduced its pseudo currency in the currency basket. The effects of the exchange rates on the inflation rates differ between the two periods, some of the used exchange rates having a negative relationship with the inflation rates, while others have a positive relationship as supported by previous literature.

CHAPTER FIVE: IMPORTED INFLATION AND DOMESTIC INFLATION

5.1 Background and problem statement

Globalisation has made today's economies more reliant on each other than in previous times. Promotion of trade in the entire world and also in economic regions had made the exchange rates an important index that reflects the status of the macro economy in many countries (Liu and Chen 2017). In most developing economies, international trade is regarded as a key player of economic development. Imports just like exports play a key role in an economy's development and economic stability. In most developing countries, imports provide the much-needed raw materials used in the domestic production processes that will not normally be available on the local markets (Ngoma 2020). To a certain extent, imports also offer some competition to local producers and this competition benefits local consumers due to cheaper and also better-quality products. In most developing countries, Zimbabwe included the production costs of producing high quality goods are still not within reach of most producers thus most end up producing cheap quality goods as an alternative. In such cases, imports enable consumers access to better quality goods at almost the same price as the locally produced goods to the comparative advantage of the export countries (The Herald, 2021). Most developing economies are also not able to produce enough goods and services to fully service their national demand.

A small open economy like that of Zimbabwe is prone to international shocks on those commodities that it imports from other countries, be it for consumption or for incorporation into the production chain. The country's industries have not been performing well in recent years and the agricultural sector has also not been spared (RBZ, 2019). According to the RBZ, this increase in the non-productivity of the economic sectors has been exhibited by the very huge increase in imports of certain goods including oil and food stuffs as well as machinery (RBZ 2019). The fact that Zimbabwe has not been able to meet its consumers demand meant that the country had to rely on imports from neighbouring countries to cover the gap that its productive sectors could not meet. This has left the Zimbabwean economy highly dependent on imported commodities including their international prices and demand (Kanyenze, Chitambara and Tyson, 2017). With the adoption of the multicurrency system since 2009, Zimbabwe experienced phenomenal growth in total trade with its trading partners (mainly South Africa and China although the direction of trade has been more inward (imports) than outward (exports).

Zimbabwe, just like many other developing countries in the world is an oil importing country as it does not have any oil reserves. Most of the industries in the country are heavily reliant on oil products as at times it is also used as a source of energy due to the rampant load shedding that is experienced in the country (REEEP, 2012). This cost push inflation dynamic, were increases in the prices of the imported raw materials used in the production sectors are passed onto the final prices to the consumers is also rampant in import reliant countries. Such scenarios have also been experienced in highly dollarised country such as Ecuador (Del Cristo, et al., 2012). Exchange rate shocks usually have a higher exchange rate pass-through on inflation in highly dollarised countries or in this case multicurrency use economies. As an import dependant country, the higher the imported goods prices rise, the higher the inflation suffered by the importing countries. So, importing countries imports the inflation of its main trading partners through these currency appreciations (Del Cristo, et al., 2012).

To add onto that, Zimbabwe has also been hit very hard by natural disasters such as flooding or drought spells at one point or the other (ERSA 2016). Regardless of these natural occurrences, there has not been much investment in the agricultural sector and this has seen the country being unable to meet its national food requirements for a number of years. This failure by the Government to put up structures that cushion for unseen or unexpected situations within the economy also makes it easy for inflation to penetrate through into the economy via the continued reliance on imported goods to cater for the increased demand that the local industry cannot satisfy. Produces such as maize, wheat and soya bean crude oil have been rampantly imported into the country (ZIMTRADE, 2020). Wheat is mainly used in the bakery industry whilst the soya bean crude oil is used in the manufacturing of cooking oil. Maize being the staple food of the country requires huge reserves to enable the economy to meet its national food demand. Zimbabwe is mainly an import country as its levels of production, even for its own major consumables is highly insufficient to cover its needs (Trading Economies, 2021).

Food prices have in the past played a very significant role in the inflation rate in Zimbabwe with changes in the price of maize, wheat and cooking oil playing a major part in pushing up the overall prices of food (Reliefweb, 2021). Food and Petroleum imports account for a total of 26% of the total import quantities in Zimbabwe (ZIMTRADE, 2020).

Fluctuations in the prices of these goods has serious effects on local prices as these commodities are a need in the everyday life of a Zimbabwean citizen. A crucial issue of interest to Economists is therefore “how do international developments and prices of imported goods influence the domestic inflation rate. The objective of this Chapter therefore is to assess whether Zimbabwe has experienced imported inflation during the multicurrency system era, focusing mainly on the effects of selected import prices on the domestic price levels.

Though there is some literature which shows studies conducted on the issue of the general causes of inflation in Zimbabwe during the period under review, studies which have looked at the subject matter have almost always only used the international oil price and only the price of maize (representing grain prices) to represent the imported inflation variable (Makena, 2017; Kavilla and Le Roux, 2016)). This study therefore seeks to include the other variables that economic observers and available data has shown to contribute quite a substantial amount to the overall import bill in the country (ZIMTRADE, 2020). Changes in the fuel and food prices in Zimbabwe have been seen as the major cause in the increase in the price levels in the country (B Zulu and G Dube, 2010; Giles, 2019; Adu-Gyamfi, 2022). The inclusion of mainly the imported food price variables is motivated by the fact that in reporting the CPI, the inflation category of Food and Non-Alcoholic Beverages has the largest weight of 33.53% alone thus any changes in the prices of the goods that make up this inflation category has the potential of making the general inflation rate of the country to jump up to quite considerable levels (ZIMSTAT, 2017). Although food inflation is clustered into one category, there is need to study the individual feed in effects of the highest contributors in that basket as this helps even in policy crafting by directly targeting specific routes of action to take to discourage/ reduce the import levels so as to ultimately reduce import inflation.

Also, looking at the studies that have analysed import inflation in Zimbabwe (Makena, 2017; Kavilla and LeRoux, 2016), they have used the domestic price of fuel as the proxy of the international oil prices. Zimbabwe is known to levy heavy taxes on its fuel prices regardless of whether the international price of oil changes or not (Bhoroma , 2021). This tends to distort the true effect of the effects of the changes in the specifies variable on the domestic prices as the local price may just be increased without giving concern to the international price fluctuations. This study therefore goes a step deeper by analysing the effects of the changes in the international price of oil as a standalone import on the local price levels.

In addition, this essay will also go a step further in contributing to the body of knowledge by using a longer time frame since the study that had specifically analysed the subject matter had only looked at the period between 20019 and 2015. The inclusion of a longer time period as well as wider study variables will aid in bringing out a much clearer analysis of the economic import inflation dynamics that were present during the multi-currency era.

It is therefore imperative to study how such changes had an impact on the price levels as it will go a long way in aiding future policy crafting and implementation so as to deal with the inflation dynamics in the country. This research therefore pursues to answer the key question of "how the prices of imported goods influenced the domestic inflation rate during the period of study. On that note, the specific objective of the study is:

To assess whether import prices affect domestic prices in a multicurrency system.

The hypothesis of the study then becomes:

H_0: The Zimbabwean economy did not experience imported inflation during the period under study.

H_1: The Zimbabwean economy experienced imported inflation during the period under study.

5.2 Literature review

This section looks at the literature that supports the relationship between imported inflation / import prices and domestic prices. Analysis of economic theories on imported inflation are looked at in subsection 5.2.1 while previous empirical analysis will be discussed in subsection 5.2.2. It may be an impossible task to look at empirical studies that have incorporated all the variables used in this study in one study. Studies that have analysed the effects of either international oil prices on its own as well as those that have incorporated some of the variables used in this study all form part of the empirical literature analysis.

5.2.1 Theoretical literature

One of the key questions of most Central Banks and Economists at large is "how do international developments and the general prices of imported goods affect the domestic prices of goods and services in local economies?" (IMF, 2021). This phenomenon can only be explained by the theory of Pass-Through. According to the Economics dictionary, imported inflation is defined as the general upsurge in the local prices of goods and services due to increases in the prices of imported goods (Oxford, 2013).

There are various ways in which external shocks of what happens in the international world can be transmitted into the domestic price mechanism of an economy. Some of these changes are passed though almost directly while some may take a longer route. The former is usually true for open small developing countries where most of the times, they are just price takers on the world's market (Economics Online, 2020). Such a case can be in the consumption basket of goods such as petroleum, natural gas, solid fuels or even food prices. Such changes in these goods can have direct effect on domestic prices and the changes can be felt directly. The shocks can also be felt indirectly via increases in production costs of firms where these changes will be felt in the retail price of goods and services through increases in mark-up the firms would have put so as to absorb the increase in production costs. This channel of pass through is known as the first-round effects (Abere and Akinbobola, 2020)

Miller (1976) in a bid to ascertain whether rises in import prices were inflationary or deflationary in the United Kingdom realised that an increase in the price of imports caused a sharp rise in the domestic prices in the early 70's. On the other hand, earlier on, Turnovsky and Kaspura (1974) while analysing the relationship/ impact on domestic prices of the rate of inflation abroad (foreign inflation) found that for a small open economy increases in the external rates of inflation in the short run increases domestic prices of goods as well as the domestic price levels.

This case of Imported Inflation theory can be supported by the Cost Push Theory of Inflation explained above. If the prices of goods and or services that a country imports increases, and such goods or services are used in the local production processes, this will then increase the local production costs. Most economists argue that the cost push inflation is mainly caused by increases in wages as attributed for by worker unions and profit increases by the employees (CAMP, 2020). The main reason for this type of inflation is mainly due to the fact that money wages rise faster than the productivity of labour. According to economic events, it has been argued that in countries were the presence of worker unions is massive, these unions advocate for wage increases in excess of increases in the productivity of labour thereby raising the production costs. In a way to safeguard their profit margins, producers will be forced to pass on the cost to the consumers, thereby increasing the price of the final output, leading to inflation (Kavila and Le Roux 2017). With the increase in the wages, workers will still be able to buy just as much as before though the continuous increases in the prices will again lead to the unions to demand more wage increases. This then causes a wage increase spiral which will then lead to a wage push inflation or cost push inflation. A good example of the cost push inflation is the case of an increase in fuel. Fuel can have both direct and indirect costs. Firstly, increases in the price of oil directly causes increases in the transport services in an economy. On the other hand, fuel can be used as a raw material in production of goods. Its increase will cause an increase in the production costs of goods, thus causing a rise in the final goods price and the case goes on and on. Initially the effects of the wage push or cost push inflation might be felt in only a few direct sectors. However, products from these sectors might be used as inputs in other sectors hence what only started as increase in prices in one sector will eventually spill over to other sectors thereby eventually making the effect be felt in the entire economy.

Similarly, when firms expect that import prices are going to be persistent, instead of adjusting their profit margins, they are more inclined to increase or change their prices in such a manner as to cushion their businesses from the changes in the import prices. Taylor (2000) also developed a model that supported this assertion. This then suggests that the import price pass through is expected to be higher in countries that experience greater persistence in exchange rates fluctuations.

The cost push inflation can also be maximised by either monopolistic or oligopolistic firms. When such firms rise the price of their goods or service to offset increases in the labour or production cost, the effect can be heavily felt in the economy. There being imperfect competition in the case of such firms, they are able to administer price of their products

(CMAP, 2020). Such an effect can be made worse in an economy where such firms rely heavily on imports for their production processes. Regardless of the changes in the international market prices of the imported raw material, such firms are prone to have many factors affecting their pricing mechanism and it is easy for them to easily pass the increase costs or increase profit maximising concerns to the end consumer.

The second-round effects of the pass-through theory occur when changes in the price levels brought about by the first-round effects lead to the inflation perceptions of economic agents. If an external shock increases the public's longer term inflation expectations, this will put additional upward pressure on inflation accordingly (Yüncüler, 2009). There are two points of departure on which the expectations theory is premised i.e., the Adaptive and the Rational Theory of Expectation. The Adaptive Expectations Theory is premised on the facts that, economics agents base their expectations about inflation based on the previous trends of inflation and also on the current state or trends of inflation. This is also known as the backward thinking decision making (CMAP, 2020). This therefore means that the Adaptive Expectations Theory is backward looking. The theory dates back to the works of Phillip Cagan and Milton Friedman. Mathematically the theory can be represented as:

$$\pi_t^e = \pi_{t-1}^e + \gamma\,(\pi_{t*1} - \pi_{t-1}^e)\; E = P_a \,/\, P_b \ldots\ldots\ldots\ldots\ldots\ldots (5.1)$$

Where π_t^e represents the current inflation rate, π_{t-1}^e is the expectation of inflation from the previous period and π_{t*1} is the actual inflation in the previous period. γ lies between zero and one, it is the adaptive coefficient. This therefore shows that current inflation expectations are dependent on the difference between actual inflation and previous expectations of inflation.

On the other hand, the Rational Expectation Theory argues that economic agents base their expectations on their human rationality, information at hand and also past experiences (Investopedia, 2021). This theory was brought to light by John F Muth in 1961 in his paper Rational Expectations and the Theory of Price Movements. Under this theory, people make decisions based on the best available information and also learn from past trends. The assumptions of the theory are that:

- with rational expectation people always learn from past mistakes
- forecasts are unbiased and people use all the available information and economic theories to make decisions

- People understand how the economy works and how government policies alter macroeconomic variables such as price level, level of unemployment, and aggregate output (Muth 1961).

The theory also asserts that with perfect information and forethought when making predictions, economic agents can predict the future without making any systematic errors. Though there is room for making errors, on average they will be correct. This therefore implies that the outcomes based on this theory do not differ systematically from the market equilibrium results since all the available information would have been used in making the predictions (Muth 1961).

This can be represented as:

$$\pi_t = \pi_t^e + \varepsilon_t \; E = P_a \, / \, P_b \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \text{(5.2)}$$

Where π_t is the current inflation rate, π_t^e is the current inflation rate expectation and ε_t is the error term. This theory is widely used in explaining a number of macroeconomics principles such as business cycles.

Dohner's study in 1984 showed that consumers of goods and services usually take some time getting used to the changes in price levels, where he developed a model of pricing by forward looking competitive profit maximising exporters. Consumer expectations of the duration and effects of the variations in the exchange rate and their adjustments are said to determine the level of passthrough of the changes in the foreign prices (Dohner, 1984).

It is also important to note that increase in the demand of imported goods is also likely to cause increases in the local inflation rate. The theory of demand-pull inflation pushes for the agenda that inflation is not normally caused by the push of cost from behind but rather by the pull of demand from the fore (CAMP, 2020). The demand pull of inflation theory is a tenet of the Keynesian economics that describes the effects of an imbalance in aggregate supply and demand (Chen 2021). The reasoning behind this theory is that when the aggregate demand in an economy strongly outweighs the aggregate supply, this has an effect of raising up the price levels. Theory asserts to the notion that demand pull inflation is usually present in an economy where there is an increase in the GDP and an increase in the employment levels (Barth and Bennet, 1975). The total demand of goods in the economy can rise either due to increase in the money stock or increase in the velocity of money. The causes of this type of inflation are normally summed up to include:

- A growing economy: when there is consumer confidence within an economy, consumers tend to spend more, hence an increase in demand.
- Increase in export demand: increased exports usually force undervaluation of the involved currencies leading to increased demand.
- Increased government spending: prices tend to increase easily when the government spends more freely.
- Increase inflation expectations and lastly.
- An expansion of the money supply (Chen 2021)

Barth and Benne (1975). explains that demand pull inflation usually occurs when goods are in short supply either because resources are not fully utilized or production cannot be increased quickly to meet the increasing demand. This situation is commonly described as "too much money chasing too few goods".

For an importing country such as Zimbabwe where the economy is underemployed in a big considerable way, the economy mostly relies on imported goods to satisfy the demand of the consumers. With the increase in the purchasing power bought about by the adoption of the multicurrency system, imports of consumer goods rose to quite a substantial level (Kanyenze, Chitambara and Tyson, 2017). There is therefore a possibility that the increased demand in imports could have brought about some inflationary pressures in the country.

There is also a theory of inflation that resonates well with developing countries such as Zimbabwe that might also be able to explain the inflation trends that were being experienced in Zimbabwe during the time of the study. The Structural Theory of inflation is a theory that is said to be applicable to developing countries as the structure of such economies at times inhibits the application of the demand and supply models in explaining inflation. Initially when this theory was brought to light it was only looking at Latin American countries who had become like a benchmark for studying inflation in developing countries (Myrdal (1968); Streeten (1972)). However, in later years Kirkpatrick and Nixon (1976) have generalised this structural theory of inflation as an explanation of inflation prevailing in all developing countries.

The structural theory of inflation argues that in developing countries, there is a lack of balanced integrated structures where substitution possibilities between consumption and production and inter-sectoral flows of resources between different sectors of the economy are not quite smooth and quick so that the inflation in them cannot be reasonably explained in terms of aggregate demand and aggregate supply (Streeten, 1972). This has led to the belief that developing countries are structurally underdeveloped due to the existence of market imperfections and structural rigidities of various types. These imperfections and rigidities give rise to the excess demand over supply in some sectors that is a frequent occurrence in such economies. In the other sectors there is also underutilisation of resources and excess capacity due to lack of demand.

The structuralist suggests that the notion of analysing inflation looking at the aggregate demand and aggregate supply should not be used in developing countries. Rather, there should be an analysis of the disaggregated sectorial demand and supply balances. These show the given structural composition of the economy and hence brings to light the different sectorial constraints present in such sectors. The Structuralist believe that these constraints are slow to change and that get easily converted into sectoral bottlenecks, which then generate as well as exacerbate inflation (Kirkpatrick and Nixon, 1976)

The proponents of this theory therefore advocate that there is need to understand the forces that that cause the various bottlenecks that lead to the increase in prices in developing countries and these bottlenecks are:

- Agricultural bottlenecks which make supply of agricultural products inelastic. One of main reason for the advancement of this theory was the question as to why there was no increase in in aggregate output especially of food grains regardless of the increase in investment expenditure and money supply in Latin America. In developing countries there are issues that hinder the reaping of absolute returns in agriculture and these issues include land tenure issues and backward technology use. In order to control inflation these bottlenecks have to be removed so that agricultural output grows rapidly to meet the increasing demand for it in the process of economic development.
- Resource Gap or Government Budget Constraint. There is usually lack of resources for financing economic development in developing countries. There is need to finance public sector investments in various industries so that the economy can be self-sufficient. Such lack of investment usually lead to the reliance of imports as economies will not be able to fully cater for its demand domestically. This increases the possibility of pass-through inflation via the dependence of imports thereby increasing the domestic prices (Chen, 2021). There has also been a tendency by most governments of developing countries to resort to deficit financing in order to invest in projects of

national development. This usually leads to increases in money supply relative to increase in output and this also usually lead to inflation. Deficit financing has been seen to be one of the major causes in developing countries and Zimbabwe has not been an exception (Sunge and Makamba, 2020).

Structuralists however believe that though this increase in money supply increases the price levels, there is need to go deeper and study the reason behind this increase in the money supply as it the main cause of the increase.

- Foreign exchange bottlenecks. Shortages of foreign currency for financing crucial imports for development is also a bottleneck the structuralist believe is a cause of inflation.
- Physical Infrastructure bottlenecks. Further, the structuralists point out various bottlenecks such as lack of infrastructural facilities, lack of power, transport and fuel which stands in the way of adequate growth in output.

In light of the above bottlenecks, the Structuralist point that these constraints are found in the different sectors, structures of the economy for example, political structures, social structures, and economic structures CMAP, 2020). Hence, they base their argument in the belief that it is in the mismanagement of these structures that there is inflation in developing countries

5.2.2 Empirical literature review

Quite a number of studies have been conducted in the field of economics to try and find a link between import prices and the domestic prices. There has been a varied discussion on which variables cause the most pass-through effect in a number of different countries. Different methodologies have also been used to try and come up with a view on how import prices affect domestic prices.

Turnovsky and Kaspura (1974) developed an analysis of imported inflation in a short run macroeconomic model. The scholars explored the effects of imported inflation under both a fixed and a flexible exchange rate economy situation. The researchers concluded that the only determinate effect of an increase in foreign inflation is that it eventually increases the domestic rate of inflation. In a case of perfect capital mobility, an increase in foreign inflation was also observed to raise both the rate of inflation for domestically produced goods and the overall domestic inflation. Muktadir-Al-Mukit and Shafiullah (2014) also carried out an almost similar study in Bangladesh where they investigated the effects of imports on inflation rates. They however included a third variable in their study, exports. The study concluded that there is a direct relationship between a country's level of imports and its domestic inflation rates. Export prices were also seen to be in direct sync with the domestic price levels. Looking at the relationship between imports, exports and the inflation rate, Ahmed, Ghauri, Vveinhard and Streimikiene (2018) also included exports in their analysis of inflation in Pakistan. The study examined the correlation between imports, exports, and the exchange rates in Pakistan during the period 2001:07 up until 2017:06. Using the three mentioned variables, the study made use of the Error Correction Model to model the short run analysis among the variable together with the Johansen cointegration to analyse the long run relationship among the same variables. The cointegration showed that there was a long run, direct relationship among all the three variables. From the Variance Decomposition analysis, among all the variables, exports had the biggest effect on the CPI. The short run results also showed that there existed a direct relationship among the three variables in the study. This results this also supports the applicability of the PPP theory in influencing inflation rate changes.

Prior to the study conducted by Ahmed, Ghauri, Vveinhard and Streimikiene (2018), Durevall, Loening and Birru (2013) had also made use of the Error Correction Model to determine the inflation dynamics and food prices in Pakistan for the period 1999 up until 2009. The ECM was employed to model the connection between domestic prices and the independent variables (cereal prices, GDP, money supply, nominal exchange rates, real effective exchange rates, terms of trade, world commodity prices [grain price index, energy price index, fertilizer price index] and world non-food producer prices). The study's findings revealed that movements in international food prices, together with movements to the goods prices, determined the long run growth of domestic prices.

The empirical works of Pain, Koske and Sollie (2006) had also included a panel of countries using the same methodology in examining the effects of globalisation (reflected by the import prices of goods and services) in 21 OECD countries for the period 1980 up until 2005. The study employed the ECM for analysing the effects on the CPI of import prices, unit labour costs and the domestic output gap as well as the effects of globalisation that were captured by the import prices. The import prices were however split into commodity and the non-commodity import prices. Results revealed that over the period of study, the impact of the import prices on the domestic price levels tend to increase. The impact of the variations in the commodity imports prices had a similar effect on the domestic price levels just as the variations in the non-commodity prices. However, sensitivity of the domestic prices to import prices differ from country to country. the advancement of the state of the economy also then comes into play in allowing the pass through of imported inflation into the local price levels. Developed nations suffer less from imported inflation than developing or underdeveloped countries.

The above assertions where proven by McCarthy (200). Using a VAR model, McCarthy (2007) studied the pass through of import prices and the exchange rate variations to domestic price levels in a number of industrialised economies (USA, Japan, France, Germany, Sweden, UK, Belgium, Netherlands and Switzerland) for the period 1976:1 up until 1998:4. The study made use of the CPI inflation, import prices inflation, oil prices inflation, exchange rate, producer price index inflation, output gap, interest rates and money growth. Comparing the rates of exchange and the import prices pass through to the domestic prices, the study found that the exchange rate shocks only have diffident effects on the local price levels while shocks to the import prices had the largest effect on the domestic price levels. This pass through appeared to be greatly noticed in countries that had extremely high import share of domestic demand. From the study, shocks on the exchange rate had mild effects on the rate of inflation in most of the countries in the study. By contrast, shocks on the import prices tend to have very large effect on the domestic prices. Just like in the works of Pain, Koske and Sollie (2006) the pass through of the import prices seemed to be greater in the countries that had higher import share of domestic demand as well as in those countries that had more constant exchange rates and import prices.

Dhal and Jain (2008) explored imported inflation in India for the period 1950-2007. The study sought to understand the role imports played in the Indian economy and their subsequent impact on domestic prices. They observed the effect of oil, industrial capital, raw materials, and food imports on domestic prices. The study explored a correlation between import price inflation and export price inflation, concluding that the export price inflation granger caused the import price inflation at both the regional and international levels, but the reverse was not true. In measuring the import pass through i.e., the import price pass through to domestic prices, the researchers used the VECM approach. The variables used for the analysis comprised of the domestic prices, import prices (unit value index), the rupee and USD exchange rate, GDP, interest rate, capital flows, domestic inflation for fuel and agricultural production. From the regression analysis, import prices and exchange rate had a statistical positive effect while the real output (GDP) had an adverse statistical effect on domestic prices. Their research revealed that import price inflation on average accounted for about 1 to 2 percentage points increase in domestic inflation. From the cointegration and the VECM approach, results also exhibited that approximately 5 percentage points increase in import prices contributed to 1.5 percentage point's rise in the domestic prices.

Muktadir-Al-Mukit, Shafiullah and Ahmed (2013) studied an association between inflation and imports in Bangladesh for the period 2000 to 2011. Using monthly data, the study made use of different econometric frameworks using CPI as the dependant variable with import prices being the independent variable. Johansen Cointegration test was used to determine the existence of a long-term relationships between study variables. The analysis revealed a stable positive significant correlation between inflation rates and the import prices. A unidirectional causality was also observed between the two variables, running from inflation to import prices.

Liu and Chen (2017) studied the relationship between imported price, inflation, and the exchange rates in China during the years 2003 to 2012. For the regression analysis, the study used the Time Series Vector Error Correction analysis. The variables used in the study were the natural logarithm monthly figures of consumer price index, import price index, exchange rate, producer price index, broad money, GDP and China's total imports from the world. The IRF's and the variance decomposition were used to interpret results of the regression analysis. Results of the cointegration analysed revealed that there was long run cointegration among some of the variables. From the regression results, a short-term pass-through channel from the exchange rate to the inflation rates via the imported prices and the producer price index was shown. It was also noted that the producer price index, the import price index, and the total imports variables had a positive and significant effect on the CPI. Also using the VECM methodology, Mukhtarov, Mammadov and Ahmadov (2019) explored the relationship between inflation rate, crude oil prices as well as the exchange rates in Azerbaijan (an oil rich country) between the years 1995 up to 2017. Long run relationship was also found to exist between all the variables. The study employed the Vector Error Correction Model (VECM) for the regression analysis using annual data of Brent crude oil prices, exchange rate and inflation rate. From the study, oil prices had a positive and significant impact on inflation rates. The same result was also observed between the exchange rate and the inflation rate relationship as that which was found in the study of Liu and Chen (2017). In (Bass, 2019) the use of the VECM modelling approach was also employed when the study analysed the effects of oil shocks on the inflation rates in Russia. The exact variables as those used in Mukhtarov, Mammadov and Ahmadov (2019) were used. The results of the study in the two studies proved to be almost exact, the short-term results showed a relationship between the concerned variables and causality was also shown to exist from the exchange rates to the inflation rate.

Using a different methodology Chinecherem et al., (2021) using the ARDL modelling technique analysed the effects of imported inflation emanation from partner countries in the African continental Free Trade Area (AfCFTA) trade area. The study analysed the effects of imports from its trade partners in the trade area on the domestic inflation rates in Nigeria. Annual time series data of exports were also included in the analysis of the study. The results of this particular study however differed a bit from those that used the same exact variables in their studies.

The exchange rate variable proved to be insignificant in effecting any real effect on the domestic price levels in Nigeria. However, the import variable proved to be a significant variable in the study. It is important to note that not all imports from all the countries included in the study were significant in increasing the inflation rates in Nigeria. Imports from those countries which benefited from the liberalisation of imports as brought about by the formation of the trade area proved to be the ones that significantly affected domestic price levels in the country. Sek, 2015 using two distinct grouping of countries also examined the determinants of inflation high inflation countries as well as low inflation countries .the modelling technique used was the ARDL technique.

Results from the study showed that import prices had a significant effect on inflation only in low inflation countries as other factors were seen to strongly affect inflation prices in high inflation countries. Ibrahim (2015) analysed the inflation dynamics in Sudan, a country still experiencing political instability as well as a rampant parallel market for the exchange rate. Using the ARDL regression model, the study analysed the domestic inflation's sensitivity to macro-economic variables i.e., the parallel market variable, foreign inflation and money supply. The study's results revealed that though the growth in money supply was seen as the main determinant of domestic inflation in Sudan, imported inflation and the parallel market were also seen to increase sensitivity of the economy to external shocks. Still using the ARDL modelling approach, Bari and Adal (2020) analysed the impact of changes in the oil prices on the inflation rates in Turkey for the period 2009:01 up to 2020:04. The study made use of crude oil prices and the gasoline prices as the proxies of the oil prices. It further employed the linear and nonlinear ARDL models to analyse the symmetrical and asymmetrical effect of the changes in the oil prices as well as the other independent variables (industrial production index and money supply) on the CPI. From the study's results, both crude oil and gasoline oil prices had asymmetrical effects on the inflation rate in the short-term. There are however symmetrical effects with the passage of time and the inflationary effect of the gasoline oil prices was much stronger than the crude oil price effects.

Zimbabwe has been for quite some time now reliant on imports to satisfy its demand rends. Looking at literature on Zimbabwe, Nyarota, Kavilla, Mupunda and Ngundu (2016) analysed the negative inflation dynamics in Zimbabwe basing their study on the effects of international oil price, world food prices, USD/ZAR exchange rates and Value Added Tax (VAT) on the CPI between the periods January 2009 and December 2015. The study made use of the Error Correction Regression Model (ECM) for their study. Results revealed that the negative inflation experienced during the study period was mainly due to external factors, international oil prices, world food prices and the USD/ZAR exchange rates. These factors accounted for about 58.4% of the variations in the inflation rates.

Just like in the study mentioned above, Kavilla and Le Roux (2016) used the Autoregressive Distributed Lag (ARDL) model to study the inflation dynamics in the country during the multicurrency era. From the study's results, it was found that international oil prices had a positive relationship with domestic prices in Zimbabwe during the period 2009:01 and 2012:12. A long run relationship was found between the variables. Pindiriri (2012) also concluded that import prices were among the major determinants of inflation in Zimbabwe for the period 2009:01 up until 2011:12. Though the world food prices are usually just bunched together to form a single unit, there are instances where there is need to really identify the direct source of the increase in the food import prices. This is especially true in situations where the food import bill contributes quite significantly to the overall import bill. Makena (2017) tried to distinguish the source of the food inflation by individually studying the effect of the world grain price on the local inflation.

Makena (2017) examined the determinants of food and non-food tradeable prices in Zimbabwe after the adoption of the multicurrency system between 2010:01 and 2015:12. The study focused on the effects of external factors: ZAR/USD exchange rate, South African CPI, world grain prices and international crude oil prices on the domestic price levels. Findings from the study revealed that in the long run, price levels were influenced by South African CPI, international oil prices as well as the ZAR/USD exchange rates.

5.2.3 Literature gap

Literature that was reviewed above exhibits that the effect of imported inflation on the domestic inflation rates has now been debated for a while. However, at times, the variables that represent foreign import prices differ from one study to the other. Most studies that have analysed imported inflation have however used international oil prices and the world food prices as representatives of imported inflation. The same can be said of those studies that have tried to incorporate imported inflation in the inflation dynamics of the post dollarised Zimbabwe, where most studies have regarded international oil prices and the world food prices proxied by international maize price as external import prices variables.

In a bid to incorporate more variables that contributed to the import variable, this study extended the tentacles and scope of studied variables. The study also incorporated the use of the South African inflation rate as a factor that contributes to imported inflation. International oil price is also a variable. The study has also dissembled world food prices by incorporating the price of food commodities that the country mostly imports and these are the international prices of corn, wheat, rice and soya bean crude oil. Zimbabwe has not been producing adequate food to feed its own people in recent years and this has forced the country to increase its food imports.

Also, studies that have tried to incorporate imported inflation in a post multicurrency system in Zimbabwe did not look at the entire period that the authorities used a multicurrency system with the USD at par with the pseudo currency. This study thus, goes on to explore this entire period to establish the true effects of imported inflation on domestic inflation in a multicurrency Zimbabwe.

5.3 Research methodology

The first two sections of this Chapter outlined the background of this Chapter's motive. Both theoretical and empirical literature was outlined to appreciate the problem that this research solved. In analysing the correlation between domestic inflation and foreign inflation, a number of regression models have been employed. Also, a different range of variables have been used to bring out the relationship between domestic price levels and import prices. This study opted to utilize the Auto Regressive Distributed Lag (ARDL) model as it suits the research's overall objectives as well as data characteristics. The nature of the available data also made the use of the Ordinary Least Squares (OLS) unsuitable, thus the only way to go would have been to make use of the ARDL modelling technique.

5.3.1 Analytical framework

Due to the nature of the entire period of study, the study period was distributed into two periods in order to fully account for and to describe the effects of the independent variable on the dependent variable. In 2009:02 when the Zimbabwean authorities introduced the multicurrency system, only foreign currencies were in the currency basket with the USD, and the ZAR being the commonly used currencies. However, with the passage of time in 2014, authorities in Zimbabwe introduced their own pseudo currency, the "Bond" which they claimed was at par with the USD (RBZ. 2014). To a certain extent, this distorted the economy as the government had some sort of influence when it came to money supply. For this reason, the study periods were divided into the pre "Bond" introduction period and the post "Bond" introduction period. The period after the introduction of the Bond was only analysed for that period where the bond was said to be at par with the USD. In early 2019 the monetary authorities however announced that the Bond currency (local fiat currency) would no longer be at par with the USD but was now going to be rated against all other currencies making it legal tender within the country. This decision of splitting the time periods therefore helped in clearly analysing the study objectives. The first period was from 2009:02 up until 2014:11 before the introduction of the fiat currency while the second period was from 2014:12 up until 2009:02 where the fiat currency was at par with the USD before the introduction of the legal local currency.

This study employed the ARDL model to examine whether Zimbabwe suffered from imported inflation during the multicurrency use era. From theory, this study was based on the Adaptive Expectations theory, which is premised on the facts that, economics agents base their expectations about inflation on the previous trends of inflation and also on the current state or trends of inflation. Empirical studies conducted by Miller (1976) and Turnovsky and Kaspura (1974) were altered to suit the objectives of this study. The basic model of this study was:

$$cpi = f(oil, wheat, soybean, maize, rice, cpisa)\ldots\ldots\ldots\ldots 5.3$$

Where *cpi* is the domestic inflation rate, *oil* is the international oil price per barrel, *wheat* is international wheat price/tonne, *rice* is the international rice prices/tonne, *soybean* is the international price of crude soyabean oil/ tonne and *cpisa* is the South African monthly inflation rate. The model illustrated above was used in its log linear form.

The ARDL model bases its foundation on the OLS based model and it can be used for both nonstationary and mixed order of integration time series which was an advantage as compared to the VAR model which demands all the variables to be stationary before running an estimation (Harrell, 2015). Differencing the non-stationary data has a tendency of losing long-term relationship information of the variables (Kallianiotis,2013) .

The analysis's ARDL model can be presented as follows (ARDL p, q):

$lncpi_t = \alpha + lncpi_t + \emptyset_1 lncpi_{t-1} + \ldots + \emptyset_p lncpi_{t-p} + \beta_0 lnx_t + \ldots + \beta_q lnx_{t-q} +$
ϵ_t………… (5.4)

In the model above,

cpi is the dependant variable, and it depends on p lags of itself.

cpi also depends on the current value of the explanatory/ independent variable X as well as q lags of X.

X are the independent variables.

ϵ_t is a random disturbance term

The model assumptions are:

$$\mathrm{Cov}\,(\epsilon_t, \epsilon_s) = 0, \text{for } t \neq s \text{ and } \mathrm{Var}(\epsilon_t) = \sigma^2$$

From a basic ARDL model, a dynamic Error Correction (EC) model can be derived through a simple linear transformation. As such, there was an integration of both the short run and the long run equilibrium in the EC model. This enables the preservation of the long run information of the model and helps in the avoidance of problems of spurious regression which arise from non-stationary time series data (Shrestha and Bhatta, 2018). The model is also capable of showing both the short run and long run parameters simultaneously.

Now expressing equation 5.4 in Error Correction form we get:

$$\Delta lncpi_t = \alpha_0 + \sum_{k=1}^{p} \forall_j \, \Delta lncpi_{t-k} + \sum_{k=1}^{q} \beta_j \, \Delta lnx_{t-k} + \sum_{k=1}^{p} \varepsilon_i \, \Delta z_{t-1} + \lambda_1 lncpi_{t-1} + \lambda_2 lnx_{t-1} + \lambda_3 z_{t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (5.5)$$

The first section of the equation from α, up until ε exemplifies the short run dynamics of the model while the second section with the λ represents the long run dynamics of the model. Equation 5.5 can then be reparameterised as an ECM to give:

$$\Delta lncpi_t = \alpha_0 + \sum_{k=1}^{p} \forall_j \, \Delta lncpi_{t-k} + \sum_{k=1}^{q} \beta_j \, \Delta lnx_{t-k} + \sum_{k=1}^{p} \varepsilon_i \, \Delta z_{t-1} + \lambda EC_{t-1} + \varepsilon_t \ldots\ldots 5.6$$

In equation 5.6 above, λ (Error Correction Coefficient) is the speed of adjustment and the EC are the residuals that are obtained from the estimated cointegration model of equation (5.5). To imply a cointegration relation, the Error Correction Coefficient, λ is expected to be less than zero and also to be negative.

5.3.1.1 Unit root tests

One of the prerequisites of the ARDL model requires that the variables either be stationary at level or integrated of first order (1) or combination of both (James, et al., 2012). This therefore implies that unit root tests need to be run prior to the estimation of the ARDL model. The Augmented Dickey Fuller (ADF) and the Phillips- Perron (PP) tests were utilised to test for the presence of unit root. The nature of the data was analysed before running the unit root test and this influenced whether a trend and or a constant would be taken for the general analysis of the unit root tests. These tests were therefore important as they showed the level of stationarity of the variables since I (2) variables were not compatible with this model.

5.3.1.2 Deterministic specification

Selecting an appropriate model to fit the data is both art and science (Eviews, 2017). There are about five different Data Generation Processes (DGP) specifications according to Peraran et al (2001). Peraran et al (2001) offer five different versions of a Conditional Error Correction (CEC) model (derived from an ARDL model), distinguished by whether deterministic terms integrate into the Error Correction term. Now, of the 5 DGP the researcher chose the one to use based on the nature and specifications of the data as explained in Chapter 4 of this study.

5.3.1.3 Estimating an ARDL model

The information criteria was used for the selection of an appropriate lag length to use in the study before the estimation of the ARDL model. This was an important step to take before the estimation of the ARDL model. The lags were supposed to control the serial correlation and (with ARDL) endogeneity and should have brought out no model specification errors. If there was no specification error, it was prudent to adopt rather small number of lags considering the principle of parsimony. However, when there was a specification error, more lags helped in correcting the errors.

5.3.1.4 Residual diagnostic tests

There was needed to establish whether the ARDL model which would have been run did not suffer from any specification errors. There was need to run some diagnostic tests. In a bid to further validate the study's data, residual diagnostic tests were conducted. The diagnostic tests that were run included the stability test, the serial correlation test together with the heteroscedasticity test. The CUSUM test for stability was conducted to test whether the model was stable or not. For the model to be considered stable, the blue CUSUM line must have been within the red lines. The Breusch-Godfrey serial correlation LM test was conducted to test for serial correlation. Finally, for the Heteroscedasticity test the Breusch-Pagan-Godfrey test was conducted as well.

5.3.1.5 Estimating a bounds test for cointegration

After ascertaining that the model was free of any specification errors, a bounds test for cointegration was then run. This test showed whether there was any cointegration and or a long run relationship between the dependent and the independent variables being studied. If there was then evidence of cointegration, an ECM Model then was estimated. If not, then it would be concluded that there was no long run relationship, and comments would only be given on the short run relationship results.

5.3.16 Estimation of an ECM Model

The ECM was run after ascertaining the existence of cointegration and a long run relationship between the independent variables and the dependent variable. The reason for running the ECM was to indicate how quickly the dependent variable returned to the equilibrium level after a change in the other variables. This is known as the speed of adjustment.

5.3.2 Data sources and characteristics

Data used in this study was obtained from reputable organisation's website which are inclusive of the Zimbabwe Reserve Bank (RBZ), the South African Reserve Bank, World Bank and the

International Monetary Fund. The entire period of the study is from 2009:02 up until 2019:02, hence the study made use of monthly data for its regression analysis. The endogenous variable remains the Consumer Price Index (CPI), the independent variables being the international prices of oil, rice, wheat, soya bean crude oil and maize plus the South African inflation rate.

The description of the variables used are as follows:

Consumer Price Index (CPI): CPI can be defined as a comprehensive measure used for estimation of price changes in a basket of goods and services representative of consumption expenditure in an economy (Oxford, 2013). This is the endogenous variable in the study. Monthly CPI values were used to represent inflation rate.

International Oil Price: The variable is represented by the international crude oil price per US Dollar/barrel of oil. The monthly prices of crude oil per barrel were used as one of the independent variables. One of Zimbabwe's major imports each year is fuel, hence the decision to include it as a variable. Zimbabwe relies heavily on oil for most of its productive sectors. In 2020 alone, Zimbabwe's fuel imports amounted to US$499.19 million which was a sharp decline from US$1.2 billion in 2019. Between 2017-2019, Zimbabwe's annual imports averaged US$1.3 billion (ZIMSTAT 2021). The changes in the international price of the oil passes through into the local prices via the cost push inflation where it is passed through as a raw material in the production of goods as well as directly via the increases in the transport costs. A positive relationship between inflation and the international oil prices is expected as supported by studies by Mukhlarov , et al., (2019), Bass (2019), Adayle (2018), Bari and Adal (2020) amongst others.

International Food Prices: The variable represents the international prices of maize/tonne, wheat/tonne, rice/tonne and soya bean crude oil/tonne. These are part of the independent variables of the study. Zimbabwe has not been producing adequate food produce to feed its own people in recent years. This has forced the country to increase its food imports especially maize, wheat, and rice and soya bean crude oil for the production of cooking oil. Shocks and changes to such products' prices are therefore most likely to have an impact on domestic prices thus such variables were included in this study. According to the RBZ, between the years 2000 and 2019, the country's food imports substantially increased (RBZ, 2019). Following the unfortunate land reform system, the local production of food took a heavy hit, with the country now spending a larger bill to import its staple maize grain as well as wheat. Zimbabwe, a net importer of cereals is estimated to have produced an average of 1.2 million tonnes of maize and imported nearly 400,000 tonnes per year between 2016 and 2020 in a bid to cover the national demand's gap. Inclusion of the variables is pertinent in studying the imported inflation dynamics as theory states that the prices of imported goods pass through to the local prices of goods directly as the general price of importing them increase hence retailers also increase the retail prices to cover their importation costs (Economics Online, 2020). Where the food items are also raw materials in the production of other goods, the effects can be felt indirectly via cost push inflation by the producers (Abere and Akinbobola, 2020). A positive relationship is expected between the variables and the inflation rates as supported by (Pindiriri,2012; Liu and Chen;2021. Loening and Bimu, 2018), Ahmed, Ghauri, Vveinhard and Streimikiene (2018), Durevall, Loening and Birru (2013).

South Africa inflation rate: this is the general rate of increase in prices of goods and services in the South African market over a given period of time, The variable is proxied by the Consumer Price Index of the South African market during the study's time period. With South Africa being Zimbabwe's major trading partner for a long time and also its currency, the Rand being one of the major currencies in use at the time under study, it is prudent to assume that any changes in the price levels in South Africa had an effect and a relationship with the domestic prices in Zimbabwe. It is expected that this variable has a positive relationship with the local CPI of Zimbabwe as supported by Kavilla and LeRoux (2017), Pindiriri (2012) amongst others. The International Monetary Fund (IMF, 2012) established that Zimbabwe's inflation was highly correlated to both the South African CPI and producer price indices inflation rates. This, according to the IMF, occurs with a lag and is largely because of the large share of imports from South Africa.

5.4 Results interpretation and analysis

This section outlines the econometric procedures that were followed to deduce the effects of foreign variables on the domestic price levels. Foreign variables considered under this section are international oil prices (LOIL), South African Inflation (LCPISA), Wheat prices per tonne (LWHEAT), Soybean Prices per tonne (LSOYBEAN), Maize price per tonne (LMAIZE) and Rice Price per tonne (LRICE). The data was converted into log forms first before the estimation. The period of study was subdivided into two periods such that the first period covered the time when Zimbabwe dollarized and was using multi-currencies, mainly the United States Dollar and the South African Rand. Other currencies like Botswana Pula, British Pound and Chinese Yuan were permissible but were not used prominently as the two that were mentioned earlier. The second period covers the period when Zimbabwe reintroduced its pseudo currency via the introduction of the fiat currency (Bond currency) from 2014:12 up until 2019:02 where the pseudo currency was now regarded as a legal currency.

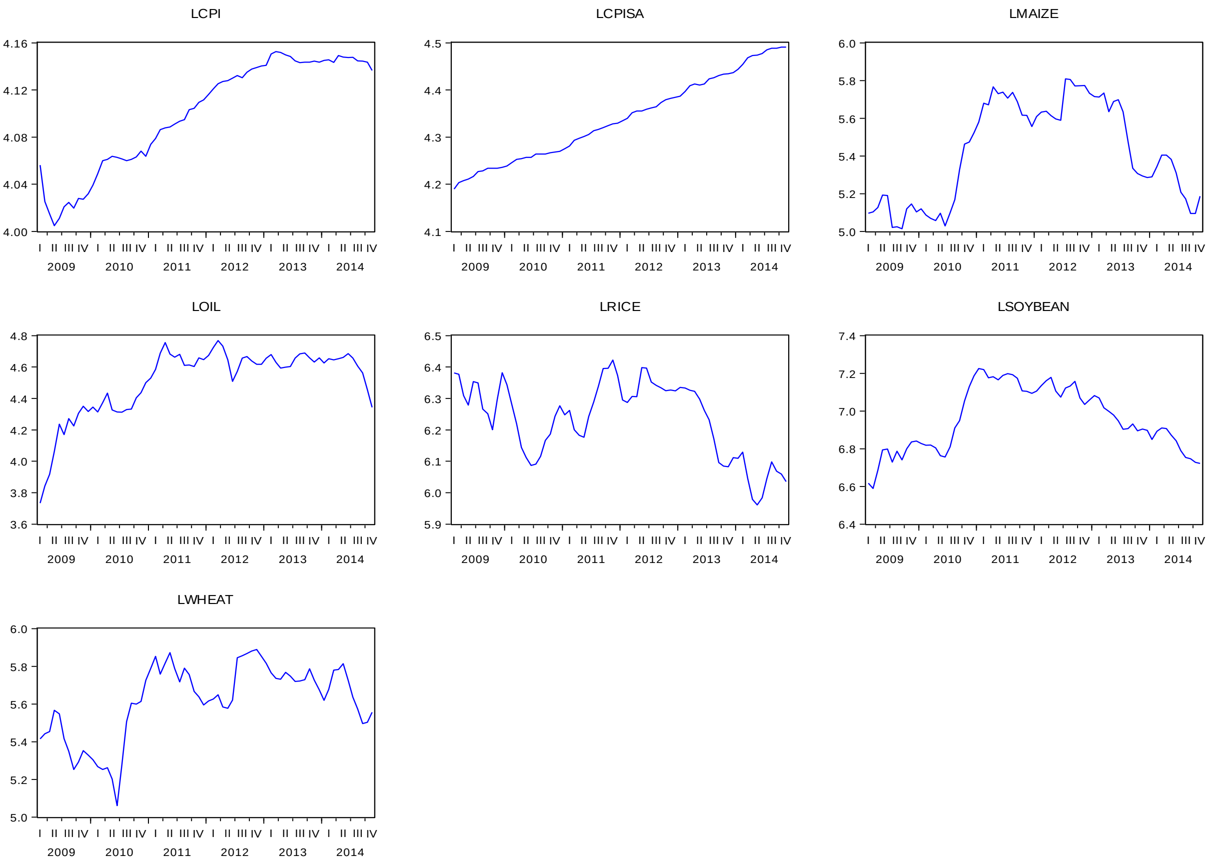
Broadly, the results are structured in such a way that there are pre-modeling checks, the modeling of the ARDL and ECM, post modeling checks and interpretation thereof.

5.4.1 Empirical analysis: 2009: 02 to 2014: 11

5.4.1.1 Nature of the data

Nature of data usually helps in picking up the correct regression models. Figure 5.1 below therefore depicts the nature of data used in the first time period.

Figure 5.1: Nature of data



Source: Author's computations

From the figure above, inflation rates for the greatest time showed an upward trend during the first period. The variable also seems to have a constant. Looking at the explanatory variables, South African inflation rate had a rising trend during the study period. All the other explanatory variables seem not to have any one trend during the period under study. The prices of the foreign variables cannot be said to be correlated to each other and each price seems to have its own movements independent of and apart from the others.

5.4.1.2 Stationarity test

The Augmented Dickey Fuller and the Phillips Peron tests were employed in this study for running the stationarity tests. The results of ADF and the PP tests for all the variables in the study are summarized in Table 5.1 below.

Table 5.1: Stationarity test

ADF TEST				PP TEST		
Variable	**Level**	**First Difference**	**Conclusion**	**Level**	**First Difference**	**Conclusion**
LCPI	-1.267	-8.450	I (1)	-1.916	-10.219***	I (1)
LOIL	-3.388**	-6.190***	I (0)	-4.283***	-6.160***	I (0)
LWHEAT	-2.441	-6.015***	I (1)	-1.859	-5.729***	I (1)
LSOYBEAN	-1.746	-6.616***	I (1)	-1.133	-6.624***	I (1)
LMAIZE	-1.150	-6.178	I (1)	-0.886	-6.164	I (1)
LRICE	-2.483	-5.511***	I (1)	-1.902	-5.152***	I (1)
LCPISA	-2.752	-6.335***	I (1)	-2.168	-7.731***	I (1)

Source: Author's computations *** H_0 rejected at 1% level of significance, ** H_0 rejected at 5% level of significance, * H_0 rejected at 10% level of significance

The table above indicates that only LOIL is I (0) while the rest of the variables are stationary after first differencing. The most critical issue from the above results is that all the variables are integrated of order I(*d*), where *d* is less than two. To estimate an ARDL model, all the variables need to be integrated of an order less than 2.

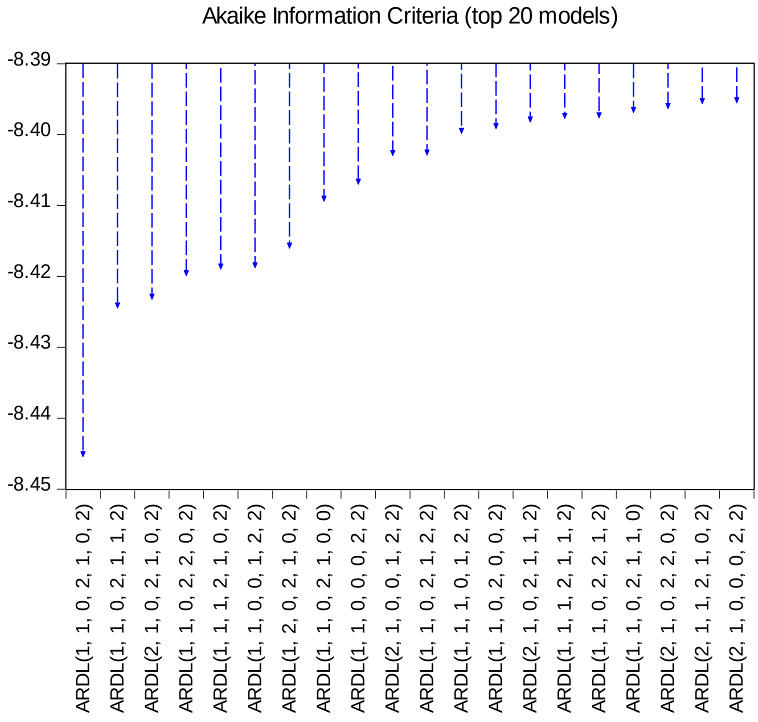
5.4.1.3 Deterministic specifications

Considering that the series in the study are not centered on zero and seem to exhibit a trend, the model that fit well typically required a constant term and a trend. There are about five different Data Generation Processes (DGP) specifications according to Peraran et al (2001). Peraran et al (2001) offer five different versions of a Conditional Error Correction (CEC) model (derived from an ARDL model), distinguished by whether deterministic terms integrate into the error correction term. Now, of the 5 DGP, the researcher considered the case whereby an Unrestricted Constant and Unrestricted Trend was incorporated in the DGP and this was case number 5.

5.4.1.4 ARDL lag structure

In this study the Akaike Information Criterion (AIC) was used to establish the correct lag length to use in the study. A starting point of 2 lags for both the exogeneous and the endogenous variables was utilised to allow automatic selection of a proper lag length using the Eviews estimation software. The results of the criterion are shown in Figure 5.2 below. Overall, an ADRL (1, 1, 0, 2, 1, 0, 2) was adopted as suggested by the AIC.

Figure 5.2: The Criteria Graph



Source: Author's computations

5.4.1.5 Estimation of ARDL model

After selecting the appropriate lag length an ARDL regression model was run. The results from the regression are shown in Table 5.2 below.

Table 5.2: ARDL estimation

Variable	Coefficient	Std. Error	t-Statistic	Prob.*	Comment at 5% level
LCPI (-1)	0.817396	0.061666	13.25515	0.0000	Significant
LCPISA	0.280777	0.139205	2.017009	0.0488	Significant
LCPISA (-1)	-0.357837	0.140327	-2.550024	0.0137	Significant
LMAIZE	-0.004153	0.007589	-0.547186	0.5865	Insignificant
LOIL	0.017226	0.009303	1.851769	0.0696	Insignificant
LOIL (-1)	-0.008525	0.011938	-0.714075	0.4783	Insignificant
LOIL(-2)	0.020260	0.009099	2.226579	0.0302	Significant
LRICE	-0.003470	0.010443	-0.332265	0.7410	Insignificant
LRICE(-1)	0.021021	0.010298	2.041336	0.0462	Significant
LSOYBEAN	-0.003037	0.011480	-0.264575	0.7924	Insignificant
LWHEAT	-0.007536	0.008525	-0.884044	0.3807	Insignificant

LWHEAT(-1)	0.019489	0.009268	2.102909	0.0402	Significant
LWHEAT(-2)	-0.014053	0.006526	-2.153420	0.0359	Significant
C	0.879281	0.557293	1.577772	0.1206	Insignificant
@TREND	0.000549	0.000477	1.149075	0.2557	Insignificant

Source: Author's computations

From the table of results above, the empirical model of the study hence becomes:

$$LCPI = \beta_1 LCPI(-1) + \beta_2 LCPISA + \beta_3 LCPISA(-1) + \beta_4 LMAIZE + \beta_5 LOIL + \beta_6 LOIL(-1) + \beta_7 LOIL(-2) + \beta_8 LRICE + \beta_9 LRICE(-1) + \beta_{10} LSOYBEAN + \beta_{11} LWHEAT + \beta_{12} LWHEAT(-1) + \beta_{13} LWHEAT(-2) + \beta_{14} + \beta_{15} @TREND \text{.......} 5.7$$

From the information provided in the table above, in the short run, the CPI lagged values are significant and the coefficient has a positive sign. This means that past inflation figures had a positive impact on the current inflation rates. Both the current and lagged values of the South African inflation rates proved to be significant variables in determining the inflation rates. The direction of the effect however changed from positive to negative during the two time periods. The international maize prices had no significant effect on the lcpi variable. The international oil prices only became significant in affecting the lcpi after 2 periods and the effect was a positive one. This means that the increases in the international oil prices significantly caused an increase in the inflation rate only after 2 periods. International rice prices only positively significantly influenced inflation rates with a lag. Current prices of soya bean crude oil and wheat did not significantly influence the inflation rates; however, wheat prices significantly influenced the inflation rates in lags 1 and 2.

5.4.1.6 Bound test: Determining the long run relationship between the variables

A Bounds test for cointegration was conducted to assess for the presence of cointegration between the variables of interest as well as to check whether there is a long run relationship between the dependent variable (inflation) and the other variables. The results are shown below.

Table 5.3: Bounds test for cointegration

Test Statistic	Value	Significance	I (0)	I (1)
F-statistic	5.535	10%	2.53	3.59
K	6	5%	2.87	4

		2.5%	3.19	4.38
		1%	3.6	4.9

Source: Author's computations

The F statistic of 5.535 is greater than I (1) with a value of 4 at 5%. Therefore, the null hypothesis of no levels relationship is rejected, and it can be concluded that there is long run relationship between local inflation and the other foreign variables. Looking at the magnitude of t-statistic of 2.961, which is lower than I(0) of 3.41 and I(1) of 4.69 at 5% level of significance (and even at 10% level of significance), we can therefore conclude that the equilibrium relationship of the variables is a bit unstable. Since there is cointegration between the dependent variable (inflation) and the independent variables, an ECM model was estimated. Results of the long run period however show that only international oil prices and the international rice prices are positively significant in effecting changes in the inflation rates. A one percent increase in the international oil prices effects a 0.15% increase in the inflation rates. As for international rice prices, a one percent increase in the international rice prices causes a 0.09% increase in the inflation rates.

5.1.1.7 Error correction model (ECM)

According to the ECM results shown below, as expected, the EC term is negative and significant, having an associated coefficient estimate of -0.183. what this means is that approximately 18.3% of any deviations into disequilibrium are corrected for within one period. Furthermore, due to the very large t-statistic of -6.567245, it can also be concluded that the coefficient is highly significant.

Table 5.4: Error correction model (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.880	0.133	6.588	0.000
@TREND	0.001	9.830	5.581	0.000
D(LCPISA)	0.281	0.121	2.312	0.025
D(LOIL)	0.017	0.008	2.257	0.028
D (LOIL (-1))	-0.020	0.008	-2.628	0.011
D(LRICE)	-0.003	0.009	-0.396	0.693
D(LWHEAT)	-0.008	0.005	-1.371	0.176
D (LWHEAT (-1))	0.014	0.006	2.521	0.015

CointEq (-1) *	-0.183	0.028	-6.567	0.000

Source: Author's computations

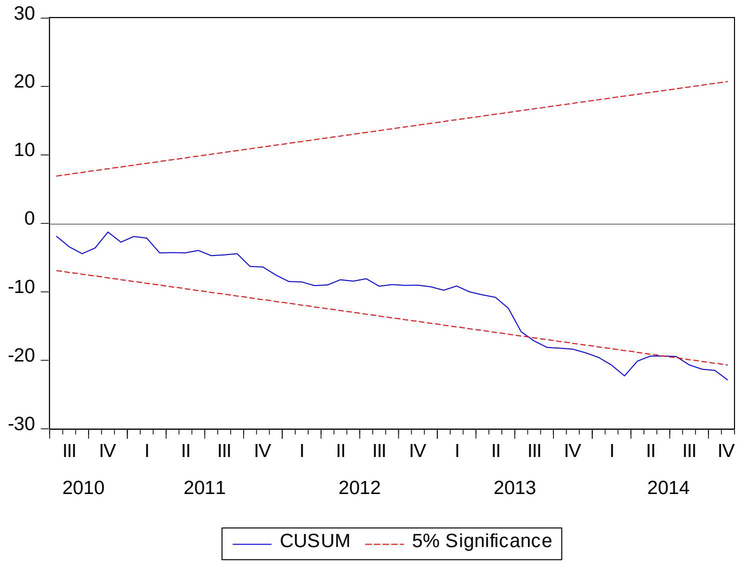
5.4.1.8 Residual diagnostic checks

The diagnostic checks conducted in this study were the stability test, serial corelation test and the heteroscedasticity test. The results are shown below.

Stability Test

The study employed the CUSUM test for stability. The results are given below.

Figure 5.3: Stability Test



Source: Author's computations

Since the blue CUSUM line is within the red lines, the model is stable at 5% level of significance.

Serial Correlation

Table 5.5: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.094	Prob. F (2,55)	0.910
Obs*R-squared	0.250	Prob. Chi-Square (2)	0.8823

Source: Author's computations

The F-statistic p-value of 0.910 is greater than 0.05 which exhibits that the null hypothesis of no serial correlation among residuals at 5% level of significance cannot be rejected. It can therefore be concluded that there is no problem of residual serial correlation.

Heteroskedasticity

Table 5.6: Heteroskedasticity Test: Breusch-Pagan-Godfrey

F-statistic	1.626	Prob. F (10,57)	0.103
Obs*R-squared	20.428	Prob. Chi-Square (10)	0.117
Scaled explained SS	12.811	Prob. Chi-Square (10)	0.5412

Source: Author's computations

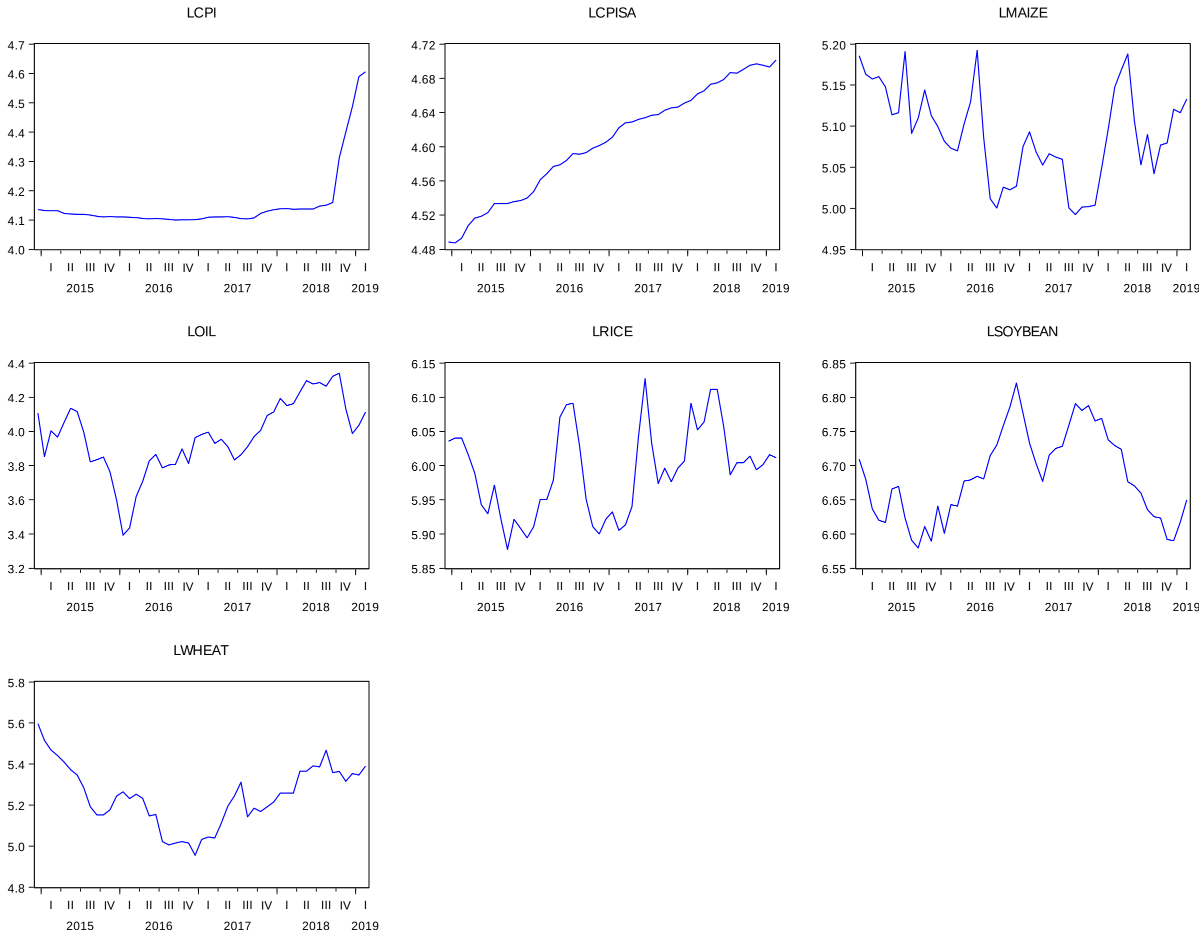
The F-statistic p-value greater than 0.05 at 0.103 indicates that the null hypothesis that the residuals are homoskedastic at 5% level of significance cannot be reject. We therefore conclude that there is no problem of heteroskedasticity on the residuals. Overall, the diagnostic checks indicate that the model is a good fit.

5.4.2 Empirical analysis: 2014: 12 to 2019: 02

5.4.2.1 Nature of the data

Figure 5.4 below show the nature of the data used for analysing the second period.

Figure 5.4: Nature of the data (2nd Period)



Source: Author's computations

According to Figure 5.4 above, the CPI data does not have a determined trend for the whole study period. However, during the last periods of the period, the data depicts an upward trend and appear to have a constant as it's not oscillating around zero. Data of the South African inflation rate appears to have an increasing trend during the period under review. However, all the other explanatory variables seem not to have any one trend during the period under study. The prices of the foreign variables cannot be said to be correlated to each other and each price seems to have its own movements apart from the others.

5.4.2.2 Stationarity test

The Augmented Dickey Fuller and the Phillips Peron tests were employed in this study for running stationarity tests. The results of ADF and the PP tests for all the variables in the study are summarized in Table 5.7 below:

Table 5.7: Stationarity test (2nd Period)

ADF TEST				**PP TEST**		
Variable	**Level**	**First Difference**	**Conclusion**	**Level**	**First Difference**	**Conclusion**
LCPI	1.637	-3.867**	I (1)	2.224	-3.904**	I (1)
LOIL	-2.179	-6.231***	I (1)	-2.606	-6.227***	I (1)
LWHEAT	-2.417	-7.380***	I (1)	-2.417	-7.378***	I (1)
LSOYBEAN	-1.515	-5.912***	I (1)	-1.645	-5.883***	I (1)
LMAIZE	-2.842	-6.811***	I (1)	-2.810	-6.993***	I (1)
LRICE	-3.828**	-5.446	I (0)	-2.995	-5.276***	I (1)
LCPISA	-1.711	-6.133***	I (1)	-1.866	-6.145***	I (1)

Source: Author's computations

According to Table 5.7 above, most of the variables are stationary after first differencing. The most critical issue from the above results is that all the variables at most are integrated of order I(*1*), In order to estimate an ARDL Model, all the variables need to be integrated of an order less than 2.

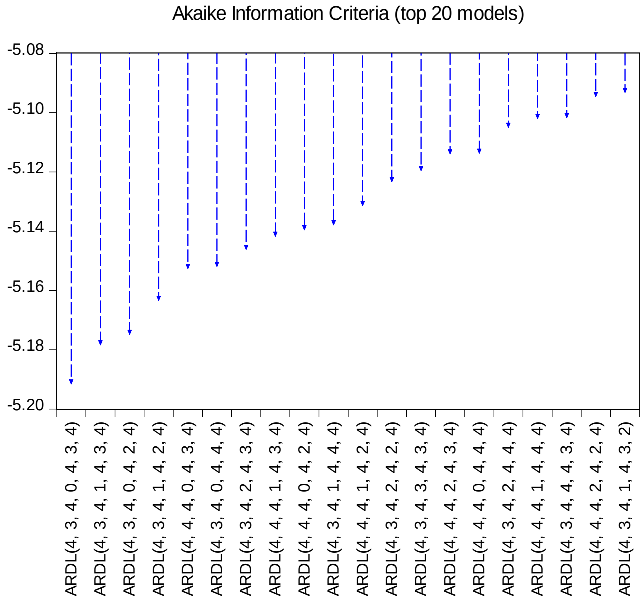
5.4.2.3 Deterministic specification

Considering that the series in the study are not centered on zero and seem to exhibit a trend therefore the model that fit well typically required a constant term and a trend. There are about five different Data Generation Processes (DGP) specifications according to Peraran et al (2001). Now, of the 5 DGP this study considered the case whereby an Unrestricted Constant and Unrestricted Trend was incorporated in the DGP and this was case number 5.

5.4.2.4 ARDL lag structure

In this study, the Akaike Information Criterion (AIC) was employed to determine the correct lag length to use. Finally, a starting point of 4 lags for both the dependent and the independent variables was utilized to allow automatic selection of a proper lag length using the Eviews estimation software. The results of the criterion are shown in Figure 5.5 below. Overall, an ARDL (4, 3, 4, 0, 4, 3, 4) was adopted as suggested by the AIC.

Figure 5.5: The criteria graph (2nd Period)



Source: Author's computations

5.4.2.5 Estimation of the ARDL model

After the selection of the appropriate lag length an ARDL regression model was run which shows the short run results. The results from the regression are shown in Table 5.8 below.

Table 5.8: ARDL estimation (2nd Period)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*	Comment
LCPI (-1)	1.132	0.180	6.278	0.000	Significant
LCPI (-2)	-0.034	0.260	-0.133	0.896	Insignificant
LCPI (-3)	0.204	0.253	0.805	0.432	Insignificant
LCPI (-4)	-1.002	0.240	-4.181	0.001	Significant
LCPISA	4.461	1.272	3.506	0.003	Significant
LCPISA (-1)	-1.757	1.324	-1.327	0.202	Insignificant
LCPISA (-2)	-2.047	1.263	-1.621	0.123	Insignificant
LCPISA (-3)	2.862	0.991	2.886	0.010	Significant
LMAIZE	-0.119	0.139	-0.858	0.403	Insignificant
LMAIZE (-1)	-0.091	0.120	-0.757	0.460	Insignificant
LMAIZE (-2)	-0.031	0.128	-0.241	0.813	Insignificant
LMAIZE (-3)	-0.119	0.130	-0.915	0.373	Insignificant
LMAIZE (-4)	-0.532	0.203	-2.617	0.018	Significant

LOIL	0.065	0.041	1.570	0.135	Insignificant
LRICE	-0.218	0.116	-1.877	0.078	Significant
LRICE (-1)	0.123	0.129	0.952	0.355	Insignificant
LRICE (-2)	0.022	0.139	0.161	0.874	Insignificant
LRICE (-3)	-0.096	0.126	-0.762	0.456	Insignificant
LRICE (-4)	0.257	0.112	2.292	0.035	Significant
LSOYBEAN	-0.215	0.208	-1.034	0.316	Insignificant
LSOYBEAN (-1)	-0.106	0.161	-0.657	0.520	Insignificant
LSOYBEAN (-2)	-0.391	0.166	-2.360	0.031	Significant
LSOYBEAN (-3)	-0.171	0.168	-1.019	0.322	Insignificant
LWHEAT	0.080	0.080	0.998	0.332	Insignificant
LWHEAT (-1)	-0.068	0.087	-0.784	0.444	Insignificant
LWHEAT (-2)	0.113	0.086	1.310	0.208	Insignificant
LWHEAT (-3)	-0.184	0.107	-1.725	0.103	Insignificant
LWHEAT (-4)	0.160	0.093	1.725	0.103	Insignificant
C	-3.815	5.541	-0.688	0.501	Insignificant
@TREND	-0.015	0.006	-2.402	0.028	Insignificant

Source: Author's computations

From the estimations shown in the table above, in the short run, only the 1st and the 4th lags of CPI are significant in determining the current rates of inflation. Moving on to the South African inflation rates, the current rates and the 3rd lag significantly influenced the lcpi variable both in a positive way. The international maize prices only significantly affected the domestic inflation rates after 4 lags, though in a negative way. International oil prices did not contemporaneously effect changes on the inflation rate. International wheat prices did not significantly effect changes on the inflation rates during all the studied lags. However, international prices of rice and wheat effected changes in the domestic inflation rates during the current lag as well as the 4th lag and during the 2nd lag only respectively.

Given the results in table 5.8 the equation for the model thus becomes:

$LCPI = \beta_1 LCPI(-1) + \beta_2 LCPI(-2) + \beta_3 LCPI(-3) + \beta_4 LCPI(-4) + \beta_5 LCPISA + \beta_6 LCPISA(-1) + \beta_7 LCPISA(-2) + \beta_8 LCPISA(-3) + \beta_9 LMAIZE + \beta_{10} LMAIZE(-1) + \beta_{11} LMAIZE(-2) + \beta_{12} LMAIZE(-3) + \beta_{13} LMAIZE(-4) + \beta_{14} LOIL + \beta_{15} LRICE + \beta_{16} LRICE(-1) + \beta_{17} LRICE(-2) + \beta_{18} LRICE(-3) +$

$\beta_{19}LRICE(-4) + \beta_{20}LSOYBEAN + \beta_{21}LSOYBEAN(-1) + \beta_{22}LSOYBEAN(-2) + \beta_{23}LSOYBEAN(-3) + \beta_{24}LWHEAT + \beta_{25}LWHEAT(-1) + \beta_{26}LWHEAT(-2) + \beta_{27}LWHEAT(-3) + \beta_{28}LWHEAT(-4) + \beta_{29} + \beta_{30}@TREND$....................................5.8

5.4.2.6 Bound test: Determining the long run relationship between the variables

The results obtained from the Bounds test for cointegration shows an F statistic value of 6.592 which is above the upper bound I (1) of 4 at 5%. It is then prudent that the null of no levels relationship is rejected and conclude that there is cointegration. In other words, there is a long run relationship between inflation, import prices and the South African inflation rates. Now looking at the t-statistic value of 4.229 which is between the upper and lower bounds at various level of significance, it can be concluded that the nature of the long run relationship gets weaker over time or is degenerate in nature. Since there is cointegration an ECM model is then run.

Table 5.9: Bounds test for cointegration (2nd period)

Test Statistic	Value	Signif.	I (0)	I (1)
F-statistic	6.592	10%	2.53	3.59
K	6	5%	2.87	4
		2.5%	3.19	4.38
		1%	3.6	4.9

Source: Author's computations

In the long run, the south African inflation rates and the international soya bean prices were the only significant variables in effecting changes in the inflation rates though the LCPISA variable was significant at the 10% level. A one percent increase in the international prices of soya beans effected a 1.2% decrease in the inflation rate prices. Meanwhile, a one percent increase in the South African inflation rates caused a 5.02% increase in the domestic inflation rates.

5.4.2.7 Error correction model (ECM)

As anticipated, the error correction term is negative with an associated coefficient estimate of -0.700. The coefficient of the error correction term is also highly significant as indicated by a high t statistic value of -7.901. The coefficient of the EC term means that 70.05% of long run deviations are corrected in one period.   However, as earlier noted, the long run relationship is degenerate.

Table 5.10: Error correction model (ECM)

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.815	0.482	-7.912	0.000
@TREND	-0.015	0.002	-7.510	0.000
D (LCPI (-1))	0.832	0.125	6.650	0.000
D (LCPI (-2))	0.798	0.156	5.131	0.000
D (LCPI (-3))	1.002	0.163	6.145	0.000
D (LCPISA)	4.461	0.920	4.850	0.000
D (LCPISA (-1))	-0.814	0.674	-1.209	0.243
D (LCPISA (-2))	-2.862	0.703	-4.072	0.001
D(LMAIZE)	-0.119	0.077	-1.542	0.142
D (LMAIZE (-1))	0.682	0.121	5.655	0.000
D (LMAIZE (-2))	0.651	0.116	5.601	0.000
D (LMAIZE (-3))	0.532	0.118	4.513	0.000
D(LRICE)	-0.218	0.073	-2.985	0.008
D (LRICE (-1))	-0.183	0.071	-2.571	0.020
D (LRICE (-2))	-0.161	0.076	-2.115	0.050
D (LRICE (-3))	-0.257	0.063	-4.067	0.001
D(LSOYBEAN)	-0.215	0.104	-2.065	0.055
D (LSOYBEAN (-1))	0.562	0.125	4.501	0.000
D (LSOYBEAN (-2))	0.171	0.105	1.625	0.123
D(LWHEAT)	0.080	0.054	1.488	0.155
D (LWHEAT (-1))	-0.089	0.049	-1.810	0.088
D (LWHEAT (-2))	0.023	0.053	0.442	0.664
D (LWHEAT (-3))	-0.160	0.059	-2.696	0.015
CointEq (-1) *	-0.700	0.089	-7.901	0.000

Source: Author's computations

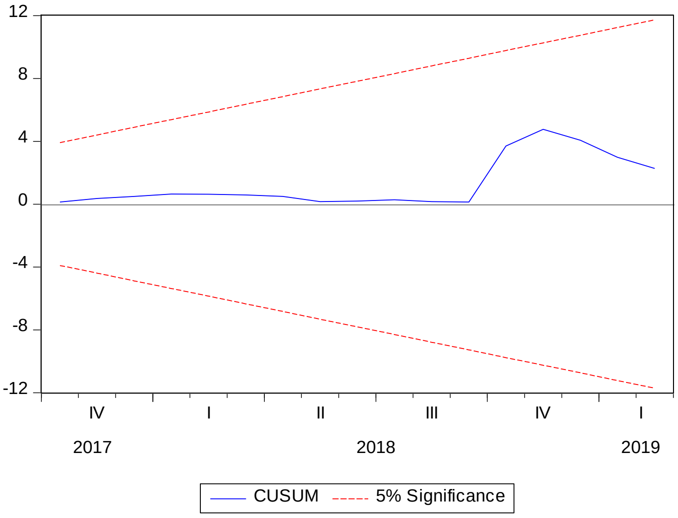
5.4.2.8 Residual diagnostic checks

The diagnostic checks conducted in this study were the stability test, serial correlation test and the heteroscedasticity test. The results are shown below.

Stability Test

The study employs the CUSUM Test for stability. The results are given below.

Figure 5.6: Stability test (2nd period)



Source: Author's computations

Since the blue CUSUM line is within the red lines, the model is stable at 5% level of significance.

Serial Correlation

Table 5.11: Breusch-Godfrey Serial Correlation LM Test (2nd period)

F-statistic	1.497	Prob. F (2,21)	0.255
Obs*R-squared	7.819	Prob. Chi-Square (2)	0.020

Source: Author's computations

From the table above, the F-statistic p-value of 0.255 is greater than 0.05 and this indicates that the null hypothesis that the residuals are serially uncorrelated at 5% level of significance cannot be rejected. It is therefore concluded that there is no problem of residual serial correlation.

Heteroskedasticity

Table 5.12: Heteroskedasticity Test: Breusch-Pagan-Godfrey (2nd period)

F-statistic	1.483	Prob. F (6,43)	0.199
Obs*R-squared	33.683	Prob. Chi-Square (6)	0.251
Scaled explained SS	4.650	Prob. Chi-Square (6)	1.000

Source: Author's computations

The F-statistic p-value of 0.199 shown above is greater than 0.05 and this indicates that we failed to reject the null hypothesis that the residuals were homoskedastic at 5% level of significance. It is therefore concluded that there is no problem of heteroskedasticity on the residuals.

Overall, since all the critical diagnostic checks are being satisfied it implies the model is a good fit.

5.4.3 Discussion of results

The preceding section outlined the results of the regression that was run for the two time periods. Table 5.13 below thus shows a summary of the ARDL regression run for the two time periods.

Table 5.13: Summary of Results

	LCPISA		**LOIL**		**LRICE**		**LWHEAT**		**LSOYABEAN**		**LMAIZE**	
	First Period	Second Period	First Period	Second Period	First Period	Second Period	First Period	Second Period	First Period	Second Period	First Period	Second Period
ARDL – long run coefficients	0.281**	4.461***	0.0172*	0.0647	-0.003	-0.218*	-0.008	0.08	0.003	-0.215	-0.004	-0.119
	(-2.017)	(-3.506)	(-1.852)	-1.57	(-0.332)	(-1.877)	(-0.884)	-0.998	(0.265)	(-1.034)	(-0.547)	(-0.858)
	0.281***	4.461***	0.017***		-0.003	-0.218	-0.008	0.08		-0.215		-0.119
ECM – short run coefficients	(-2.312)	-4.85	(-2.257)		(-0.396)	(-2.985)	(-1.371)	-1.488		(-2.065)		(-1.542)
ECT	-0.183***	-0.700***										
	(-6.567)	(-7.901)										

Source: Author's computations. Note: ****,**,* shows level of significance at 1%, 5% and 10% respectively*. In parenthesis (--) are the t-statistics.

The objective of this study was to test the supposition that the Zimbabwean economy did not experience imported inflation during the period under study against the null hypothesis that the Zimbabwean economy experienced imported inflation during the period under study. In a bid to test the hypothesis, an association between Zimbabwe inflation rate (denoted by LCPI), South African Inflation (LCPISA), together with international prices of oil (LOIL), Wheat per tonne (LWHEAT), Soybean per tonne (LSOYBEAN), Maize per tonne (LMAIZE) and Rice per tonne (LRICE) was regressed using the ARDL Model.

Looking at the first period results, the study revealed that there was a long run relationship that existed between the variables during dollarization period. This indicates that there were some feed-in effects of foreign factors on local inflation. In fact, some of the local inflation was influenced by external factors hence, there was imported inflation during the period under study. In fact, as presented in table 5.2, with the increase in lags South African inflation and international prices of oil, wheat and rice largely influenced local inflation since Zimbabwe is largely a net importer of such commodities that were seen as significant influencers of the local CPI. The international soya bean prices and the South African inflation rates were also significant contributors of inflation in the long run (with the increases in lags). The lagged variables of the foreign factors were more significant indication that the effects of such prices were felt in Zimbabwe after 2 or more months. This is supported by the CointEq(-1) coefficient of -0.183 which implies that only about 18.3% of any changes towards disequilibrium are adjusted for within one period. Looking at the South African inflation rates, the current rates of inflation in South Africa tended to positively influence the local rates of inflation. This can be because most of Zimbabwe's imported consumables were coming from South Africa and, the fact that the Rand was also one of the major currencies that were in use made Zimbabwe more like an extension of South Africa, hence the immediate impact of its inflation rate being felt on the local market.

The analysis of results from the second period revealed that there was a long run relationship between the variables during dollarization period and about 70% of deviations were corrected in one period. This indicated high influence of external factors on local inflation. This indicates that there were some feed-in effects of foreign factors on local inflation. In fact, local inflation was influenced by external factors, hence there was imported inflation during the period under study. Current and lagged variables of South African inflation and rice affected the inflation prices in the short run with the international rice price also positively significantly affecting the inflation prices in the long run. Also, lagged values of international prices of maize and soya bean crude oil (also in the long run) largely influenced local inflation as Zimbabwe was largely a net importer of such commodities as presented in table 5.8.

Looking at the overall analysis of the whole period, it can be noted that past inflation rates had a positive effect on the current inflation rates. This can be explained by the fact that when forward looking, competitive profit maximising companies study the economy and perceive that commodity prices are increasing or decreasing. They then tend to hedge the risk against losses by benchmarking their current price to last period's prices (Dohner's 1984). Pindiriri (2012) also alluded to the same fact.

The current and lagged values of the South African inflation rate overall positively influenced the local inflation rates during the two periods. This can be supported by the fact that during the entire study period, Zimbabwe mainly used the South African Rand as one of its legal tenders. Moreover, the fact that Zimbabwe relied heavily on South African products as it was one of its biggest trading partners also supports this result. Both formal and informal traders relied on imports from South Africa, hence it was easy for changes in the price levels of goods in South African to quickly show on local prices. This result is also supported by Makena (2017) who also found that South African inflation rates positively affected Zimbabwe's inflation rates between 2010 and 2015.

From the analysis, it was also seen that though international oil prices influenced the inflation rates during the entire study period, international food prices tend to also affect the inflation rates much quicker as compared to the oil prices. This may be due to the fact that Zimbabwe at sometimes heavily relies on food imports to meet its national requirements and due to the rent seeking behavior of most firms, the moment international prices of the food commodities increase, the effects will be quickly reflected on local prices usually only after one or two lags. The effects of rice and wheat were much more significant as compared to maize prices. This may be because the country also produces a considerable amount of maize, hence in periods where there are enough rains, the nation will be able to meet most of its required demand. Nyarota et al (2016), Kavilla and Le Roux (2016), Pindiriri (2012) as well as Makena (2017) also aligned to such reasoning.

The outcome from the regression analysis shows that in the short run, there is not much difference in the relationship between the variables for both the first and the second period. The difference is noticeable on international oil prices and wheat prices which are not significant at all during the second period where maize and soya bean crude oil prices do not affect the local prices during the first period. The significance of variables in the long run however, differ in both time periods. During the first period, only South African inflation rates and the international soya bean prices were significant, while international oil prices and the international rice prices were significant in the second period. The results therefore show that the source of imported inflation in Zimbabwe was not constant during the study period. Variables that affected the inflation rates during the short run differed from those that affected the CPI in the long run. This then shows that Zimbabwe during the multicurrency era was extremely prone to fluctuations in the prices of foreign variables. This goes along with basic economic theory which states that a small open economy, in this case one using multi-currencies is prone to international shocks of the foreign variables that it frequently imports and relies on.

5.5 Conclusion

This Chapter studied the effects of imported inflation on domestic inflation, more specifically, it analyzed whether the Zimbabwean economy experience or suffered from imported inflation during the period it was using a multicurrency system. The study used the prices of imports (international oil prices, international rice prices, international wheat prices, international maize prices and international soya bean crude oil prices) as well as the South African inflation rates as independent variables while local CPI was used to represent the inflation rates. Several literatures that seek to study such a relationship have been published, though only a few have explicitly studied import prices' effect on local prices during the multicurrency era. Also, not all independent variables of this study have been used to study the subject with only international oil prices mainly being used to represent import prices and world food prices being bunched together to form one combined variable.

The ARDL regression model was used to examine the hypothesis of the study as it sought to analyse the connection between the dependant and the independent variables to establish whether there was any cointegration between the variables. The nature of the data also promoted the use of the model. The study period was divided into two separate analyses and similar estimation techniques were applied to the time periods in order to give a clear and fair analysis as well as comparisons.

Looking at the results from the regression during the first period, a long run relationship between the dependant and the independent variable was identified, and this was consistent with previous literature conducted both in Zimbabwe and in other countries. The signs of the coefficients of the significant variables were also consistent with economic literature. It was also noted that not all the prices of the variables included in the study were significant in affecting the domestic inflation prices.

Results of the second period of study differ only a bit from those of the first study. Some of the variables that were significant in affecting local CPI during the first period ended up not affecting the CPI during the second period. However, a long run relationship between the dependant variables and the independent variables was observed as the variables were seen to be cointegrated. Of interest to note is the higher cointegration equation coefficient noted during the second period of 70% as compared to 18.3% realised from the first period. Much of the long run deviations from the equilibrium were corrected in one period in period 2 as compared to study period 1.

Overall, there was a long run relationship between the independent variables and the dependent variable, and it can be concluded that Zimbabwe suffered from imported inflation during the period when it used the multicurrency era. There was a long run, mainly positive relationship between local CPI and import prices as well as between foreign inflation (South African inflation rates and the local CPI.)

CHAPTER 6: CONCLUSION AND RECOMMENDATIONS

6.1 Introduction

This Chapter outlines the whole thesis and succinctly sums it up. It also reveals the implications and the recommendation drawn from the study. Section 6.2 outlines the summary of the entire study while section 6.3 highlights the summary of the research findings, 6.4 shows implications and the policy recommendations. Lastly, section 6.5 outlines the limitations and the proposed areas of further study.

6.2 Summary of Study

The first chapter provided the main introduction of the whole study. In this chapter, the background to the study was chronicled, problem statement stated, broad research objectives set, theoretical foundations of the study were also discussed in that section. The study timeframe was a time when Zimbabwe operated under the multicurrency system from early 2009 up until 2019. With regards to the background of Zimbabwe, the main salient features were the hyperinflationary environment that prevailed during the period prior to the study. During the study period, the country changed the monetary regime to a multicurrency regime as a way of correcting the hyperinflation and mitigating associated challenges. The study period also coincided with a peaceful political environment that prevailed after 2009 brought about by the Government of National Unity in Zimbabwe which, together with the enactment of sound economic reforms, resulted in a remarkable enhancement of economic activity. Of note is the fact that inflation fell tremendously to even negative territory by 2015 while GDP growth rate reached a high of around 16.7% in 2011. The period after 2015 saw inflation resurfacing and rising once again. The unfolding of economic events during the study period highlighted a puzzling phenomenon to most researchers and policy makers as the country was experiencing a positive GDP growth, it was concurrently experiencing mixed movements in the rate of inflation. That formed the basis of the research problem and questions. In summary, the research objectives were to examine the effects of money supply shocks, money demand shocks and changes in the foreign exchange rate on the price level in a multicurrency economy. Additionally, the study aimed at assessing whether Zimbabwe experienced imported inflation during the study period. Lastly, the chapter highlighted the contributions that the study brings around the subject matter of QTM. For the purpose of this thesis, the research period was subdivided into 2 sections. The first period (2009:02 to 2014:11) was when the Zimbabwean economy was solely using foreign currencies as their legal tender and the country's monetary authorities had no autonomy over money supply issues in the economy. The second period

(2014:12 to 2019:02) represents that era when the country had its own pseudo money in the currency basket that was in circulation. During this second period, the pseudo currency was pegged at par with the US Dollar.

Chapter two covers money supply and inflation. This was based on the first objective of the study i.e., to investigate the effects of money supply on the price levels in a multicurrency economy. The chapter articulates, first, the background and the theoretical framework that relates to the relationship between money supply and inflation. The theoretical framework discussed included the Monetarist Theory of Inflation the Transactions approach to the Quantity Theory of Money as well as the Keynesian view on money supply and inflation. Empirical literature was also discussed revealing mixed results around QTM. Various methods of estimation that were used by various researchers who studies similar areas were also highlighted including the Johansen cointegration technique; Structural Vector Autoregressive Modelling technique; Auto-Regressive Distributed Lag (ARDL); Engel-Granger two stage test for cointegration; Vector Error Correction Model (VECM) and the Ordinary Least Squares Multiple regression, among others. This study employed the Structural Vector Auto Regression modelling technique and used monthly data for 2009:02 up until 2019:02 from RBZ, IMF and the South African Reserve Bank. The contemporaneous variables used in the study were Income (GDP), International Oil prices, Exchange Rate and Interest rates. M1, M2 and M3 monetary aggregates were used as proxies for the variable, money supply in this chapter to investigate the effects of money supply shocks on inflation. However, in all the time periods, it is important to note that the effects of money supply were shown to be very insignificant to claim applicability of the QTM. Thus, it is safe to conclude that in a multicurrency economy, the tenets of the Quantity Theory of Money are inapplicable since growths in the shocks of money supply did not cause equal increases in the inflation rates.

Chapter Three zooms into money demand and inflation. This section was premised on the second objective of examining the effects of the money demand shocks on the price level in a multicurrency economy. The background and the theoretical tenets of money demand and its relationship with price level was discussed. The Cash-Balance Approach to the Quantity Theory of Money was the main theoretical foundation of the subject matter under this chapter however also supported by the Modern Quantity Theory of Money as well as the Theory of the Liquidity Trap. Empirical literature highlighted a number of studies that produced mixed results having utilised SVAR, VECM, VEC, UECM and ARDL amongst other methods of estimation. The majority of studies that have explored the relationship between money demand

and the inflation rate have mostly used the Error Correction Models (ECM) and the Johansen cointegration method of analysis. This study however employed the Structural Vector Autoregressive (SVAR) model as it studies the effects of the money demand shocks and other variables of interest to the inflation rate. From the literature available, there has not been any study conducted in Zimbabwe in both the pre and post dollarization era that has examined the effect of shocks of the variables in this study to the inflation rate. Monthly data for 2009:02 up until 2019:02 sourced from RBZ, IMF and the South African Reserve Bank were used in the study. Variables used in the study were Consumer Price Index (CPI), Money demand (Demand for private credit was used as proxy for the demand of money), Income (GDP), International Oil prices, Exchange Rate and Interest rates. Results of the analysis showed that even when using the money demand variable, there was not enough evidence to support the holding of QTM during the two periods of study as changes in money demand did not contemporaneously cause changes in inflation levels.

Chapter Four focuses on the exchange rate and inflation. This chapter used the same approach used in the previous chapters whereby the first step was to lay the background and the theoretical tenets of the subject matter, in this case the relationship between exchange rate and inflation. The scope of the study was confined to the exploration of how the exchange rates may have an effect on the price levels, thus it is the Purchasing Power Parity (PPP) and the Quantity Theory of the Exchange Rate which mattered the most though there are a number of theoretical frameworks that relate to exchange rate determination. The discussed literature revealed that quite a number of studies have been conducted to explore the relationship between inflation rate and exchange rates. However, it is important to note that of the studies conducted on the subject matter, focus was mainly given to economies that use their own local currency as legal tender as well as those countries that had fully dollarized or partially dollarized. From such studies, the exchange rates used where those of the local currencies against the USD. However, there has not been a single study that sought to address the exact subject matter on a multicurrency economy. In analysing the relationship between inflation rates and the exchange rates, scholars have employed a diverse range of econometric regressions. This study makes use of the Auto Regressive Distributed Lag (ARDL) model as it suits the study's overall objectives. The dependent variable remains the Consumer Price Index (CPI), the independent variables being the foreign exchange rates and the interest rate. Overall, exchange rates influenced the inflation rate more during the period that Zimbabwe was solely utilising a foreign multicurrency regime as compared to the period where it introduced its pseudo currency in the currency basket. The effects of the exchange rates on the inflation rates differ between the two periods, some of the used exchange rates having a negative relationship with the inflation rates, while others have a positive relationship as supported by previous literature.

The penultimate, Chapter Five explores the possibility of imported inflation and its likely effects on Zimbabwe inflation. The background and the problem statement were discussed first. The literature highlighted the role of the theory of Pass-Through, Cost Push Theory of Inflation, the Adaptive and the Rational Theory of Expectation in modelling imported inflation. The reviewed literature showed that the effect of imported inflation on the domestic inflation rates has now been debated for a while. However, at times, the variables that represent foreign import prices differ from one study to the other. As of this study, a different range of variables was used to bring out the relationship between domestic price levels and import prices. This study opted to utilize the Auto Regressive Distributed Lag (ARDL) model as it suits the research's overall objectives as well as data characteristics. Looking at the overall analysis of the whole period, it was noted that past inflation rates had a positive effect on the current inflation rates. Local inflation was also found to be influenced by external factors, hence there was imported inflation during the period under study. In fact, South African inflation and international prices of oil, wheat and rice largely influenced local inflation since Zimbabwe is largely a net importer of such commodities that were seen as significant influencers of the local CPI.

6.3 Summary of findings

This thesis set out to investigate the applicability of the Quantity Theory of Money (QTM) in a multicurrency economy. It sought to answer the following research questions:

i. Do changes in the shocks to money supply have an effect of the prices in a multicurrency economy?

ii. Do changes in the shocks to money demand influence the prices in a multicurrency economy?

iii. Do foreign exchange rates have any effect on the price levels in a multicurrency economy?

iv. Did Zimbabwe suffer from imported inflation during the time it was using a multicurrency system?

The first two empirical Chapters of this study analysed the tenets of the QTM, looking at the two different points of deducing the QTM which is the transactional approach to the QTM and the Cash Balance Approach to the QTM. The two Chapters analysed the QTM looking at the money demand as well as the money supply interpretation of the QTM. In the Third and Fourth empirical Chapters, the study undertook to investigate the association existing between foreign exchange rates and the inflation rates as well as the relationship between imported inflation and the local inflation respectively.

The Quantity Theory of Money has some assumptions that it bases its study on. The main assumption being that variations in the amount of money in circulation in a country should give proportional changes in the general prices of goods and services in an economy. The other assumption of interest to note is that in an equilibrium state in an economy, money supply should be equal to money demand, hence the two variables can be used interchangeably. The first two empirical Chapters employed the Structural Vector Autoregressive (SVAR) model to analyse the applicability of the QTM in a multicurrency economy. The use of the SVAR model meant that the variables in their exact form could not be used for the analysis of the data. However, effects of the shocks to the independent variables were anlaysed to identify their effect on the dependent variable. Hence, in this study it was also expected that changes in the independent variables caused by the shocks to the independent variables were expected to cause a significantly proportional change in the dependent variable for it to be concluded that the tenets of the QTM were holding sway during the period of the study.

As Jan (2001) rightfully states, the SVAR approach is useful to explore what a given theoretical view implies for the dynamic behaviour of the variables of interest. Or, as Breitung (1998) also puts it, SVAR model are useful to take a theory guided look at the data, hence the option to use the SVAR model to look at the theoretical applicability of the data to support the applicability of the QTM in a multicurrency economy. Comparing the money supply and the money demand results during the first period where the economy was strictly using the multicurrency, the results do not seem to stray away from each other that much. Shocks to the money demand variable did not contemporaneously cause changes in the price levels. The same can also be said of the money supply variables (M1, M2 and M3). Shocks to both the money supply and the money demand variables had no contemporaneous effect on the price levels between the period 2009:02 and 2014:11. Shocks to money demand were in the positive in the entire 24 lags while just like that of M2 and M3 in the money supply model. Shocks to the M1 variable were different form all the earlier mentioned shocks in that the shocks started off in the negative, only becoming positive after about 3 lags. In both models, looking at the variance decomposition results, the contribution of the money demand and all the money supply variables did not proportionally cause changes in the inflation variable. The variables were not even among the highest contributors of the changes in the inflation rates.

In the Money Demand model, the money demand variable came 4th when ranking the explanatory power of the changes in the inflation rates after international oil prices, lags of CPI itself, USD/ZAR exchange rates and the interest rates respectively. When looking at the Money Supply model, the international oil prices explained changes in the CPI much better than any other variable in the models (M1:60%, M2: 65% and M3: 61%). CPI explained itself better than money supply which came in 3rd in the M2 model and 4th in the M1 and M3 model when ranking the variables.

This analysis then clearly goes on to show that, regardless of the variables used as proxies for money demand or money supply as well as the theory of QTM that will be in use, the tenets of the QTM did not hold in the explicit multicurrency system in Zimbabwe. Now, when looking at one of the tenets of the QTM where it states that in a market in equilibrium, money supply should be equal to money demand, that assumption cannot be said to be applicable with certainty. The proportionality of the variables to each other is not equal. However, the effects of the variables to CPI almost have similar effects.

Now going on to the results of the second period, the country now had introduced its own pseudo currency in circulation. Under the tenets of the QTM, it would be prudent to assume that with the authorities now having some control over the quantity of money in circulation, there would then be a strong positive correlation between quantity of money in circulation and the inflation rates. The performance of the money supply variables is more or less the same for all three variables in terms of the reaction of the CPI to shocks in the variables. All the three variables exhibit a negative relation between the money supply and the inflation rates only being significant in the first few lags, then becoming insignificant with the passage of time. Though the relationship of the variables was not as expected according to economic theory, during some months in this period, there was recorded negative inflation though the money supply was increasing in the country. This could be attributed to the fact that the Zimbabwean economy was now on a rebound and improving, hence the negative inflation though money supply was still increasing so as to have a balance with the growth that was being experienced in the country. The direction of the money supply variables is also the same with the money demand variable which also show a negative relationship between money demand and the inflation rates. The response of the CPI to shocks in the money demand variable is however not significant in all the time lags.

Looking at the explanatory power of the variables of interest in the second period, the income variable proved to be the variable that explained most variation in the inflation rate variable in both the money demand and the money supply models. The money demand variable came third in explaining the variations in the CPI after CPI itself and the income variable during the first lag. The money supply variables M1, M2 and M3 also came third in explaining the variations in the CPI variable during the first lag and just like in the money supply variable, they were behind the CPI and income variables. Now looking at the end of the 24-lag period, the variables appear to be going in different directions. M2 and M1 variables were ranked the third highest contributors to the changes in the inflation rate in their respective models. M1 variable was the 2nd most significant contributor in its model only after income. Looking at the money demand variable, it was the fourth highest contributor to changes in the CPI after income, exchange rate and lagged values of CPI.

When it comes to analysing one of the assumptions of the QTM which states that money supply is equal to money demand in equilibrium state, the behaviour of the money demand variable and the majority of the money supply variables when looking at the impulse response function is more or less the same. Looking at the explanatory power of the money demand and the money supply variables, though the result was not the same in all the four models, it can be concluded that the explanatory power of all the aforementioned variable does not suffice to ascertain the applicability of the Quantity Theory of Money in a multicurrency Zimbabwean economy. However, what can be of interest to note is that in both the money demand and the money supply models, the behaviour of all the four explanatory variables (M1, M2, M3 and the demand for credit as shown by the impulse response function showed a similar trend. Thus, to say shocks to the four aforementioned variables caused an almost identical effect on the variable of interest , the CPI. However, of particular note of interest is the comparison between the M1 variable and the demand for credit variable which exhibit the closest likeness as compared to the other monetary aggregates variable. This closely resembles the findings by Bernanke and Blinder (1988) who warranted for a more symmetrical treatment of money and credit. Thus, from this study, in the Zimbabwean economy during the multicurrency era use, money demand shocks and money supply shocks overally exhibited similar effects to the inflation rate as represented by the CPI variable.

Therefore, in response to one of the motives of this study i.e., to study the QTM applicability from both the money supply and the money demand side, both prove to be inapplicable in the Zimbabwean multicurrency use context but however, both money supply and money demand shocks exhibit the same effect on the CPI.

Chapters Four and Five explored the relationship between local inflation rates and the foreign exchange rates as well as the relationship between imported inflation and the local inflation rates respectively. Both Chapters employed the ARDL model for analysis. The results of both studies revealed that there was a long run relationship between the dependent and independent variables in both studies.

The study revealed that during the first period of the investigation of the connection between inflation rates and foreign exchange rates, about 16.66% of any movements into disequilibrium were corrected within one period. The correction of the movements into disequilibrium is corrected a bit higher during the second period under study in which 47.18% of long run deviations were corrected in one period. In the first period, no foreign currency exchange rate significantly contemporaneously effected changes in the inflation rates. All the significant foreign exchange rates variables affected the inflation rate with a lag. The South African/ USD exchange rate was the only variable that was significant in both the short and the long run, hence it can be concluded that among the foreign exchange rates included in the study, it was the most significant one.

During the second period, the foreign currency that significantly contemporaneously caused changes in the inflation rate was the South African Rand while the other currencies (Chinese Yuan and the Mozambique Metical) affected the inflation rates with lags.

Results of the study therefore managed to answer the research question of whether foreign exchange rates had an effect on the local price of goods and services during the period under study. It can therefore be concluded that there was a long run relationship between the study variables, implying that inflation rates in Zimbabwe were indeed influenced by the foreign exchange rates during the period under study.

Looking at the results of the study which analysed the relationship between foreign inflation and the local inflation. The lagged variables of the foreign factors were more significant, an indication that the effects of such prices were felt in Zimbabwe after 2 or more months. The CointEq (-1) coefficient of -0.183 revealed that only about 18.3% of any movements into disequilibrium were corrected within one period. During the second period of the study, the analysis exhibited that there was a long run relationship between the earlier mentioned variables during dollarization period and about 70% of deviations were corrected in one period (month). Results of the study revealed that sources of foreign inflation differ from variable to variable during the two-time period as well as between the short and the long run.

Therefore, to answer the research questions as to whether Zimbabwe suffered from imported inflation during the period it was using a multicurrency economy, the answer is Yes, it did suffer from imported inflation. It was proven that typically there existed a positive long run relationship among foreign prices and foreign inflation rates as well as the domestic inflation rates.

6.4 Implications and policy recommendations

Results of the study revealed that that in a multicurrency economy, the applicability of the QTM is not proven to exist. This then exhibits that inflation in a multicurrency is not a monetary phenomenon. However, it was shown that inflation in a multicurrency use economy is not mainly influenced by the changes in the money supply and or money demand. Inflation was observed to be influenced by other factors namely, foreign prices of the goods that the country imports, foreign inflation rates as well as the exchange rates of the currencies that the multicurrency economy recognizes as legal tender. Hence it is safe to say that from this study, in a multicurrency economy, inflation is mainly influenced by external factors.

There is need for the governments of small open economies to increase their self-reliance and increase their production levels so as to minimize or avoid reliance on imported items. By reducing imports and turning to local production of the goods that they can produce themselves, governments greatly reduce the effects of imported inflation in their economies and ultimately reduce their import bill. Policies that promote local production and at the same time lure investors into the different sectors of the economy, especially in those sectors were the highest import bill comes from need to be implemented. Campaigns such as the “Buy Zimbabwe” campaign should be widely promoted to promote import substitute. However, this can only be beneficial when proper trade policies are implemented.

As advocated for by the trade protection theories, the Government can also impose import restrictions by way of imposing quotas and import restriction such as import licences or permits. This protects the local industry from unfair competition from cheaper import substitutes as well as gives it a chance to thrive on the local market. Tariff restrictions can also be imposed so as to discourage excess importation , specifically on finished goods. On the other hand, lower tariffs can also then be imposed on those goods that enter the production line as raw materials so as to give the local producers a competitive edge on the market. Such policies can be implemented for only a short while the country industries become competitive and then can be removed when their intentions have been met as it has been proven that in the long run, such trade protectionism policies can make industries less competitive in international trade (Amadeo, 2022). Frequent reviews of such measures should be done to assess their relevance given the would-be current situations. Brazil is one country that has managed to implement successful trade policies that has worked in its advantage. It embarked on both trade protectionist policies and also trade liberalisation policies and both policies have worked well to keep its economic system sound.

There is also need to do away with overreliance on one nation as a major trading partner. New and diverse trading partner nations need to be established at all times. South Africa being Zimbabwe's major trading partner in both imports and exports, exposed Zimbabwe to great macro-economic shocks as even the slightest disturbance in the South African economy had great effects on the economic operations in Zimbabwe. This was also shown by the positive correlation that was seen between the South African inflation rates and the Zimbabwean inflation rates during the study period. This policy recommendation also strongly lies with the implementation and advocacy of having proper trade policies within the country as they determine who your trade partners might be. It has been shown that a developing country's economics can be affected by its trading partners and can greatly benefit from trading with developed countries. By making full use of the trade treaties, it has with other countries, Zimbabwe will be able to diversify its trading partners and not depend on just one country. Lessons from China can be put in use as it has greatly transformed its trading patterns to its own advantage.

Though dollarisation can serve nations from adverse economic pressures, in the long term, economies should thrive to have their own currency as it might protect them from adverse, imported foreign shocks. It's very easy for the fluctuations of the currencies the country is using as its own currency to swiftly filter into the local market and cause disruption in the economy. There is also need for countries to promote the sole use of their own legal currency within their economy. From this study, it has been shown that multicurrency use economies are greatly affected by the fluctuation of the currencies that they normally will be using the most in the system. Fluctuations in the USD/ZAR exchange rate proved to have had the greatest impact on the inflation rates that were experienced in Zimbabwe during the multicurrency use era. Countries should therefore strive to establish their own currency and if possible, use it as a sole currency so as to avoid foreign feed in factors to the local inflation rate. However, the country must first put in place proper economic fundamental and deal with economic structures that initially lead to the abandonment of the use of the local currency. Without such fundamentals in place, history will likely repeat itself as such the case is in Zimbabwe currently. There are only a few nations (Israel and Poland among others) that have managed to successfully de-dollarize their economies. Though the process takes a long time, Zimbabwe can opt to learn from these countries and hopefully in the near future, put in place policies that then enable the country to go back to the sole use of its currency. In contrast to the few successes, there have been many more countries with unsuccessful attempts at de-dollarization (Peru, Bolivia, Ecuador). Often, these attempts involved administrative enforcements without fully restoring confidence in the local currency or eliminating the underlying instability that led to dollarization in the first place hence Zimbabwe needs to have the correct economic fundamentals in place (IMF, 2013).

There is also need for authorities to motivate their citizens to have confidence in the economy as past inflation rates were observed from this study to greatly influence the current rates of inflations. This shows that to a great extent, the speculative nature of the economic players in the economy influences price levels as previous rates of inflation are used to affect or forecast the current as well as the future rates of inflation. However, this can only be done when there is confidence in the policies that the government implement, Haphazard changes in the country's policies make it difficult for the citizens to have confidence in their government. Human expectations and past experiences (as explained by the adaptive and rational expectations theory of inflation) play a very important role in determining how the price levels behave in an economy. By controlling these or influencing these by the proper utilisation of economic policies the government may go a long way in curbing high inflation rates.

Zimbabwe has in place a lot of policy that could have worked to its advantage but however, due to the policy inconsistences that the country has, this discourages investment and ultimately affects economic growth hence shies away potential investments that could boost up local production of goods.

6.5 Limitations of the study and areas of further research

Future areas of study could consider analysing the inflation determinants in a panel of countries that used a multicurrency system. This would provide a broader understanding of the inflation dynamics in a number of countries under the same situation and broaden the scope of literature on the subject matter. Further studies could also deeply look into the domestic factors that affect inflation in a multicurrency system in comparison to the foreign factors. In future research, there is also a need to promote the use of the Structural Vector Auto Regression (SVAR) Model in analysing the inflation dynamics in multicurrency economies as the modelling technique has not been widely used in the subject area.

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APPENDICES

Appendix 1

Appendix 1A: VAR output
1st Period output

M1 VAR (3) Output

Vector Autoregression Estimates

Sample (adjusted): 2009M05 2014M11

Included observations: 67 after adjustments
Standard errors in () & t-statistics in []

	LOIL	LUSDZAR	LCAP	LM1	LLR	LCPI
LOIL (-1)	1.020537	-0.050325	0.049913	0.189131	-0.774726	0.010315
	(0.16882)	(0.07743)	(0.26903)	(0.19652)	(0.35759)	(0.00914)
	[6.04513]	[-0.64996]	[0.18553]	[0.96240]	[-2.16653]	[1.12892]
LOIL (-2)	-0.088244	0.062458	-0.159414	-0.541232	0.915932	0.015878
	(0.23502)	(0.10779)	(0.37452)	(0.27358)	(0.49780)	(0.01272)
	[-0.37548]	[0.57946]	[-0.42565]	[-1.97834]	[1.83995]	[1.24828]
LOIL (-3)	-0.176180	-0.051333	0.105774	0.478204	-1.272878	-0.022662
	(0.17216)	(0.07896)	(0.27435)	(0.20041)	(0.36466)	(0.00932)
	[-1.02337]	[-0.65013]	[0.38555]	[2.38618]	[-3.49061]	[-2.43213]
LUSDZAR (-1)	0.087071	1.021380	0.756297	-0.440710	-0.236164	0.008447
	(0.38142)	(0.17493)	(0.60783)	(0.44401)	(0.80792)	(0.02064)
	[0.22828]	[5.83865]	[1.24425]	[-0.99257]	[-0.29231]	[0.40918]
LUSDZAR (-2)	0.189036	-0.259638	-1.444102	0.559283	0.907931	-0.010044
	(0.50233)	(0.23039)	(0.80051)	(0.58475)	(1.06401)	(0.02719)
	[0.37632]	[-1.12697]	[-1.80398]	[0.95644]	[0.85331]	[-0.36944]
LUSDZAR (-3)	-0.370947	0.095992	0.685774	-0.090295	-0.957773	-0.004492
	(0.31950)	(0.14654)	(0.50916)	(0.37193)	(0.67676)	(0.01729)
	[-1.16102]	[0.65508]	[1.34687]	[-0.24278]	[-1.41523]	[-0.25978]
LCAP (-1)	0.169522	0.027228	0.561477	-0.184439	-0.203765	0.006376
	(0.08671)	(0.03977)	(0.13818)	(0.10094)	(0.18367)	(0.00469)
	[1.95505]	[0.68467]	[4.06336]	[-1.82726]	[-1.10944]	[1.35863]
LCAP (-2)	-0.111281	0.005264	-0.096118	0.269061	-0.209416	-0.006126
	(0.10978)	(0.05035)	(0.17495)	(0.12779)	(0.23253)	(0.00594)
	[-1.01366]	[0.10456]	[-0.54941]	[2.10541]	[-0.90058]	[-1.03109]

LCAP (-3)	-0.051187	0.013091	0.283628	-0.011172	0.084805	-0.002885
	(0.08623)	(0.03955)	(0.13742)	(0.10038)	(0.18265)	(0.00467)
	[-0.59360]	[0.33101]	[2.06397]	[-0.11130]	[0.46429]	[-0.61806]
LM1(-1)	0.199871	-0.017003	0.160295	0.342445	0.148147	0.007017
	(0.12641)	(0.05798)	(0.20145)	(0.14715)	(0.26776)	(0.00684)
	[1.58111]	[-0.29328]	[0.79571]	[2.32711]	[0.55328]	[1.02563]
LM1(-2)	-0.038956	0.088117	-0.490079	0.145808	0.288916	0.017185
	(0.12728)	(0.05837)	(0.20283)	(0.14816)	(0.26959)	(0.00689)
	[-0.30608]	[1.50954]	[-2.41624]	[0.98412]	[1.07168]	[2.49473]
LM1(-3)	-0.140682	-0.041783	0.036353	0.313023	0.422503	-0.012390
	(0.12952)	(0.05940)	(0.20641)	(0.15078)	(0.27435)	(0.00701)
	[-1.08616]	[-0.70338]	[0.17612]	[2.07608]	[1.54001]	[-1.76743]
LLR (-1)	-0.024061	-0.003741	0.232904	-0.108312	0.853642	-0.002422
	(0.06041)	(0.02770)	(0.09626)	(0.07032)	(0.12795)	(0.00327)
	[-0.39832]	[-0.13503]	[2.41945]	[-1.54032]	[6.67170]	[-0.74092]
LLR (-2)	0.007445	-0.002367	-0.058490	-0.004459	-0.461863	0.008021
	(0.07651)	(0.03509)	(0.12193)	(0.08907)	(0.16206)	(0.00414)
	[0.09730]	[-0.06746]	[-0.47971]	[-0.05006]	[-2.84990]	[1.93690]
LLR (-3)	0.041498	-0.025988	-0.051152	0.009682	0.196554	-0.009105
	(0.05227)	(0.02397)	(0.08330)	(0.06085)	(0.11072)	(0.00283)
	[0.79387]	[-1.08401]	[-0.61405]	[0.15912]	[1.77518]	[-3.21810]
LCPI (-1)	3.237009	0.061672	-3.190785	-4.177412	0.871143	0.872648
	(2.27441)	(1.04313)	(3.62451)	(2.64762)	(4.81759)	(0.12310)
	[1.42323]	[0.05912]	[-0.88034]	[-1.57780]	[0.18083]	[7.08910]
LCPI (-2)	-1.561924	0.188609	0.201232	4.100972	-10.43907	0.259902
	(2.80783)	(1.28777)	(4.47456)	(3.26856)	(5.94745)	(0.15197)
	[-0.55627]	[0.14646]	[0.04497]	[1.25467]	[-1.75522]	[1.71025]
LCPI (-3)	-0.982018	0.110029	6.169029	0.077129	5.744351	-0.238725
	(1.89960)	(0.87123)	(3.02720)	(2.21130)	(4.02366)	(0.10281)
	[-0.51696]	[0.12629]	[2.03787]	[0.03488]	[1.42764]	[-2.32197]
C	-2.073860	-2.327306	-3.614373	0.963157	17.66803	0.332839
	(3.32043)	(1.52287)	(5.29144)	(3.86527)	(7.03322)	(0.17971)
	[-0.62458]	[-1.52824]	[-0.68306]	[0.24918]	[2.51208]	[1.85209]
R-squared	0.922120	0.981508	0.789904	0.986274	0.907844	0.996851
Adj. R-squared	0.892915	0.974573	0.711119	0.981127	0.873285	0.995669
Sum sq. resids	0.142056	0.029881	0.360760	0.192500	0.637352	0.000416
S.E. equation	0.054401	0.024950	0.086694	0.063328	0.115231	0.002944
F-statistic	31.57396	141.5384	10.02597	191.6148	26.26976	844.0301

Log likelihood	111.1647	163.3910	79.94297	100.9849	60.87782	306.5704
Akaike AIC	-2.751185	-4.310179	-1.819193	-2.447309	-1.250084	-8.584192
Schwarz SC	-2.125974	-3.684968	-1.193982	-1.822098	-0.624873	-7.958980
Mean dependent	4.539880	2.128711	22.14540	14.32191	2.997033	4.103256
S.D. dependent	0.166243	0.156471	0.161298	0.460972	0.323710	0.044742

Determinant resid covariance (dof adj.)	3.56E-18
Determinant resid covariance	4.81E-19
Log likelihood	842.5808
Akaike information criterion	-21.74868
Schwarz criterion	-17.99741
Number of coefficients	114

M2 VAR (2) Output

Vector Autoregression Estimates

Sample (adjusted): 2009M04 2014M11
Included observations: 68 after adjustments
Standard errors in () & t-statistics in []

	LOIL	LUSDZAR	LCAP	LM2	LLR	LCPI
LOIL (-1)	0.975312	-0.033262	-0.129412	0.105259	-0.521313	0.016928
	(0.15489)	(0.07154)	(0.25613)	(0.11836)	(0.38279)	(0.01042)
	[6.29661]	[-0.46491]	[-0.50526]	[0.88932]	[-1.36187]	[1.62496]
LOIL (-2)	-0.211639	0.039591	0.082220	-0.027336	-0.104635	0.001027
	(0.16380)	(0.07566)	(0.27086)	(0.12516)	(0.40480)	(0.01102)
	[-1.29204]	[0.52328]	[0.30355]	[-0.21840]	[-0.25848]	[0.09321]
LUSDZAR (-1)	-0.246425	1.018170	0.388567	0.019582	0.448655	0.018316
	(0.31653)	(0.14620)	(0.52341)	(0.24187)	(0.78225)	(0.02129)
	[-0.77851]	[6.96402]	[0.74237]	[0.08096]	[0.57355]	[0.86035]
LUSDZAR (-2)	0.119667	-0.129794	-0.391569	0.060614	-0.477410	-0.016702
	(0.29903)	(0.13812)	(0.49448)	(0.22850)	(0.73900)	(0.02011)
	[0.40018]	[-0.93970]	[-0.79188]	[0.26527]	[-0.64602]	[-0.83046]
LCAP (-1)	0.165041	0.040907	0.653978	-0.119750	-0.206374	0.009517
	(0.07876)	(0.03638)	(0.13024)	(0.06018)	(0.19465)	(0.00530)
	[2.09543]	[1.12445]	[5.02133]	[-1.98972]	[-1.06025]	[1.79650]
LCAP (-2)	-0.145862	0.015887	0.085465	0.136477	-0.089162	-0.008799
	(0.07727)	(0.03569)	(0.12777)	(0.05904)	(0.19096)	(0.00520)
	[-1.88769]	[0.44513]	[0.66889]	[2.31146]	[-0.46692]	[-1.69302]
LM2(-1)	-0.008905	-0.039514	0.533636	0.469689	1.128300	0.013754
	(0.15905)	(0.07347)	(0.26301)	(0.12154)	(0.39307)	(0.01070)
	[-0.05599]	[-0.53786]	[2.02898]	[3.86460]	[2.87049]	[1.28571]
LM2(-2)	0.048610	0.044745	-0.684638	0.367503	-0.430805	-0.007255
	(0.15817)	(0.07306)	(0.26155)	(0.12086)	(0.39088)	(0.01064)
	[0.30733]	[0.61246]	[-2.61766]	[3.04070]	[-1.10213]	[-0.68196]
LLR (-1)	-0.061669	0.012901	0.182053	-0.016989	0.925314	0.003208
	(0.05222)	(0.02412)	(0.08636)	(0.03990)	(0.12906)	(0.00351)
	[-1.18088]	[0.53483]	[2.10819]	[-0.42574]	[7.16969]	[0.91333]
LLR (-2)	0.039750	-0.038830	-0.088031	0.003802	-0.251107	-0.004301
	(0.04594)	(0.02122)	(0.07597)	(0.03511)	(0.11354)	(0.00309)
	[0.86522]	[-1.82987]	[-1.15877]	[0.10829]	[-2.21168]	[-1.39201]

LCPI (-1)	2.250327	0.422593	-4.811600	-0.726271	0.272310	0.967411
	(1.86564)	(0.86173)	(3.08499)	(1.42558)	(4.61057)	(0.12548)
	[1.20619]	[0.49040]	[-1.55968]	[-0.50946]	[0.05906]	[7.70981]
LCPI (-2)	-1.900238	-0.161223	7.154172	1.070051	-4.707697	-0.119528
	(1.74170)	(0.80448)	(2.88003)	(1.33087)	(4.30426)	(0.11714)
	[-1.09103]	[-0.20041]	[2.48406]	[0.80402]	[-1.09373]	[-1.02037]
C	-1.037099	-2.116144	-1.682555	0.178658	18.33168	0.431955
	(3.42896)	(1.58381)	(5.67005)	(2.62015)	(8.47399)	(0.23062)
	[-0.30245]	[-1.33611]	[-0.29674]	[0.06819]	[2.16329]	[1.87300]
R-squared	0.928543	0.979255	0.787535	0.995142	0.881080	0.994902
Adj. R-squared	0.912952	0.974729	0.741179	0.994082	0.855134	0.993789
Sum sq. resids	0.157604	0.033624	0.430940	0.092022	0.962538	0.000713
S.E. equation	0.053531	0.024725	0.088517	0.040904	0.132290	0.003600
F-statistic	59.55738	216.3523	16.98881	938.7982	33.95812	894.4258
Log likelihood	109.7962	162.3209	75.59616	128.0900	48.27361	293.3439
Akaike AIC	-2.846948	-4.391791	-1.841064	-3.385001	-1.037459	-8.245410
Schwarz SC	-2.422631	-3.967474	-1.416746	-2.960684	-0.613141	-7.821092
Mean dependent	4.530729	2.129752	22.13714	14.71314	2.980953	4.101954
S.D. dependent	0.181435	0.155536	0.173991	0.531695	0.347572	0.045685
Determinant resid covariance (dof adj.)		2.92E-18				
Determinant resid covariance		8.18E-19				
Log likelihood		837.0691				
Akaike information criterion		-22.32556				
Schwarz criterion		-19.77966				
Number of coefficients		78				

M3 VAR (3) Output

Vector Autoregression Estimates

Sample (adjusted): 2009M05 2014M11
Included observations: 67 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LOIL	LUSDZAR	LCAP	LM3	LLR	LCPI
LOIL(-1)	1.013503	-0.010717	-0.161299	0.076568	-0.540919	0.016730
	(0.17056)	(0.07928)	(0.27031)	(0.10526)	(0.39445)	(0.00970)
	[5.94234]	[-0.13517]	[-0.59671]	[0.72740]	[-1.37132]	[1.72431]
LOIL(-2)	-0.074312	0.002708	0.072850	-0.041805	0.746915	0.005674
	(0.22975)	(0.10680)	(0.36414)	(0.14180)	(0.53136)	(0.01307)
	[-0.32344]	[0.02536]	[0.20006]	[-0.29482]	[1.40566]	[0.43415]
LOIL(-3)	-0.220951	-0.008481	0.038932	0.128410	-1.071087	-0.018818
	(0.16962)	(0.07885)	(0.26883)	(0.10468)	(0.39228)	(0.00965)
	[-1.30264]	[-0.10756]	[0.14482]	[1.22665]	[-2.73039]	[-1.95026]
LUSDZAR(-1)	-0.196301	1.082464	0.297560	0.074830	0.784690	0.015436
	(0.36810)	(0.17111)	(0.58340)	(0.22718)	(0.85131)	(0.02094)
	[-0.53329]	[6.32627]	[0.51005]	[0.32939]	[0.92174]	[0.73718]
LUSDZAR(-2)	0.562400	-0.356685	-1.134094	-0.327564	0.341767	-0.022513
	(0.48557)	(0.22571)	(0.76958)	(0.29968)	(1.12299)	(0.02762)
	[1.15823]	[-1.58027]	[-1.47366]	[-1.09305]	[0.30434]	[-0.81504]
LUSDZAR(-3)	-0.487946	0.131627	0.669315	0.425097	-1.270081	0.004451
	(0.31599)	(0.14689)	(0.50082)	(0.19502)	(0.73081)	(0.01798)
	[-1.54417]	[0.89612]	[1.33644]	[2.17974]	[-1.73791]	[0.24764]
LCAP(-1)	0.146098	0.033101	0.532562	-0.060617	-0.181964	0.009742
	(0.08898)	(0.04136)	(0.14102)	(0.05491)	(0.20578)	(0.00506)
	[1.64201]	[0.80033]	[3.77658]	[-1.10388]	[-0.88428]	[1.92471]
LCAP(-2)	-0.126499	0.004076	-0.134532	0.077653	-0.079443	-0.008237
	(0.10699)	(0.04973)	(0.16956)	(0.06603)	(0.24743)	(0.00609)
	[-1.18238]	[0.08196]	[-0.79339]	[1.17603]	[-0.32107]	[-1.35346]
LCAP(-3)	-0.010473	0.019915	0.317051	-0.054334	0.142164	-0.001525
	(0.08426)	(0.03917)	(0.13355)	(0.05200)	(0.19487)	(0.00479)
	[-0.12429]	[0.50846]	[2.37410]	[-1.04480]	[0.72952]	[-0.31822]
LM3(-1)	-0.134943	0.023873	-0.028853	0.461329	1.348109	0.013128
	(0.23304)	(0.10833)	(0.36935)	(0.14383)	(0.53897)	(0.01326)
	[-0.57904]	[0.22038]	[-0.07812]	[3.20748]	[2.50126]	[0.99025]
LM3(-2)	0.374161	0.081993	-0.784841	0.206928	0.026760	0.018690

	(0.24582)	(0.11427)	(0.38960)	(0.15171)	(0.56852)	(0.01398)
	[1.52209]	[0.71756]	[-2.01447]	[1.36394]	[0.04707]	[1.33654]
LM3(-3)	-0.191295	-0.092368	0.430603	0.231276	-0.747372	-0.015959
	(0.22421)	(0.10422)	(0.35534)	(0.13837)	(0.51853)	(0.01275)
	[-0.85321]	[-0.88628]	[1.21179]	[1.67139]	[-1.44133]	[-1.25127]
LLR(-1)	-0.069922	0.004813	0.212682	0.008716	1.013431	-0.002298
	(0.05677)	(0.02639)	(0.08997)	(0.03504)	(0.13129)	(0.00323)
	[-1.23173]	[0.18239]	[2.36390]	[0.24879]	[7.71912]	[-0.71170]
LLR(-2)	0.031710	-0.004049	-0.067135	-0.037821	-0.421168	0.006485
	(0.07917)	(0.03680)	(0.12548)	(0.04886)	(0.18311)	(0.00450)
	[0.40051]	[-0.11003]	[-0.53501]	[-0.77400]	[-2.30007]	[1.43984]
LLR(-3)	0.019272	-0.026961	-0.017602	0.011338	0.141605	-0.010014
	(0.05295)	(0.02461)	(0.08392)	(0.03268)	(0.12245)	(0.00301)
	[0.36399]	[-1.09541]	[-0.20975]	[0.34696]	[1.15639]	[-3.32466]
LCPI(-1)	2.031129	0.202690	-4.225601	-0.895643	1.775030	0.837190
	(2.18184)	(1.01421)	(3.45801)	(1.34657)	(5.04604)	(0.12412)
	[0.93092]	[0.19985]	[-1.22198]	[-0.66513]	[0.35177]	[6.74521]
LCPI(-2)	-2.040271	-0.290908	3.557244	0.956565	-11.33244	0.165981
	(2.80600)	(1.30434)	(4.44724)	(1.73179)	(6.48956)	(0.15962)
	[-0.72711]	[-0.22303]	[0.79988]	[0.55236]	[-1.74626]	[1.03983]
LCPI(-3)	0.415265	0.548308	5.246877	-0.954119	7.136625	-0.166287
	(1.97436)	(0.91776)	(3.12916)	(1.21852)	(4.56618)	(0.11231)
	[0.21033]	[0.59744]	[1.67677]	[-0.78302]	[1.56293]	[-1.48056]
C	-0.986403	-2.894149	-6.568062	4.977109	8.268381	0.442219
	(3.87030)	(1.79907)	(6.13405)	(2.38864)	(8.95100)	(0.22017)
	[-0.25486]	[-1.60869]	[-1.07076]	[2.08366]	[0.92374]	[2.00857]
R-squared	0.921413	0.980832	0.790306	0.996724	0.889138	0.996489
Adj. R-squared	0.891943	0.973644	0.711671	0.995496	0.847565	0.995173
Sum sq. resids	0.143345	0.030973	0.360070	0.054600	0.766720	0.000464
S.E. equation	0.054648	0.025402	0.086611	0.033727	0.126386	0.003109
F-statistic	31.26611	136.4534	10.05028	811.3972	21.38737	756.8754
Log likelihood	110.8621	162.1884	80.00709	143.1968	54.68707	302.9314
Akaike AIC	-2.742154	-4.274280	-1.821107	-3.707367	-1.065286	-8.475565
Schwarz SC	-2.116942	-3.649069	-1.195896	-3.082156	-0.440074	-7.850353
Mean dependent	4.539880	2.128711	22.14540	14.80369	2.997033	4.103256
S.D. dependent	0.166243	0.156471	0.161298	0.502540	0.323710	0.044742

Determinant resid covariance (dof adj.)	1.23E-18
Determinant resid covariance	1.66E-19
Log likelihood	878.1715

Akaike information criterion	-22.81109
Schwarz criterion	-19.05982
Number of coefficients	114

2nd Period Output

VAR (1) With a Trend - (for model using M1)

Vector Autoregression Estimates

Sample (adjusted): 2015M01 2019M02
Included observations: 50 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	LOIL	LUSDZAR	LCAP	LM1	LLR	LCPI
LOIL(-1)	0.593586	-0.009137	-0.116921	-0.038706	-0.025665	0.075517
	(0.11040)	(0.04425)	(0.16181)	(0.04199)	(0.08493)	(0.02867)
	[5.37659]	[-0.20648]	[-0.72258]	[-0.92177]	[-0.30220]	[2.63396]
LUSDZAR(-1)	-0.278662	0.855519	-0.421780	-0.111887	-0.124254	0.247920
	(0.23915)	(0.09586)	(0.35051)	(0.09096)	(0.18397)	(0.06211)
	[-1.16521]	[8.92428]	[-1.20332]	[-1.23004]	[-0.67542]	[3.99189]
LCAP(-1)	-0.051695	0.039657	0.743211	-0.005693	0.032318	0.029806
	(0.06951)	(0.02786)	(0.10188)	(0.02644)	(0.05347)	(0.01805)
	[-0.74370]	[1.42328]	[7.29512]	[-0.21535]	[0.60440]	[1.65119]
LM1(-1)	0.245829	-0.002693	0.441849	1.052115	0.021966	-0.131460
	(0.11211)	(0.04494)	(0.16432)	(0.04264)	(0.08624)	(0.02911)
	[2.19270]	[-0.05992]	[2.68899]	[24.6731]	[0.25470]	[-4.51525]
LLR(-1)	0.338499	-0.115790	0.273279	-0.068621	0.756952	0.046085
	(0.13758)	(0.05515)	(0.20164)	(0.05233)	(0.10583)	(0.03573)
	[2.46040]	[-2.09960]	[1.35526]	[-1.31135]	[7.15237]	[1.28986]
LCPI(-1)	-0.292573	-0.018513	-0.046614	-0.001072	0.009318	1.051805
	(0.18594)	(0.07453)	(0.27253)	(0.07072)	(0.14304)	(0.04829)
	[-1.57347]	[-0.24838]	[-0.17104]	[-0.01516]	[0.06514]	[21.7820]
@TREND	0.003852	-0.002552	0.003901	-0.000956	-0.002972	0.003005
	(0.00246)	(0.00099)	(0.00361)	(0.00094)	(0.00190)	(0.00064)
	[1.56315]	[-2.58319]	[1.08006]	[-1.01992]	[-1.56800]	[4.69532]
R-squared	0.861195	0.851502	0.967811	0.994384	0.897018	0.968240
Adj. R-squared	0.841827	0.830782	0.963320	0.993601	0.882649	0.963809
Sum sq. resids	0.309074	0.049662	0.663934	0.044713	0.182892	0.020844
S.E. equation	0.084781	0.033984	0.124259	0.032246	0.065217	0.022017
F-statistic	44.46470	41.09448	215.4787	1269.010	62.42486	218.4855
Log likelihood	56.20802	101.9164	37.09295	104.5410	69.32515	123.6208
Akaike AIC	-1.968321	-3.796655	-1.203718	-3.901640	-2.493006	-4.664833
Schwarz SC	-1.700638	-3.528972	-0.936035	-3.633957	-2.225323	-4.397150
Mean dependent	3.965241	2.600533	22.45369	15.30908	2.502349	4.154356
S.D. dependent	0.213173	0.082614	0.648803	0.403102	0.190379	0.115732

Determinant resid covariance (dof adj.)	1.12E-16
Determinant resid covariance	4.54E-17
Log likelihood	515.1155
Akaike information criterion	-18.92462
Schwarz criterion	-17.31852
Number of coefficients	42

VAR (1) with a Trend - (for model using M2)

Vector Autoregression Estimates

Sample (adjusted): 2015M01 2019M02
Included observations: 50 after adjustments
Standard errors in () & t-statistics in []

	LOIL	LUSDZAR	LCAP	LM2	LLR	LCPI
LOIL (-1)	0.587112	-0.015698	-0.132896	-0.038560	-0.014563	0.077427
	(0.11117)	(0.04461)	(0.16219)	(0.02811)	(0.08574)	(0.02906)
	[5.28099]	[-0.35190]	[-0.81940]	[-1.37182]	[-0.16986]	[2.66430]
LUSDZAR (-1)	-0.281575	0.832771	-0.441922	-0.127704	-0.084392	0.244148
	(0.23767)	(0.09537)	(0.34673)	(0.06009)	(0.18329)	(0.06213)
	[-1.18471]	[8.73217]	[-1.27453]	[-2.12513]	[-0.46043]	[3.92976]
LCAP (-1)	-0.046640	0.033495	0.748301	-0.018453	0.043526	0.025674
	(0.06723)	(0.02698)	(0.09808)	(0.01700)	(0.05185)	(0.01757)
	[-0.69375]	[1.24166]	[7.62977]	[-1.08565]	[0.83953]	[1.46094]
LM2(-1)	0.240584	0.011377	0.441593	1.061708	-0.003183	-0.125377
	(0.10783)	(0.04327)	(0.15731)	(0.02726)	(0.08316)	(0.02819)
	[2.23109]	[0.26294]	[2.80710]	[38.9420]	[-0.03827]	[-4.44798]
LLR (-1)	0.344042	-0.113138	0.285017	-0.020577	0.752670	0.043755
	(0.13765)	(0.05523)	(0.20081)	(0.03480)	(0.10615)	(0.03598)
	[2.49938]	[-2.04837]	[1.41931]	[-0.59123]	[7.09037]	[1.21603]
LCPI (-1)	-0.327042	-0.019191	-0.109258	0.000386	0.008097	1.069990
	(0.18564)	(0.07449)	(0.27082)	(0.04694)	(0.14316)	(0.04853)
	[-1.76169]	[-0.25763]	[-0.40343]	[0.00822]	[0.05656]	[22.0496]
@TREND	0.005883	-0.002524	0.007584	0.000122	-0.002879	0.001930
	(0.00243)	(0.00098)	(0.00355)	(0.00061)	(0.00188)	(0.00064)
	[2.41887]	[-2.58625]	[2.13749]	[0.19857]	[-1.53502]	[3.03653]
R-squared	0.861687	0.851728	0.968222	0.995267	0.896866	0.967935
Adj. R-squared	0.842387	0.831039	0.963788	0.994607	0.882476	0.963461
Sum sq. resids	0.307980	0.049587	0.655463	0.019688	0.183162	0.021044
S.E. equation	0.084630	0.033958	0.123464	0.021397	0.065265	0.022122
F-statistic	44.64813	41.16804	218.3561	1507.015	62.32239	216.3391
Log likelihood	56.29668	101.9545	37.41397	125.0477	69.28832	123.3819
Akaike AIC	-1.971867	-3.798178	-1.216559	-4.721909	-2.491533	-4.655276
Schwarz SC	-1.704184	-3.530495	-0.948876	-4.454226	-2.223849	-4.387592
Mean dependent	3.965241	2.600533	22.45369	15.62409	2.502349	4.154356
S.D. dependent	0.213173	0.082614	0.648803	0.291360	0.190379	0.115732
Determinant resid covariance (dof adj.)		4.90E-17				

Determinant resid covariance	1.98E-17
Log likelihood	535.8253
Akaike information criterion	-19.75301
Schwarz criterion	-18.14691
Number of coefficients	42

VAR (1) with a time trend - (for model using M3)

Vector Autoregression Estimates
Date: 07/11/21 Time: 13:04

Included observations: 50 after adjustments
Standard errors in () & t-statistics in []

	LOIL	LUSDZAR	LCAP	LM3	LLR	LCPI
LOIL (-1)	0.585429	-0.015657	-0.135870	-0.045551	-0.013692	0.078563
	(0.11150)	(0.04475)	(0.16267)	(0.02817)	(0.08599)	(0.02908)
	[5.25044]	[-0.34991]	[-0.83523]	[-1.61704]	[-0.15922]	[2.70141]
LUSDZAR (-1)	-0.279649	0.833268	-0.437995	-0.126586	-0.081556	0.244016
	(0.23694)	(0.09509)	(0.34569)	(0.05986)	(0.18274)	(0.06180)
	[-1.18023]	[8.76337]	[-1.26702]	[-2.11464]	[-0.44631]	[3.94838]
LCAP (-1)	-0.045850	0.033641	0.749855	-0.018703	0.044280	0.025495
	(0.06696)	(0.02687)	(0.09769)	(0.01692)	(0.05164)	(0.01746)
	[-0.68476]	[1.25198]	[7.67610]	[-1.10560]	[0.85751]	[1.45986]
LM3(-1)	0.239737	0.011087	0.439797	1.063349	-0.004934	-0.125473
	(0.10738)	(0.04309)	(0.15666)	(0.02713)	(0.08281)	(0.02801)
	[2.23258]	[0.25729]	[2.80727]	[39.1962]	[-0.05958]	[-4.47991]
LLR (-1)	0.343829	-0.113197	0.284579	-0.015290	0.752332	0.043762
	(0.13763)	(0.05523)	(0.20079)	(0.03477)	(0.10614)	(0.03590)
	[2.49830]	[-2.04960]	[1.41731]	[-0.43976]	[7.08819]	[1.21913]
LCPI (-1)	-0.328648	-0.019246	-0.112186	-0.002808	0.008264	1.070871
	(0.18566)	(0.07451)	(0.27087)	(0.04691)	(0.14318)	(0.04843)
	[-1.77015]	[-0.25832]	[-0.41417]	[-0.05987]	[0.05771]	[22.1139]
@TREND	0.005945	-0.002522	0.007696	0.000262	-0.002887	0.001896
	(0.00244)	(0.00098)	(0.00355)	(0.00062)	(0.00188)	(0.00064)
	[2.43993]	[-2.57938]	[2.16521]	[0.42634]	[-1.53627]	[2.98389]
R-squared	0.861706	0.851718	0.968223	0.995173	0.896871	0.968080
Adj. R-squared	0.842409	0.831028	0.963789	0.994499	0.882481	0.963626
Sum sq. resids	0.307937	0.049590	0.655451	0.019655	0.183153	0.020949
S.E. equation	0.084625	0.033960	0.123463	0.021380	0.065264	0.022072
F-statistic	44.65531	41.16474	218.3603	1477.436	62.32576	217.3538
Log likelihood	56.30014	101.9527	37.41444	125.0894	69.28953	123.4951

Akaike AIC	-1.972006	-3.798110	-1.216578	-4.723576	-2.491581	-4.659805
Schwarz SC	-1.704323	-3.530427	-0.948894	-4.455893	-2.223898	-4.392122
Mean dependent	3.965241	2.600533	22.45369	15.63538	2.502349	4.154356
S.D. dependent	0.213173	0.082614	0.648803	0.288259	0.190379	0.115732

Determinant resid covariance (dof adj.)	4.97E-17
Determinant resid covariance	2.01E-17
Log likelihood	535.4405
Akaike information criterion	-19.73762
Schwarz criterion	-18.13152
Number of coefficients	42

Appendix 1B: Diagnostic tests (Stability test)

1st Period Output

Model using M1

Roots of Characteristic Polynomial
Endogenous variables: LOIL LUSDZAR LCAP LM1 LLR LCPI
Exogenous variables: C
Lag specification: 1 3

Root	Modulus
0.976631 + 0.069681i	0.979114
0.976631 - 0.069681i	0.979114
0.874858	0.874858
0.794664 + 0.301772i	0.850034
0.794664 - 0.301772i	0.850034
0.620000 + 0.351394i	0.712655
0.620000 - 0.351394i	0.712655
0.338498 + 0.619871i	0.706273
0.338498 - 0.619871i	0.706273
-0.448781 - 0.468404i	0.648696
-0.448781 + 0.468404i	0.648696
-0.126481 + 0.624284i	0.636968
-0.126481 - 0.624284i	0.636968
-0.437302	0.437302
-0.006719 + 0.384185i	0.384244
-0.006719 - 0.384185i	0.384244
-0.278620	0.278620
0.217569	0.217569

No root lies outside the unit circle.
VAR satisfies the stability condition.

Model using M2

Roots of Characteristic Polynomial
Endogenous variables: LOIL LUSDZAR LCAP LM2 LLR LCPI
Exogenous variables: C
Lag specification: 1 2

Root	Modulus
0.942589 - 0.093950i	0.947260
0.942589 + 0.093950i	0.947260
0.920101	0.920101

0.583467 - 0.345174i	0.677922
0.583467 + 0.345174i	0.677922
0.658931	0.658931
0.448925 - 0.084816i	0.456867
0.448925 + 0.084816i	0.456867
-0.217344 - 0.352639i	0.414237
-0.217344 + 0.352639i	0.414237
-0.105141	0.105141
0.020708	0.020708

No root lies outside the unit circle.
VAR satisfies the stability condition.

Model using M3

Roots of Characteristic Polynomial
Endogenous variables: LOIL LUSDZAR LCAP LM3 LLR LCPI
Exogenous variables: C
Lag specification: 1 3

Root	Modulus
0.951359 - 0.076412i	0.954422
0.951359 + 0.076412i	0.954422
0.924192	0.924192
0.790159 - 0.248076i	0.828187
0.790159 + 0.248076i	0.828187
-0.523280 + 0.532256i	0.746404
-0.523280 - 0.532256i	0.746404
0.527556 + 0.516827i	0.738529
0.527556 - 0.516827i	0.738529
0.066615 + 0.650772i	0.654173
0.066615 - 0.650772i	0.654173
0.569797	0.569797
-0.136571 + 0.427982i	0.449244
-0.136571 - 0.427982i	0.449244
0.309577 + 0.278354i	0.416316
0.309577 - 0.278354i	0.416316
-0.394511	0.394511
-0.129828	0.129828

No root lies outside the unit circle.
VAR satisfies the stability condition.

2nd Period Output

Model using M1

Roots of Characteristic Polynomial
Endogenous variables: LOIL LUSDZAR
LCAP LM1 LLR LCPI
Exogenous variables: @TREND
Lag specification: 1 1

Root	Modulus
0.996703 - 0.005893i	0.996720
0.996703 + 0.005893i	0.996720
0.864239 - 0.077805i	0.867734
0.864239 + 0.077805i	0.867734
0.665652 - 0.016015i	0.665845
0.665652 + 0.016015i	0.665845

No root lies outside the unit circle.
VAR satisfies the stability condition.

Model using M2

Roots of Characteristic Polynomial
Endogenous variables: LOIL LUSDZAR
LCAP LM2 LLR LCPI
Exogenous variables: @TREND
Lag specification: 1 1

Root	Modulus
0.994423	0.994423
0.982167	0.982167
0.863622 - 0.044444i	0.864765
0.863622 + 0.044444i	0.864765
0.740961	0.740961
0.607756	0.607756

No root lies outside the unit circle.
VAR satisfies the stability condition.

Model using M3

Roots of Characteristic Polynomial
Endogenous variables: LOIL LUSDZAR
LCAP LM3 LLR LCPI
Exogenous variables: @TREND
Lag specification: 1 1

Root	Modulus
0.995117	0.995117
0.978216	0.978216
0.868023 - 0.050016i	0.869463
0.868023 + 0.050016i	0.869463
0.736007	0.736007
0.609718	0.609718

No root lies outside the unit circle.
VAR satisfies the stability condition.

Appendix 1C: SVAR output
1st Period SVAR Output

Model Using M1

Structural VAR Estimates

Sample (adjusted): 2009M05 2014M11
Included observations: 67 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 11 iterations
Structural VAR is just identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0	0	0
C (1)	1	0	0	0	0
C (2)	C (6)	1	0	0	0
C (3)	C (7)	C (10)	1	0	0
C (4)	C (8)	C (11)	C (13)	1	0
C (5)	C (9)	C (12)	C (14)	C (15)	1

B =

C (16)	0	0	0	0	0
0	C (17)	0	0	0	0
0	0	C (18)	0	0	0
0	0	0	C (19)	0	0
0	0	0	0	C (20)	0
0	0	0	0	0	C (21)

	Coefficient	Std. Error	z-Statistic	Prob.
C (1)	0.208498	0.049907	4.177744	0.0000
C (2)	0.110474	0.210116	0.525775	0.5990
C (3)	0.169261	0.151047	1.120586	0.2625
C (4)	-0.249316	0.285730	-0.872558	0.3829
C (5)	-0.010517	0.007165	-1.467835	0.1421
C (6)	1.042812	0.458131	2.276230	0.0228
C (7)	0.844150	0.341134	2.474544	0.0133
C (8)	0.321186	0.667923	0.480873	0.6306
C (9)	0.010193	0.016683	0.610954	0.5412
C (10)	-0.062567	0.087644	-0.713874	0.4753
C (11)	-0.129375	0.164884	-0.784641	0.4327
C (12)	0.005703	0.004130	1.380771	0.1673
C (13)	0.292038	0.228967	1.275455	0.2021
C (14)	0.007065	0.005778	1.222663	0.2215
C (15)	5.95E-05	0.003046	0.019524	0.9844
C (16)	0.054401	0.004700	11.57584	0.0000
C (17)	0.022223	0.001920	11.57584	0.0000
C (18)	0.083336	0.007199	11.57584	0.0000
C (19)	0.059785	0.005165	11.57584	0.0000
C (20)	0.112048	0.009679	11.57584	0.0000
C (21)	0.002794	0.000241	11.57584	0.0000

Log likelihood	775.5490				
Estimated A matrix:					
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.208498	1.000000	0.000000	0.000000	0.000000	0.000000
0.110474	1.042812	1.000000	0.000000	0.000000	0.000000
0.169261	0.844150	-0.062567	1.000000	0.000000	0.000000
-0.249316	0.321186	-0.129375	0.292038	1.000000	0.000000
-0.010517	0.010193	0.005703	0.007065	5.95E-05	1.000000
Estimated B matrix:					
0.054401	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.022223	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.083336	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.059785	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.112048	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.002794
Estimated S matrix:					
0.054401	0.000000	0.000000	0.000000	0.000000	0.000000
-0.011343	0.022223	0.000000	0.000000	0.000000	0.000000
0.005818	-0.023175	0.083336	0.000000	0.000000	0.000000
0.000731	-0.020210	0.005214	0.059785	0.000000	0.000000
0.017745	-0.004234	0.009259	-0.017460	0.112048	0.000000
0.000648	4.87E-05	-0.000513	-0.000421	-6.66E-06	0.002794
Estimated F matrix:					
0.320404	-0.099013	-0.023454	0.073871	0.010459	0.020857
0.336198	-0.021027	0.028491	0.079430	-0.082973	0.259134
0.063722	-0.128373	0.195195	0.001688	0.043307	0.144434
0.609101	-0.272627	0.038991	0.303637	-0.090017	0.238641
-0.636956	0.110935	0.093544	0.108134	0.194334	-0.260234
0.084698	-0.032437	-0.010838	0.024101	-0.012463	0.043706

Model Using M2

Structural VAR Estimates

Sample (adjusted): 2009M04 2014M11
Included observations: 68 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 12 iterations
Structural VAR is just identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0	0	0
C(1)	1	0	0	0	0
C(2)	C(6)	1	0	0	0
C(3)	C(7)	C(10)	1	0	0
C(4)	C(8)	C(11)	C(13)	1	0
C(5)	C(9)	C(12)	C(14)	C(15)	1

B =

C(16)	0	0	0	0	0
0	C(17)	0	0	0	0
0	0	C(18)	0	0	0
0	0	0	C(19)	0	0
0	0	0	0	C(20)	0
0	0	0	0	0	C(21)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.199492	0.050519	3.948844	0.0001
C(2)	0.002118	0.216780	0.009769	0.9922
C(3)	0.127798	0.096605	1.322889	0.1859
C(4)	-0.617799	0.327612	-1.885763	0.0593
C(5)	-0.021929	0.008742	-2.508338	0.0121
C(6)	0.797048	0.469328	1.698274	0.0895
C(7)	0.626262	0.213539	2.932777	0.0034
C(8)	-0.460624	0.758899	-0.606964	0.5439
C(9)	-0.038149	0.019795	-1.927182	0.0540
C(10)	0.060489	0.054041	1.119309	0.2630
C(11)	-0.012847	0.182614	-0.070349	0.9439
C(12)	0.006776	0.004751	1.426386	0.1538
C(13)	0.038241	0.406059	0.094175	0.9250
C(14)	-0.011080	0.010564	-1.048832	0.2943
C(15)	0.000939	0.003155	0.297753	0.7659
C(16)	0.053531	0.004590	11.66191	0.0000
C(17)	0.022300	0.001912	11.66190	0.0000
C(18)	0.086307	0.007401	11.66190	0.0000
C(19)	0.038461	0.003298	11.66190	0.0000
C(20)	0.128786	0.011043	11.66190	0.0000
C(21)	0.003350	0.000287	11.66190	0.0000

Log likelihood 793.7855

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.199492	1.000000	0.000000	0.000000	0.000000	0.000000
0.002118	0.797048	1.000000	0.000000	0.000000	0.000000
0.127798	0.626262	0.060489	1.000000	0.000000	0.000000
-0.617799	-0.460624	-0.012847	0.038241	1.000000	0.000000
-0.021929	-0.038149	0.006776	-0.011080	0.000939	1.000000

Estimated B matrix:

0.053531	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.022300	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.086307	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.038461	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.128786	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.003350

Estimated S matrix:

0.053531	0.000000	0.000000	0.000000	0.000000	0.000000
-0.010679	0.022300	0.000000	0.000000	0.000000	0.000000
0.008398	-0.017774	0.086307	0.000000	0.000000	0.000000
-0.000661	-0.012891	-0.005221	0.038461	0.000000	0.000000
0.028285	0.010537	0.001308	-0.001471	0.128786	0.000000
0.000676	0.000818	-0.000644	0.000428	-0.000121	0.003350

Estimated F matrix:

0.315145	-0.114000	-0.047977	0.040329	-0.017480	0.006770
0.299108	0.094488	0.121708	0.048248	-0.054890	0.204270
0.120290	-0.034233	0.261718	0.077258	0.084952	0.129374
0.499897	-0.135417	0.020219	0.310411	-0.070193	0.208348
-0.545961	0.178940	-0.022286	0.235733	0.319899	-0.190716
0.070663	-0.014307	-0.006345	0.020015	-0.008338	0.035873

Model Using M3

Structural VAR Estimates

Sample (adjusted): 2009M05 2014M11
Included observations: 67 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 13 iterations
Structural VAR is just identified

Model: Ae = Bu where E[uu'] =I

A =

1	0	0	0	0	0
C (1)	1	0	0	0	0
C (2)	C (6)	1	0	0	0
C (3)	C (7)	C (10)	1	0	0
C (4)	C (8)	C (11)	C (13)	1	0
C (5)	C (9)	C (12)	C (14)	C (15)	1

B =

C (16)	0	0	0	0	0
0	C (17)	0	0	0	0
0	0	C (18)	0	0	0
0	0	0	C (19)	0	0
0	0	0	0	C (20)	0
0	0	0	0	0	C (21)

	Coefficient	Std. Error	z-Statistic	Prob.
C (1)	0.213530	0.050443	4.233102	0.0000
C (2)	0.003796	0.207010	0.018339	0.9854
C (3)	0.018237	0.076226	0.239242	0.8109
C (4)	-0.380989	0.311409	-1.223434	0.2212
C (5)	-0.015664	0.007429	-2.108406	0.0350
C (6)	1.072039	0.445337	2.407252	0.0161
C (7)	0.527576	0.170928	3.086530	0.0020
C (8)	-0.400798	0.745975	-0.537281	0.5911
C (9)	-0.015850	0.017640	-0.898573	0.3689
C (10)	0.142323	0.044986	3.163734	0.0016
C (11)	-0.093463	0.196947	-0.474559	0.6351
C (12)	0.004393	0.004655	0.943839	0.3453
C (13)	-0.574004	0.498889	-1.150565	0.2499
C (14)	-0.016190	0.011887	-1.361967	0.1732
C (15)	-0.000808	0.002883	-0.280392	0.7792
C (16)	0.054648	0.004721	11.57584	0.0000
C (17)	0.022564	0.001949	11.57584	0.0000
C (18)	0.082250	0.007105	11.57584	0.0000
C (19)	0.030286	0.002616	11.57584	0.0000
C (20)	0.123677	0.010684	11.57584	0.0000
C (21)	0.002918	0.000252	11.57584	0.0000

Log likelihood	811.1397

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.213530	1.000000	0.000000	0.000000	0.000000	0.000000
0.003796	1.072039	1.000000	0.000000	0.000000	0.000000
0.018237	0.527576	0.142323	1.000000	0.000000	0.000000
-0.380989	-0.400798	-0.093463	-0.574004	1.000000	0.000000
-0.015664	-0.015850	0.004393	-0.016190	-0.000808	1.000000

Estimated B matrix:

0.054648	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.022564	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.082250	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.030286	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.123677	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.002918

Estimated S matrix:

0.054648	0.000000	0.000000	0.000000	0.000000	0.000000
-0.011669	0.022564	0.000000	0.000000	0.000000	0.000000
0.012302	-0.024189	0.082250	0.000000	0.000000	0.000000
0.003409	-0.008461	-0.011706	0.030286	0.000000	0.000000
0.019250	0.001926	0.000968	0.017384	0.123677	0.000000
0.000688	0.000328	-0.000550	0.000504	0.000100	0.002918

Estimated F matrix:

0.289416	-0.054606	-0.036503	0.023531	-0.029418	-0.016254
0.315983	0.024848	0.048555	0.011173	-0.186523	0.207739
0.077648	-0.122803	0.178763	0.046701	0.059965	0.152813
0.471522	-0.027048	-0.065389	0.190496	-0.186082	0.060228
-0.635316	0.270494	-0.051940	0.313203	0.493328	-0.248714
0.074022	-0.011864	-0.009481	0.010755	-0.032755	0.028910

2nd Period SVAR Output

Model Using M1

Structural VAR Estimates

Sample (adjusted): 2015M01 2019M02
Included observations: 50 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 10 iterations
Structural VAR is just identified

Model: Ae = Bu where E[uu']=I
A =

1	0	0	0	0	0
C(1)	1	0	0	0	0
C(2)	C(6)	1	0	0	0
C(3)	C(7)	C(10)	1	0	0
C(4)	C(8)	C(11)	C(13)	1	0
C(5)	C(9)	C(12)	C(14)	C(15)	1

B =

C(16)	0	0	0	0	0
0	C(17)	0	0	0	0
0	0	C(18)	0	0	0
0	0	0	C(19)	0	0
0	0	0	0	C(20)	0
0	0	0	0	0	C(21)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.065326	0.055931	1.167975	0.2428
C(2)	0.093141	0.209325	0.444961	0.6563
C(3)	-0.069058	0.048415	-1.426375	0.1538
C(4)	0.187838	0.107381	1.749270	0.0802
C(5)	0.006308	0.030160	0.209133	0.8343
C(6)	-0.171359	0.522202	-0.328146	0.7428
C(7)	-0.378626	0.120671	-3.137661	0.0017
C(8)	-0.187340	0.287025	-0.652693	0.5140
C(9)	-0.061644	0.078591	-0.784358	0.4328
C(10)	-0.053096	0.032645	-1.626491	0.1038
C(11)	-0.011062	0.072828	-0.151890	0.8793
C(12)	-0.104984	0.019861	-5.285862	0.0000
C(13)	0.275092	0.307470	0.894695	0.3710
C(14)	0.273188	0.084501	3.232949	0.0012
C(15)	-0.012379	0.038559	-0.321033	0.7482
C(16)	0.084781	0.008478	9.999999	0.0000
C(17)	0.033530	0.003353	10.00000	0.0000
C(18)	0.123811	0.012381	9.999998	0.0000
C(19)	0.028580	0.002858	9.999999	0.0000
C(20)	0.062136	0.006214	9.999999	0.0000

C(21)	0.016942	0.001694	9.999999	0.0000	
Log likelihood	492.4921				
Estimated A matrix:					
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.065326	1.000000	0.000000	0.000000	0.000000	0.000000
0.093141	-0.171359	1.000000	0.000000	0.000000	0.000000
-0.069058	-0.378626	-0.053096	1.000000	0.000000	0.000000
0.187838	-0.187340	-0.011062	0.275092	1.000000	0.000000
0.006308	-0.061644	-0.104984	0.273188	-0.012379	1.000000
Estimated B matrix:					
0.084781	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.033530	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.123811	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.028580	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.062136	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.016942
Estimated S matrix:					
0.084781	0.000000	0.000000	0.000000	0.000000	0.000000
-0.005538	0.033530	0.000000	0.000000	0.000000	0.000000
-0.008846	0.005746	0.123811	0.000000	0.000000	0.000000
0.003288	0.013000	0.006574	0.028580	0.000000	0.000000
-0.017965	0.002769	-0.000439	-0.007862	0.062136	0.000000
-0.002925	-0.000847	0.011197	-0.007905	0.000769	0.016942
Estimated F matrix:					
-0.567319	2.211852	4.308900	-1.464089	2.515259	1.873987
-0.620067	1.849555	3.220801	-1.397632	1.627843	1.302361
-5.008502	9.666203	21.66477	-12.70242	14.97895	8.766889
-3.308277	7.522319	15.40364	-8.390452	9.916906	6.374837
-0.701779	0.825544	2.272640	-1.743097	2.166522	0.917467
-1.038276	0.733586	2.690871	-3.457287	3.148060	1.025194

Model Using M2

Structural VAR Estimates

Sample (adjusted): 2015M01 2019M02
Included observations: 50 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 11 iterations
Structural VAR is just identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0	0	0
C(1)	1	0	0	0	0
C(2)	C(6)	1	0	0	0
C(3)	C(7)	C(10)	1	0	0
C(4)	C(8)	C(11)	C(13)	1	0
C(5)	C(9)	C(12)	C(14)	C(15)	1

B =

C(16)	0	0	0	0	0
0	C(17)	0	0	0	0
0	0	C(18)	0	0	0
0	0	0	C(19)	0	0
0	0	0	0	C(20)	0
0	0	0	0	0	C(21)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.072262	0.055818	1.294583	0.1955
C(2)	0.109411	0.209030	0.523424	0.6007
C(3)	-0.054526	0.032926	-1.656013	0.0977
C(4)	0.186064	0.110000	1.691490	0.0907
C(5)	-0.001534	0.029780	-0.051523	0.9589
C(6)	-0.084309	0.520939	-0.161841	0.8714
C(7)	-0.236255	0.081855	-2.886252	0.0039
C(8)	-0.115753	0.287585	-0.402499	0.6873
C(9)	-0.094565	0.075844	-1.246841	0.2125
C(10)	-0.028545	0.022216	-1.284911	0.1988
C(11)	-0.010858	0.073447	-0.147830	0.8825
C(12)	-0.105377	0.019343	-5.447900	0.0000
C(13)	0.158430	0.460015	0.344402	0.7305
C(14)	0.453746	0.121265	3.741764	0.0002
C(15)	-0.006653	0.037236	-0.178665	0.8582
C(16)	0.084630	0.008463	9.999999	0.0000
C(17)	0.033403	0.003340	9.999999	0.0000
C(18)	0.123044	0.012304	9.999999	0.0000
C(19)	0.019329	0.001933	9.999999	0.0000
C(20)	0.062873	0.006287	9.999999	0.0000
C(21)	0.016554	0.001655	9.999999	0.0000

Log likelihood	513.2019

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.072262	1.000000	0.000000	0.000000	0.000000	0.000000
0.109411	-0.084309	1.000000	0.000000	0.000000	0.000000
2-0.054526	-0.236255	-0.028545	1.000000	0.000000	0.000000
0.186064	-0.115753	-0.010858	0.158430	1.000000	0.000000
-0.001534	-0.094565	-0.105377	0.453746	-0.006653	1.000000

Estimated B matrix:

0.084630	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.033403	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.123044	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.019329	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.062873	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.016554

Estimated S matrix:

0.084630	0.000000	0.000000	0.000000	0.000000	0.000000
-0.006116	0.033403	0.000000	0.000000	0.000000	0.000000
-0.009775	0.002816	0.123044	0.000000	0.000000	0.000000
0.002891	0.007972	0.003512	0.019329	0.000000	0.000000
-0.017019	0.002634	0.000780	-0.003062	0.062873	0.000000
-0.002903	-0.000144	0.011378	-0.008791	0.000418	0.016554

Estimated F matrix:

-0.596453	2.336175	4.486288	-1.370731	2.439088	1.906275
-0.654105	2.179236	3.631075	-1.254194	1.476427	1.446484
-5.108929	14.19520	27.50500	-10.09303	13.28609	10.73630
-3.527258	10.59489	19.53981	-7.190541	9.173567	7.798511
-0.697756	1.576469	3.255482	-1.264998	1.909102	1.244218
-1.025265	2.602370	5.086272	-2.370653	2.511536	1.862624

Model Using M3

Structural VAR Estimates

Sample (adjusted): 2015M01 2019M02
Included observations: 50 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 11 iterations
Structural VAR is just identified

Model: Ae = Bu where E[uu']=I

A =

1	0	0	0	0	0
C(1)	1	0	0	0	0
C(2)	C(6)	1	0	0	0
C(3)	C(7)	C(10)	1	0	0
C(4)	C(8)	C(11)	C(13)	1	0
C(5)	C(9)	C(12)	C(14)	C(15)	1

B =

C(16)	0	0	0	0	0
0	C(17)	0	0	0	0
0	0	C(18)	0	0	0
0	0	0	C(19)	0	0
0	0	0	0	C(20)	0
0	0	0	0	0	C(21)

	Coefficient	Std. Error	z-Statistic	Prob.
C(1)	0.072157	0.055827	1.292512	0.1962
C(2)	0.109474	0.209028	0.523731	0.6005
C(3)	-0.064403	0.032838	-1.961248	0.0499
C(4)	0.185540	0.111222	1.668199	0.0953
C(5)	-0.004975	0.030363	-0.163858	0.8698
C(6)	-0.085690	0.520880	-0.164511	0.8693
C(7)	-0.231098	0.081627	-2.831135	0.0046
C(8)	-0.108455	0.286976	-0.377923	0.7055
C(9)	-0.086397	0.076359	-1.131457	0.2579
C(10)	-0.026252	0.022156	-1.184855	0.2361
C(11)	-0.010440	0.073322	-0.142389	0.8868
C(12)	-0.103984	0.019486	-5.336458	0.0000
C(13)	0.127418	0.461570	0.276053	0.7825
C(14)	0.430004	0.122734	3.503557	0.0005
C(15)	-0.007374	0.037576	-0.196248	0.8444
C(16)	0.084625	0.008462	9.999999	0.0000
C(17)	0.033406	0.003341	9.999999	0.0000
C(18)	0.123041	0.012304	9.999999	0.0000
C(19)	0.019277	0.001928	9.999999	0.0000
C(20)	0.062915	0.006291	9.999999	0.0000
C(21)	0.016717	0.001672	9.999999	0.0000

Log likelihood	512.8171

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.072157	1.000000	0.000000	0.000000	0.000000	0.000000
0.109474	-0.085690	1.000000	0.000000	0.000000	0.000000
-0.064403	-0.231098	-0.026252	1.000000	0.000000	0.000000
0.185540	-0.108455	-0.010440	0.127418	1.000000	0.000000
-0.004975	-0.086397	-0.103984	0.430004	-0.007374	1.000000

Estimated B matrix:

0.084625	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.033406	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.123041	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.019277	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.062915	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.016717

Estimated S matrix:

0.084625	0.000000	0.000000	0.000000	0.000000	0.000000
-0.006106	0.033406	0.000000	0.000000	0.000000	0.000000
-0.009787	0.002863	0.123041	0.000000	0.000000	0.000000
0.003782	0.007795	0.003230	0.019277	0.000000	0.000000
-0.016948	0.002660	0.000873	-0.002456	0.062915	0.000000
-0.002876	-0.000149	0.011412	-0.008307	0.000464	0.016717

Estimated F matrix:

-0.580683	2.354674	4.531481	-1.256891	2.452944	1.935263
-0.634141	2.188702	3.666765	-1.162726	1.495897	1.473837
-4.934312	14.26284	27.79493	-9.354996	13.45758	10.95689
-3.407017	10.65237	19.76326	-6.674076	9.306040	7.2963317
-0.674289	1.584599	3.293017	-1.171019	1.932089	1.271928
-0.972757	2.605834	5.147755	-2.213623	2.565166	1.915711

Appendix 2

Appendix 2A: VAR output
1st Period output

Vector Autoregression Estimates

Sample (adjusted): 2009M06 2014M11
Included observations: 66 after adjustments
Standard errors in () & t-statistics in [ ]

	LOIL	LUSDZAR	LCAP	LLR	LMD	LCPI
LOIL (-1)	0.961974	-0.006722	-0.090023	-0.765875	0.004317	0.012824
	(0.15702)	(0.08157)	(0.26127)	(0.37314)	(0.11379)	(0.00933)
	[6.12628]	[-0.08240]	[-0.34456]	[-2.05252]	[0.03794]	[1.37397]
LOIL (-2)	-0.053857	0.038759	-0.242360	0.831253	0.239556	0.017651
	(0.21735)	(0.11291)	(0.36164)	(0.51648)	(0.15751)	(0.01292)
	[-0.24779]	[0.34328]	[-0.67017]	[1.60945]	[1.52092]	[1.36628]
LOIL (-3)	-0.198159	-0.136867	0.360408	-1.098071	-0.335217	-0.029053
	(0.22337)	(0.11604)	(0.37166)	(0.53080)	(0.16187)	(0.01328)
	[-0.88713]	[-1.17951]	[0.96972]	[-2.06872]	[-2.07086]	[-2.18817]
LOIL (-4)	0.027213	0.123230	-0.361247	0.209161	0.206073	0.007716
	(0.17936)	(0.09318)	(0.29844)	(0.42623)	(0.12998)	(0.01066)
	[0.15172]	[1.32252]	[-1.21044]	[0.49072]	[1.58538]	[0.72369]
LUSDZAR (-1)	-0.162996	1.080355	0.598736	-0.553980	0.084193	0.002662
	(0.33926)	(0.17624)	(0.56448)	(0.80618)	(0.24585)	(0.02017)
	[-0.48045]	[6.13005]	[1.06068]	[-0.68717]	[0.34245]	[0.13202]
LUSDZAR (-2)	0.096710	-0.410035	-1.476695	1.148953	0.186310	-0.008224
	(0.48212)	(0.25046)	(0.80220)	(1.14568)	(0.34939)	(0.02866)
	[0.20059]	[-1.63715]	[-1.84081]	[1.00286]	[0.53325]	[-0.28698]
LUSDZAR (-3)	0.414950	0.060540	0.986247	-2.353241	-0.464988	0.002159
	(0.47142)	(0.24490)	(0.78439)	(1.12024)	(0.34163)	(0.02802)
	[0.88021]	[0.24721]	[1.25734]	[-2.10065]	[-1.36108]	[0.07704]
LUSDZAR (-4)	-0.565902	0.128786	-0.243040	1.565447	0.328481	-0.003677
	(0.30293)	(0.15737)	(0.50404)	(0.71986)	(0.21953)	(0.01801)
	[-1.86809]	[0.81837]	[-0.48218]	[2.17466]	[1.49629]	[-0.20418]
LCAP (-1)	0.145282	0.041943	0.592393	-0.446940	0.009605	0.006668
	(0.09563)	(0.04968)	(0.15912)	(0.22726)	(0.06930)	(0.00568)
	[1.51914]	[0.84425]	[3.72281]	[-1.96667]	[0.13860]	[1.17305]
LCAP (-2)	-0.210326	-0.025093	-0.122227	0.253466	-0.059588	-0.014717
	(0.11408)	(0.05926)	(0.18982)	(0.27109)	(0.08267)	(0.00678)

	[-1.84364]	[-0.42342]	[-0.64391]	[0.93497]	[-0.72077]	[-2.17036]
LCAP (-3)	0.112888	0.003783	0.331775	0.044243	0.018065	0.000615
	(0.11431)	(0.05938)	(0.19020)	(0.27163)	(0.08284)	(0.00679)
	[0.98758]	[0.06370]	[1.74438]	[0.16288]	[0.21808]	[0.09047]
LCAP (-4)	0.017985	0.048022	0.049284	0.020879	0.000415	0.001796
	(0.08647)	(0.04492)	(0.14387)	(0.20548)	(0.06266)	(0.00514)
	[0.20799]	[1.06907]	[0.34255]	[0.10161]	[0.00663]	[0.34938]
LLR (-1)	-0.102173	0.023732	0.069924	1.051512	0.028761	0.000191
	(0.06539)	(0.03397)	(0.10880)	(0.15539)	(0.04739)	(0.00389)
	[-1.56252]	[0.69862]	[0.64268]	[6.76705]	[0.60693]	[0.04907]
LLR (-2)	0.058453	-0.038995	0.113475	-0.342719	-0.023656	0.002083
	(0.09085)	(0.04719)	(0.15116)	(0.21589)	(0.06584)	(0.00540)
	[0.64341]	[-0.82627]	[0.75069]	[-1.58751]	[-0.35932]	[0.38576]
LLR (-3)	0.107009	0.009897	-0.264451	-0.031481	-0.003258	-0.001093
	(0.08002)	(0.04157)	(0.13314)	(0.19015)	(0.05799)	(0.00476)
	[1.33730]	[0.23809]	[-1.98624]	[-0.16556]	[-0.05619]	[-0.22979]
LLR (-4)	-0.108587	-0.012434	0.185931	-0.016782	0.017078	-0.006574
	(0.05639)	(0.02929)	(0.09382)	(0.13399)	(0.04086)	(0.00335)
	[-1.92575]	[-0.42446]	[1.98174]	[-0.12525]	[0.41794]	[-1.96149]
LMD (-1)	0.007134	-0.028917	0.126042	0.502549	0.623047	-0.010326
	(0.21387)	(0.11110)	(0.35586)	(0.50823)	(0.15499)	(0.01271)
	[0.03336]	[-0.26027]	[0.35419]	[0.98882]	[4.01989]	[-0.81228]
LMD (-2)	-0.042200	0.099808	0.145715	-1.782005	0.237423	0.024201
	(0.24000)	(0.12468)	(0.39934)	(0.57033)	(0.17393)	(0.01427)
	[-0.17583]	[0.80052]	[0.36489]	[-3.12453]	[1.36506]	[1.69641]
LMD (-3)	-0.145864	-0.078265	-0.357236	1.002800	0.044154	-0.006560
	(0.26081)	(0.13549)	(0.43395)	(0.61976)	(0.18900)	(0.01550)
	[-0.55928]	[-0.57766]	[-0.82321]	[1.61805]	[0.23362]	[-0.42314]
LMD (-4)	0.191727	-0.016571	-0.041897	0.549953	-0.036523	-0.000352
	(0.16620)	(0.08634)	(0.27654)	(0.39494)	(0.12044)	(0.00988)
	[1.15359]	[-0.19192]	[-0.15151]	[1.39248]	[-0.30324]	[-0.03562]
LCPI (-1)	3.296480	0.525257	-1.930489	2.047235	0.572406	0.850074
	(2.86063)	(1.48606)	(4.75978)	(6.79777)	(2.07306)	(0.17004)
	[1.15236]	[0.35346]	[-0.40558]	[0.30116]	[0.27612]	[4.99934]
LCPI (-2)	-3.277673	-0.737190	4.689172	-4.562085	0.371559	-0.026029
	(3.33089)	(1.73035)	(5.54223)	(7.91525)	(2.41385)	(0.19799)
	[-0.98402]	[-0.42603]	[0.84608]	[-0.57637]	[0.15393]	[-0.13147]

LCPI (-3)	-2.752396	0.993135	2.516271	-0.235287	-3.507495	-0.057711
	(2.91205)	(1.51277)	(4.84533)	(6.91995)	(2.11032)	(0.17309)
	[-0.94517]	[0.65650]	[0.51932]	[-0.03400]	[-1.66207]	[-0.33341]
LCPI (-4)	3.222217	-0.011729	-1.418511	0.831180	2.811315	0.112789
	(2.09560)	(1.08864)	(3.48684)	(4.97981)	(1.51865)	(0.12456)
	[1.53761]	[-0.01077]	[-0.40682]	[0.16691]	[1.85119]	[0.90548]
C	-1.885809	-3.901461	-8.375746	10.22498	1.651010	0.466094
	(4.04334)	(2.10046)	(6.72766)	(9.60825)	(2.93015)	(0.24034)
	[-0.46640]	[-1.85743]	[-1.24497]	[1.06419]	[0.56346]	[1.93933]
R-squared	0.934170	0.982484	0.828998	0.907913	0.997921	0.996970
Adj. R-squared	0.895636	0.972230	0.728899	0.854008	0.996704	0.995196
Sum sq. resids	0.104880	0.028304	0.290363	0.592246	0.055080	0.000371
S.E. equation	0.050577	0.026274	0.084155	0.120187	0.036653	0.003006
F-statistic	24.24240	95.82069	8.281805	16.84294	819.9303	562.0512
Log likelihood	119.0216	162.2459	85.41721	61.89518	140.2748	305.3252
Akaike AIC	-2.849140	-4.158967	-1.830825	-1.118036	-3.493175	-8.494702
Schwarz SC	-2.019726	-3.329552	-1.001410	-0.288621	-2.663760	-7.665287
Mean dependent	4.547105	2.128778	22.14748	3.007502	21.08758	4.104747
S.D. dependent	0.156559	0.157669	0.161627	0.314554	0.638401	0.043374

Determinant resid covariance (dof adj.)	8.05E-19
Determinant resid covariance	4.63E-20
Log likelihood	907.2640
Akaike information criterion	-22.94740
Schwarz criterion	-17.97091
Number of coefficients	150

2nd Period Output

Vector Autoregression Estimates

Sample (adjusted): 2015M01 2019M02

Included observations: 50 after adjustments

Standard errors in () & t-statistics in [ ]

	LOIL	LUSDZAR	LCAP	LLR	LMD	LCPI
LOIL (-1)	0.584056	-0.012380	-0.073730	0.001700	-0.050720	0.076596
	(0.10686)	(0.04370)	(0.16395)	(0.08370)	(0.03632)	(0.02704)
	[5.46549]	[-0.28326]	[-0.44970]	[0.02031]	[-1.39648]	[2.83234]
LUSDZAR (-1)	-0.261810	0.844704	-0.199892	-0.033124	-0.060885	0.226149
	(0.21254)	(0.08692)	(0.32609)	(0.16646)	(0.07224)	(0.05379)
	[-1.23182]	[9.71764]	[-0.61300]	[-0.19899]	[-0.84285]	[4.20452]
LCAP (-1)	-0.030338	0.036888	0.827286	0.055598	-0.002146	0.015342
	(0.05818)	(0.02379)	(0.08926)	(0.04556)	(0.01977)	(0.01472)
	[-0.52149]	[1.55041]	[9.26874]	[1.22023]	[-0.10853]	[1.04212]
LLR (-1)	0.386591	-0.113766	0.313736	0.739740	0.050884	0.023429
	(0.13789)	(0.05640)	(0.21156)	(0.10800)	(0.04687)	(0.03490)
	[2.80354]	[-2.01727]	[1.48294]	[6.84951]	[1.08573]	[0.67139]
LMD (-1)	0.151250	0.002673	0.193819	-0.022989	1.017156	-0.075686
	(0.05810)	(0.02376)	(0.08914)	(0.04550)	(0.01975)	(0.01470)
	[2.60337]	[0.11248]	[2.17440]	[-0.50522]	[51.5123]	[-5.14778]
LCPI (-1)	-0.368817	-0.019392	-0.152746	0.016962	-0.031306	1.090519
	(0.18353)	(0.07506)	(0.28158)	(0.14374)	(0.06238)	(0.04644)

	[-2.00960]	[-0.25836]	[-0.54247]	[0.11801]	[-0.50190]	[23.4798]
@TREND	0.011001	-0.002459	0.013667	-0.003776	0.001293	-0.000613
	(0.00329)	(0.00135)	(0.00505)	(0.00258)	(0.00112)	(0.00083)
	[3.34288]	[-1.82689]	[2.70675]	[-1.46508]	[1.15590]	[-0.73605]
R-squared	0.866688	0.851534	0.966123	0.897471	0.786877	0.971033
Adj. R-squared	0.848086	0.830817	0.961396	0.883165	0.757139	0.966991
Sum sq. resids	0.296844	0.049652	0.698748	0.182087	0.034289	0.019011
S.E. equation	0.083086	0.033981	0.127475	0.065074	0.028239	0.021027
F-statistic	46.59184	41.10465	204.3858	62.73249	26.46027	240.2441
Log likelihood	57.21733	101.9216	35.81526	69.43543	111.1766	125.9222
Akaike AIC	-2.008693	-3.796866	-1.152611	-2.497417	-4.167063	-4.756889
Schwarz SC	-1.741010	-3.529183	-0.884927	-2.229734	-3.899380	-4.489205
Mean dependent	3.965241	2.600533	22.45369	2.502349	21.71929	4.154356
S.D. dependent	0.213173	0.082614	0.648803	0.190379	0.057302	0.115732

Determinant resid covariance (dof adj.)	1.24E-16
Determinant resid covariance	5.01E-17
Log likelihood	512.6447
Akaike information criterion	-18.82579
Schwarz criterion	-17.21969
Number of coefficients	42

Appendix 2B: Diagnostic tests

1st Period Output

a) **Lag Selection Output**

VAR Lag Order Selection Criteria

Endogenous variables: LOIL LUSDZAR LCAP LLR LMD LCPI

Exogenous variables: C

Sample: 2009M02 2014M11

Included observations: 64

Lag	LogL	LR	FPE	AIC	SC	HQ
0	332.5697	NA	1.49e-12	-10.20530	-10.00291	-10.12557
1	774.0294	786.3501	4.70e-18*	-22.87592	-21.45915*	-22.31778*
2	805.3186	49.86719	5.61e-18	-22.72871	-20.09757	-21.69217
3	845.0938	5.93396*	5.38e-18	-22.84668	-19.00117	-21.33174
4	883.6720	47.01719	5.78e-18	-22.92725	-17.86737	-20.93391
5	924.1768	41.77052	6.57e-18	-23.06802	-16.79377	-20.59628
6	978.5920	45.91286	5.78e-18	-23.64350*	-16.15488	-20.69335

* Indicates lag order selected by the criterion

LR: sequential modified LR test statistic (each test at 5% level)

FPE: Final prediction error

AIC: Akaike information criterion

SC: Schwarz information criterion

HQ: Hannan-Quinn information criterion

b) Residual Normality Test

VAR Residual Normality Tests

Orthogonalization: Cholesky (Lutkepohl)

Null Hypothesis: Residuals are multivariate normal

Sample: 2009M02 2014M11

Included observations: 66

Component	Skewness	Chi-sq	df	Prob.*
1	-0.109232	0.131248	1	0.7171
2	0.189432	0.394730	1	0.5298
3	0.117016	0.150621	1	0.6979
4	-0.202429	0.450750	1	0.5020
5	0.451867	2.246026	1	0.1340
6	0.529842	3.088061	1	0.0789
Joint		6.461436	6	0.3735

Component	Kurtosis	Chi-sq	df	Prob.
1	2.595366	0.450254	1	0.5022
2	2.443409	0.851933	1	0.3560
3	3.119854	0.039503	1	0.8425
4	3.638795	1.122162	1	0.2895
5	3.704927	1.366537	1	0.2424
6	3.534309	0.785086	1	0.3756
Joint		4.615477	6	0.5940

Component	Jarque-Bera	df	Prob.
1	0.581502	2	0.7477
2	1.246663	2	0.5362
3	0.190124	2	0.9093
4	1.572912	2	0.4555
5	3.612564	2	0.1643
6	3.873147	2	0.1442
Joint	11.07691	12	0.5223

*Approximate p-values do not account for coefficient

Estimation

c) Residual Serial Correlation Test

VAR Residual Serial Correlation LM Tests

Sample: 2009M02 2014M11
Included observations: 66

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	39.06996	36	0.3336	1.099139	(36, 134.5)	0.3411
2	37.52614	36	0.3991	1.050117	(36, 134.5)	0.4068
3	36.21476	36	0.4586	1.008866	(36, 134.5)	0.4664
5	35.68820	36	0.4833	0.992403	(36, 134.5)	0.4910

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	39.06996	36	0.3336	1.099139	(36, 134.5)	0.3411
2	85.64989	72	0.1298	1.228056	(72, 136.4)	0.1525
3	136.2488	108	0.0343	1.331066	(108, 110.3)	0.0682
4	205.9165	144	0.0005	1.615713	(144, 78.0)	0.0101
5	304.1888	180	0.0000	2.160368	(180, 43.7)	0.0017

*Edgeworth expansion corrected likelihood ratio statistic.

Roots of Characteristic Polynomial

Endogenous variables: LOIL LUSDZAR LCAP LLR LMD LCPI

Exogenous variables: C

Lag specification: 1 4

Root	Modulus
0.987542 + 0.076034i	0.990465
0.987542 - 0.076034i	0.990465
0.905325 + 0.228474i	0.933709
0.905325 - 0.228474i	0.933709
0.925307	0.925307
0.692849 + 0.505797i	0.857829
0.692849 - 0.505797i	0.857829
0.000760 + 0.857470i	0.857470
0.000760 - 0.857470i	0.857470
-0.846417	0.846417

0.285567 + 0.737513i	0.790869
0.285567 - 0.737513i	0.790869
-0.567283 - 0.512817i	0.764716
-0.567283 + 0.512817i	0.764716
0.616857 + 0.419474i	0.745970
0.616857 - 0.419474i	0.745970
0.476862 + 0.462304i	0.664171
0.476862 - 0.462304i	0.664171
-0.162642 + 0.544492i	0.568264
-0.162642 - 0.544492i	0.568264
-0.372167 + 0.352426i	0.512555
-0.372167 - 0.352426i	0.512555
-0.472972	0.472972
-0.173904	0.173904

No root lies outside the unit circle.

VAR satisfies the stability condition.

2nd Period Output

a. Lag Selection Output

VAR Lag Order Selection Criteria
Endogenous variables: LOIL LUSDZAR LCAP LLR LMD LCPI
Exogenous variables: C

Sample: 2014M12 2019M02
Included observations: 47

Lag	LogL	LR	FPE	AIC	SC	HQ
VAR Resid Sample: 20 2019M02 Included ob						
0	213.8101	NA	5.82e-12	-8.842981	-8.606792	-8.754102
1	481.0848	454.9357	3.14e-16	-18.68446	-17.03114*	-18.06230*
2	527.9406	67.79134*	2.13e-16*	-19.14641	-16.07595	-17.99097
3	561.0113	39.40342	2.96e-16	-19.02176	-14.53417	-17.33305
4	607.4021	43.42966	2.95e-16	-19.46392*	-13.55919	-17.24193

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

b. VAR (1) @trend: Residual Serial Correlation LM Tests

VAR Residual Serial Correlation LM Tests

Sample: 2014M12
2019M02
Included observations: 50

Null hypothesis: No serial correlation at lag h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
2	30.29771	36	0.7361	0.828147	(36, 143.3)	0.7410

Null hypothesis: No serial correlation at lags 1 to h

Lag	LRE* stat	df	Prob.	Rao F-stat	df	Prob.
1	59.67265	36	0.0078	1.795264	(36, 143.3)	0.0085
2	107.5410	72	0.0042	1.644535	(72, 147.3)	0.0058

*Edgeworth expansion corrected likelihood ratio statistic.

VAR (1) @trend: VAR Residual Normality Tests

VAR Residual Normality Tests
Orthogonalization: Cholesky (Lutkepohl)
Null Hypothesis: Residuals are multivariate normal

Sample: 2014M12 2019M02
Included observations: 50

Component	Skewness	Chi-sq	df	Prob.*
1	-0.533606	2.372794	1	0.1235
2	-0.085001	0.060210	1	0.8062
3	1.789796	26.69475	1	0.0000
4	-1.644202	22.52832	1	0.0000

5	-1.032790	8.888792	1	0.0029
6	0.548196	2.504325	1	0.1135
Joint		63.04919	6	0.0000

Component	Kurtosis	Chi-sq	df	Prob.
1	2.961922	0.003021	1	0.9562
2	3.116557	0.028303	1	0.8664
3	9.117150	77.95733	1	0.0000
4	9.933301	100.1472	1	0.0000
5	7.015380	33.59015	1	0.0000
6	6.803730	30.14243	1	0.0000
Joint		241.8685	6	0.0000

Component	Jarque-Bera	df	Prob.
1	2.375815	2	0.3049
2	0.088513	2	0.9567
3	104.6521	2	0.0000
4	122.6755	2	0.0000
5	42.47895	2	0.0000
6	32.64675	2	0.0000
Joint	304.9176	12	0.0000

*Approximate p-values do not account for coefficient estimation

c. VAR (1) @trend: Stability tests

Roots of Characteristic Polynomial

Endogenous variables: LOIL LUSDZAR LCAP LLR LMD LCPI

Exogenous variables: @TREND

Lag specification: 1 1

Root	Modulus
0.998432	0.998432
0.943491 - 0.019097i	0.943684
0.943491 + 0.019097i	0.943684
0.918241	0.918241
0.684413	0.684413
0.615394	0.615394

No root lies outside the unit circle.

VAR satisfies the stability condition.

Appendix 2C: SVAR output

1st Period SVAR Output

Structural VAR Estimates

Sample (adjusted): 2009M06 2014M11
Included observations: 66 after adjustments
Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)
Convergence achieved after 12 iterations
Structural VAR is just-identified

Model: Ae = Bu where E[uu'] =I

A =

1	0	0	0	0	0
C (1)	1	0	0	0	0
C (2)	C (6)	1	0	0	0
C (3)	C (7)	C (10)	1	0	0
C (4)	C (8)	C (11)	C (13)	1	0
C (5)	C (9)	C (12)	C (14)	C (15)	1

B =

C (16)	0	0	0	0	0
0	C (17)	0	0	0	0
0	0	C (18)	0	0	0
0	0	0	C (19)	0	0
0	0	0	0	C (20)	0
0	0	0	0	0	C (21)

	Coefficient	Std. Error	z-Statistic	Prob.
C (1)	0.247103	0.056247	4.393172	0.0000
C (2)	-0.155601	0.211345	-0.736242	0.4616
C (3)	-0.570557	0.326192	-1.749145	0.0803
C (4)	0.107845	0.091396	1.179974	0.2380
C (5)	-0.009567	0.007641	-1.252129	0.2105
C (6)	1.175534	0.406835	2.889464	0.0039
C (7)	-0.664932	0.663725	-1.001818	0.3164
C (8)	0.031868	0.183181	0.173971	0.8619
C (9)	-0.002393	0.015158	-0.157884	0.8745
C (10)	0.017407	0.189205	0.091998	0.9267
C (11)	-0.212924	0.051829	-4.108188	0.0000
C (12)	0.006013	0.004805	1.251510	0.2107

C (13)	-0.023633	0.033717	-0.700920	0.4834	
C (14)	-0.008739	0.002800	-3.121280	0.0018	
C (15)	-0.021195	0.010184	-2.081306	0.0374	
C (16)	0.050577	0.004402	11.48912	0.0000	
C (17)	0.023111	0.002012	11.48912	0.0000	
C (18)	0.076386	0.006649	11.48912	0.0000	
C (19)	0.117414	0.010220	11.48912	0.0000	
C (20)	0.032161	0.002799	11.48912	0.0000	
C (21)	0.002661	0.000232	11.48912	0.0000	
Log likelihood	812.9997				
Estimated A matrix:					
1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.247103	1.000000	0.000000	0.000000	0.000000	0.000000
-0.155601	1.175534	1.000000	0.000000	0.000000	0.000000
-0.570557	-0.664932	0.017407	1.000000	0.000000	0.000000
0.107845	0.031868	-0.212924	-0.023633	1.000000	0.000000
-0.009567	-0.002393	0.006013	-0.008739	-0.021195	1.000000
Estimated B matrix:					
0.050577	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.023111	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.076386	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.117414	0.000000	0.000000
0.000000	0.000000	0.000000	0.000000	0.032161	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.002661
Estimated S matrix:					
0.050577	0.000000	0.000000	0.000000	0.000000	0.000000
-0.012498	0.023111	0.000000	0.000000	0.000000	0.000000
0.022561	-0.027168	0.076386	0.000000	0.000000	0.000000
0.020154	0.015840	-0.001330	0.117414	0.000000	0.000000
0.000224	-0.006147	0.016233	0.002775	0.032161	0.000000
0.000499	0.000227	-0.000127	0.001085	0.000682	0.002661
Estimated F matrix:					
0.211229	-0.099468	0.005626	-0.014154	0.002586	-0.033396
0.253310	-0.047725	0.043619	-0.077973	0.040177	0.128490
0.056196	-0.112354	0.202285	0.089666	0.085829	0.155052
-0.558362	0.367797	0.008932	0.422947	0.117507	-0.052952
0.449662	-0.143911	0.113032	-0.057301	0.305491	0.078694
0.053458	-0.022308	-0.006503	-0.013883	0.011833	0.011625

2nd Period SVAR Output

Structural VAR Estimates

Sample (adjusted): 2015M01 2019M02

Included observations: 50 after adjustments

Estimation method: Maximum likelihood via Newton-Raphson (analytic derivatives)

Convergence achieved after 9 iterations

Structural VAR is just identified

Model: Ae = Bu where E[uu’] =I

A =

1	0	0	0	0	0
C (1)	1	0	0	0	0
C (2)	C (6)	1	0	0	0
C (3)	C (7)	C (10)	1	0	0
C (4)	C (8)	C (11)	C (13)	1	0
C (5)	C (9)	C (12)	C (14)	C (15)	1

B =

C (16)	0	0	0	0	0
0	C (17)	0	0	0	0
0	0	C (18)	0	0	0
0	0	0	C (19)	0	0
0	0	0	0	C (20)	0
0	0	0	0	0	C (21)

	Coefficient	Std. Error	z-Statistic	Prob.
C (1)	0.072078	0.056933	1.266002	0.2055
C (2)	0.091651	0.219806	0.416961	0.6767
C (3)	0.177913	0.109272	1.628167	0.1035
C (4)	-0.019367	0.049512	-0.391163	0.6957
C (5)	0.015267	0.031904	0.478535	0.6323

C (6)	-0.134734	0.537448	-0.250693	0.8021
C (7)	-0.088328	0.266885	-0.330958	0.7407
C (8)	-0.009136	0.117974	-0.077443	0.9383
C (9)	0.018399	0.075906	0.242388	0.8085
C (10)	-0.019644	0.070183	-0.279904	0.7796
C (11)	-0.032787	0.031014	-1.057186	0.2904
C (12)	-0.077972	0.020175	-3.864710	0.0001
C (13)	0.021539	0.062446	0.344926	0.7301
C (14)	0.001526	0.040224	0.037934	0.9697
C (15)	-0.115876	0.090987	-1.273547	0.2028
C (16)	0.083086	0.008309	9.999999	0.0000
C (17)	0.033449	0.003345	9.999999	0.0000
C (18)	0.127117	0.012712	9.999999	0.0000
C (19)	0.063084	0.006308	9.999999	0.0000
C (20)	0.027855	0.002786	9.999999	0.0000
C (21)	0.017921	0.001792	9.999998	0.0000
Log likelihood	490.0212			

Estimated A matrix:

1.000000	0.000000	0.000000	0.000000	0.000000	0.000000
0.072078	1.000000	0.000000	0.000000	0.000000	0.000000
0.091651	-0.134734	1.000000	0.000000	0.000000	0.000000
0.177913	-0.088328	-0.019644	1.000000	0.000000	0.000000
-0.019367	-0.009136	-0.032787	0.021539	1.000000	0.000000
0.015267	0.018399	-0.077972	0.001526	-0.115876	1.000000

Estimated B matrix:

0.083086	0.000000	0.000000	0.000000	0.000000	0.000000
0.000000	0.033449	0.000000	0.000000	0.000000	0.000000
0.000000	0.000000	0.127117	0.000000	0.000000	0.000000
0.000000	0.000000	0.000000	0.063084	0.000000	0.000000

0.000000	0.000000	0.000000	0.000000	0.027855	0.000000
0.000000	0.000000	0.000000	0.000000	0.000000	0.017921

Estimated S matrix:

0.083086	0.000000	0.000000	0.000000	0.000000	0.000000
-0.005989	0.033449	0.000000	0.000000	0.000000	0.000000
-0.008422	0.004507	0.127117	0.000000	0.000000	0.000000
-0.015477	0.003043	0.002497	0.063084	0.000000	0.000000
0.001612	0.000388	0.004114	-0.001359	0.027855	0.000000
-0.001605	-0.000224	0.010384	-0.000254	0.003228	0.017921

Estimated F matrix:

-0.973865	1.457860	4.603236	2.438727	2.537189	1.385026
-0.778191	1.928715	4.056622	1.443514	1.446291	1.260178
-5.671453	13.25875	31.66138	12.98090	9.925942	9.764402
-0.733981	1.547609	3.849157	1.869116	1.111146	1.160762
-5.548984	14.58992	32.54778	12.83345	9.919450	10.39981
-0.702462	3.501568	6.706928	2.379329	0.528087	2.221874

Appendix 3

Appendix 3A: Estimation of ARDL model
1st period estimation

Dependent Variable: LCPI
Method: ARDL

Sample (adjusted): 2009M04 2014M11
Included observations: 68 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): LLR LUSDCNY LUSDMZN
LUSDZAR
Fixed regressors: C @TREND
Number of models evalulated: 162
Selected Model: ARDL (1, 0, 2, 1, 1)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LCPI (-1)	0.834448	0.052403	15.92352	0.0000
LLR	0.005626	0.002249	2.501665	0.0153
LUSDCNY	-0.023950	0.150723	-0.158897	0.8743
LUSDCNY (-1)	0.199022	0.241399	0.824450	0.4131
LUSDCNY (-2)	-0.272023	0.153359	-1.773775	0.0814
LUSDMZN	0.032863	0.022969	1.430749	0.1580
LUSDMZN (-1)	-0.047872	0.021954	-2.180534	0.0334
LUSDZAR	0.029472	0.018221	1.617480	0.1113
LUSDZAR (-1)	-0.050570	0.016953	-2.983006	0.0042
C	0.932984	0.305270	3.056260	0.0034
@TREND	0.000209	0.000136	1.535941	0.1301

R-squared	0.994957	Mean dependent var	4.101954
Adjusted R-squared	0.994072	S.D. dependent var	0.045685
S.E. of regression	0.003517	Akaike info criterion	-8.315066
Sum squared resid	0.000705	Schwarz criterion	-7.956028
Log likelihood	293.7123	Hannan-Quinn criter.	-8.172804
F-statistic	1124.518	Durbin-Watson stat	2.024446
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

2nd period estimation

Dependent Variable: LCPI
Method: ARDL

Sample (adjusted): 2015M04 2019M02
Included observations: 47 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LLR LUSDCNY LUSDMZN
LUSDZAR
Fixed regressors: C @TREND
Number of models evalulated: 2500
Selected Model: ARDL (4, 4, 4, 4, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LCPI (-1)	0.995360	0.176747	5.631550	0.0000
LCPI (-2)	0.121769	0.236342	0.515226	0.6113
LCPI (-3)	-0.055779	0.227231	-0.245474	0.8083
LCPI (-4)	-0.533131	0.210712	-2.530135	0.0187
LLR	0.034757	0.054864	0.633511	0.5326
LLR (-1)	0.055537	0.081722	0.679586	0.5035
LLR (-2)	-0.016218	0.069566	-0.233134	0.8177
LLR (-3)	0.022799	0.072150	0.316000	0.7549
LLR (-4)	0.105523	0.066564	1.585296	0.1266
LUSDCNY	0.444048	0.387917	1.144699	0.2641
LUSDCNY (-1)	-0.866614	0.511628	-1.693838	0.1038
LUSDCNY (-2)	0.264173	0.594026	0.444716	0.6607
LUSDCNY (-3)	1.792490	0.584405	3.067206	0.0055
LUSDCNY (-4)	-1.120679	0.324891	-3.449403	0.0022
LUSDMZN	-0.099616	0.100762	-0.988628	0.3331
LUSDMZN (-1)	0.139202	0.138109	1.007915	0.3240
LUSDMZN (-2)	0.009070	0.150016	0.060463	0.9523
LUSDMZN (-3)	0.158338	0.160729	0.985128	0.3348
LUSDMZN (-4)	-0.257805	0.116537	-2.212227	0.0372
LUSDZAR	-0.025944	0.117613	-0.220591	0.8274
LUSDZAR (-1)	0.305933	0.132309	2.312257	0.0301
LUSDZAR (-2)	-0.156843	0.103789	-1.511172	0.1444
C	0.258717	0.742802	0.348299	0.7308
@TREND	0.003650	0.000700	5.212073	0.0000

R-squared	0.991122	Mean dependent var	4.155807
Adjusted R-squared	0.982245	S.D. dependent var	0.119296
S.E. of regression	0.015896	Akaike info criterion	-5.138861
Sum squared resid	0.005812	Schwarz criterion	-4.194105
Log likelihood	144.7632	Hannan-Quinn criter.	-4.783343
F-statistic	111.6422	Durbin-Watson stat	2.181573
Prob(F-statistic)	0.000000		

Appendix 3B: ARDL long run Bounds test

1st period estimation

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LCPI)
Selected Model: ARDL (1, 0, 2, 1, 1)
Case 5: Unrestricted Constant and Unrestricted Trend

Sample: 2009M02 2014M11
Included observations: 68

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.932984	0.305270	3.056260	0.0034
@TREND	0.000209	0.000136	1.535941	0.1301
LCPI (-1)*	-0.165552	0.052403	-3.159186	0.0025
LLR**	0.005626	0.002249	2.501665	0.0153
LUSDCNY (-1)	-0.096951	0.067010	-1.446829	0.1534
LUSDMZN (-1)	-0.015009	0.009451	-1.588090	0.1178
LUSDZAR (-1)	-0.021098	0.007368	-2.863478	0.0059
D(LUSDCNY)	-0.023950	0.150723	-0.158897	0.8743
D(LUSDCNY (-1))	0.272023	0.153359	1.773775	0.0814
D(LUSDMZN)	0.032863	0.022969	1.430749	0.1580
D(LUSDZAR)	0.029472	0.018221	1.617480	0.1113

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z (-1) + D(Z).

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LLR	0.033981	0.015349	2.213867	0.0309
LUSDCNY	-0.585624	0.322631	-1.815149	0.0748
LUSDMZN	-0.090660	0.065782	-1.378175	0.1735
LUSDZAR	-0.127437	0.046526	-2.739064	0.0082

EC = LCPI - (0.0340*LLR -0.5856*LUSDCNY -
0.0907*LUSDMZN -0.1274
*LUSDZAR)

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I (0)	I (1)
			Asymptotic: n=1000	
F-statistic	4.699232	10%	3.03	4.06
K	4	5%	3.47	4.57
		2.5%	3.89	5.07
		1%	4.4	5.72
			Finite Sample: n=70	
Actual Sample Size	68			
		10%	3.182	4.258
		5%	3.72	4.904
		1%	4.922	6.328
			Finite Sample: n=65	
		10%	3.196	4.262
		5%	3.732	4.92
		1%	4.974	6.378

t-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I (0)	I (1)
t-statistic	-3.159186	10%	-3.13	-4.04
		5%	-3.41	-4.36
		2.5%	-3.65	-4.62
		1%	-3.96	-4.96

2nd period estimation

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LCPI)
Selected Model: ARDL (4, 4, 4, 4, 2)
Case 5: Unrestricted Constant and Unrestricted Trend

Sample: 2014M12 2019M02
Included observations: 47

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	0.258717	0.742802	0.348299	0.7308
@TREND	0.003650	0.000700	5.212073	0.0000
LCPI (-1)*	-0.471781	0.121365	-3.887303	0.0007
LLR (-1)	0.202398	0.089941	2.250336	0.0343
LUSDCNY (-1)	0.513418	0.298754	1.718533	0.0991
LUSDMZN (-1)	-0.050811	0.075276	-0.674996	0.5064
LUSDZAR (-1)	0.123146	0.098490	1.250330	0.2238
D(LCPI (-1))	0.467141	0.237991	1.962853	0.0619
D(LCPI (-2))	0.588910	0.204686	2.877137	0.0085
D(LCPI (-3))	0.533131	0.210712	2.530135	0.0187
D(LLR)	0.034757	0.054864	0.633511	0.5326
D(LLR (-1))	-0.112104	0.065247	-1.718160	0.0992
D(LLR (-2))	-0.128323	0.071829	-1.786508	0.0872
D(LLR (-3))	-0.105523	0.066564	-1.585296	0.1266
D(LUSDCNY)	0.444048	0.387917	1.144699	0.2641
D(LUSDCNY (-1))	-0.935984	0.340101	-2.752074	0.0114
D(LUSDCNY (-2))	-0.671811	0.393376	-1.707808	0.1011
D(LUSDCNY (-3))	1.120679	0.324891	3.449403	0.0022
D(LUSDMZN)	-0.099616	0.100762	-0.988628	0.3331
D(LUSDMZN (-1))	0.090397	0.109935	0.822273	0.4194
D(LUSDMZN (-2))	0.099467	0.110965	0.896381	0.3793
D(LUSDMZN (-3))	0.257805	0.116537	2.212227	0.0372
D(LUSDZAR)	-0.025944	0.117613	-0.220591	0.8274
D(LUSDZAR (-1))	0.156843	0.103789	1.511172	0.1444

* p-value incompatible with t-Bounds distribution.

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LLR	0.429009	0.202187	2.121843	0.0448
LUSDCNY	1.088256	0.736913	1.476776	0.1533
LUSDMZN	-0.107701	0.165282	-0.651619	0.5211
LUSDZAR	0.261023	0.212579	1.227885	0.2319

EC = LCPI - (0.4290*LLR + 1.0883*LUSDCNY -
0.1077*LUSDMZN + 0.2610
*LUSDZAR)

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.024120	10%	3.03	4.06
K	4	5%	3.47	4.57

		2.5%	3.89	5.07
		1%	4.4	5.72
Actual Sample Size	47		Finite Sample: n=50	
		10%	3.24	4.35
		5%	3.834	5.064
		1%	5.184	6.684
			Finite Sample: n=45	
		10%	3.298	4.378
		5%	3.89	5.104
		1%	5.224	6.696

t-Bounds Test — Null Hypothesis: No levels relationship

Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-3.887303	10%	-3.13	-4.04
		5%	-3.41	-4.36
		2.5%	-3.65	-4.62
		1%	-3.96	-4.96

Appendix 4

Appendix 4A: Estimation of ARDL model

1st period estimation

Dependent Variable: LCPI
Method: ARDL

Sample (adjusted): 2009M04 2014M11
Included observations: 68 after adjustments
Maximum dependent lags: 2 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (2 lags, automatic): LCPISA LMAIZE LOIL LRICE
LSOYBEAN LWHEAT
Fixed regressors: C @TREND
Number of models evalulated: 1458
Selected Model: ARDL(1, 1, 0, 2, 1, 0, 2)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LCPI(-1)	0.817396	0.061666	13.25515	0.0000
LCPISA	0.280777	0.139205	2.017009	0.0488
LCPISA(-1)	-0.357837	0.140327	-2.550024	0.0137
LMAIZE	-0.004153	0.007589	-0.547186	0.5865
LOIL	0.017226	0.009303	1.851769	0.0696
LOIL(-1)	-0.008525	0.011938	-0.714075	0.4783
LOIL(-2)	0.020260	0.009099	2.226579	0.0302
LRICE	-0.003470	0.010443	-0.332265	0.7410
LRICE(-1)	0.021021	0.010298	2.041336	0.0462
LSOYBEAN	-0.003037	0.011480	-0.264575	0.7924
LWHEAT	-0.007536	0.008525	-0.884044	0.3807
LWHEAT(-1)	0.019489	0.009268	2.102909	0.0402
LWHEAT(-2)	-0.014053	0.006526	-2.153420	0.0359
C	0.879281	0.557293	1.577772	0.1206
@TREND	0.000549	0.000477	1.149075	0.2557

R-squared	0.996063	Mean dependent var	4.101954
Adjusted R-squared	0.995023	S.D. dependent var	0.045685
S.E. of regression	0.003223	Akaike info criterion	-8.445015
Sum squared resid	0.000551	Schwarz criterion	-7.955418
Log likelihood	302.1305	Hannan-Quinn criter.	-8.251022
F-statistic	957.7488	Durbin-Watson stat	2.071381
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

2^{nd} period estimation

Dependent Variable: LCPI
Method: ARDL

Sample (adjusted): 2015M04 2019M02
Included observations: 47 after adjustments
Maximum dependent lags: 4 (Automatic selection)
Model selection method: Akaike info criterion (AIC)
Dynamic regressors (4 lags, automatic): LCPISA LMAIZE LOIL LRICE
LSOYBEAN LWHEAT
Fixed regressors: C @TREND
Number of models evalulated: 62500
Selected Model: ARDL(4, 3, 4, 0, 4, 3, 4)

Variable	Coefficient	Std. Error	t-Statistic	Prob.*
LCPI(-1)	1.131997	0.180303	6.278298	0.0000
LCPI(-2)	-0.034437	0.259737	-0.132586	0.8961
LCPI(-3)	0.203923	0.253201	0.805380	0.4317
LCPI(-4)	-1.001982	0.239674	-4.180599	0.0006
LCPISA	4.460787	1.272253	3.506210	0.0027
LCPISA(-1)	-1.757285	1.324442	-1.326812	0.2021
LCPISA(-2)	-2.047066	1.262632	-1.621269	0.1234
LCPISA(-3)	2.861541	0.991404	2.886351	0.0103
LMAIZE	-0.119275	0.138987	-0.858178	0.4027
LMAIZE(-1)	-0.091039	0.120290	-0.756833	0.4595
LMAIZE(-2)	-0.030678	0.127511	-0.240588	0.8128
LMAIZE(-3)	-0.119332	0.130414	-0.915025	0.3730
LMAIZE(-4)	-0.531518	0.203071	-2.617393	0.0180
LOIL	0.064667	0.041189	1.570023	0.1348
LRICE	-0.217531	0.115905	-1.876809	0.0778
LRICE(-1)	0.122725	0.128919	0.951959	0.3545
LRICE(-2)	0.022312	0.138732	0.160826	0.8741
LRICE(-3)	-0.096092	0.126038	-0.762404	0.4563
LRICE(-4)	0.256835	0.112034	2.292470	0.0349
LSOYBEAN	-0.214600	0.207529	-1.034073	0.3156
LSOYBEAN(-1)	-0.105903	0.161094	-0.657398	0.5197
LSOYBEAN(-2)	-0.391426	0.165885	-2.359624	0.0305
LSOYBEAN(-3)	-0.170822	0.167572	-1.019395	0.3223
LWHEAT	0.079964	0.080130	0.997920	0.3323
LWHEAT(-1)	-0.068106	0.086872	-0.783987	0.4438
LWHEAT(-2)	0.112894	0.086160	1.310291	0.2075
LWHEAT(-3)	-0.183814	0.106561	-1.724975	0.1027
LWHEAT(-4)	0.160379	0.092982	1.724844	0.1027
C	-3.814652	5.540882	-0.688456	0.5005
@TREND	-0.014592	0.006074	-2.402363	0.0280

R-squared	0.993471	Mean dependent var	4.155807
Adjusted R-squared	0.982332	S.D. dependent var	0.119296

S.E. of regression	0.015857	Akaike info criterion	-5.190763
Sum squared resid	0.004274	Schwarz criterion	-4.009818
Log likelihood	151.9829	Hannan-Quinn criter.	-4.746365
F-statistic	89.19318	Durbin-Watson stat	2.300455
Prob(F-statistic)	0.000000		

*Note: p-values and any subsequent tests do not account for model selection.

Appendix 4B: ARDL long run Bounds test
1st period estimation

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LCPI)
Selected Model: ARDL(1, 1, 0, 2, 1, 0, 2)
Case 5: Unrestricted Constant and Unrestricted Trend

Sample: 2009M02 2014M11
Included observations: 68

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.879281	0.557293	1.577772	0.1206
@TREND	0.000549	0.000477	1.149075	0.2557
LCPI(-1)*	-0.182604	0.061666	-2.961166	0.0046
LCPISA(-1)	-0.077060	0.103565	-0.744074	0.4601
LMAIZE**	-0.004153	0.007589	-0.547186	0.5865
LOIL(-1)	0.028961	0.007610	3.805564	0.0004
LRICE(-1)	0.017551	0.006029	2.911252	0.0053
LSOYBEAN**	-0.003037	0.011480	-0.264575	0.7924
LWHEAT(-1)	-0.002100	0.007003	-0.299822	0.7655
D(LCPISA)	0.280777	0.139205	2.017009	0.0488
D(LOIL)	0.017226	0.009303	1.851769	0.0696
D(LOIL(-1))	-0.020260	0.009099	-2.226579	0.0302
D(LRICE)	-0.003470	0.010443	-0.332265	0.7410
D(LWHEAT)	-0.007536	0.008525	-0.884044	0.3807
D(LWHEAT(-1))	0.014053	0.006526	2.153420	0.0359

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCPISA	-0.422006	0.558489	-0.755622	0.4532
LMAIZE	-0.022740	0.046820	-0.485702	0.6292
LOIL	0.158601	0.057129	2.776216	0.0076
LRICE	0.096117	0.042116	2.282224	0.0265
LSOYBEAN	-0.016633	0.061348	-0.271125	0.7873
LWHEAT	-0.011499	0.036859	-0.311979	0.7563

EC = LCPI - (-0.4220*LCPISA -0.0227*LMAIZE + 0.1586*LOIL + 0.0961
*LRICE -0.0166*LSOYBEAN -0.0115*LWHEAT)

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	5.534676	10%	2.53	3.59
K	6	5%	2.87	4
		2.5%	3.19	4.38
		1%	3.6	4.9
			Finite Sample: n=70	
Actual Sample Size	68			
		10%	2.683	3.807
		5%	3.107	4.343
		1%	4.07	5.534
			Finite Sample: n=65	
		10%	2.69	3.83
		5%	3.137	4.363
		1%	4.111	5.586

t-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-2.961166	10%	-3.13	-4.37
		5%	-3.41	-4.69
		2.5%	-3.65	-4.96
		1%	-3.96	-5.31

2nd period estimation

ARDL Long Run Form and Bounds Test
Dependent Variable: D(LCPI)
Selected Model: ARDL(4, 3, 4, 0, 4, 3, 4)
Case 5: Unrestricted Constant and Unrestricted Trend

Sample: 2014M12 2019M02
Included observations: 47

Conditional Error Correction Regression

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-3.814652	5.540882	-0.688456	0.5005
@TREND	-0.014592	0.006074	-2.402363	0.0280
LCPI(-1)*	-0.700499	0.165658	-4.228584	0.0006
LCPISA(-1)	3.517976	1.364605	2.578019	0.0195
LMAIZE(-1)	-0.891842	0.360934	-2.470928	0.0244
LOIL**	0.064667	0.041189	1.570023	0.1348
LRICE(-1)	0.088249	0.175655	0.502400	0.6218
LSOYBEAN(-1)	-0.882751	0.262064	-3.368453	0.0036
LWHEAT(-1)	0.101317	0.082480	1.228386	0.2360
D(LCPI(-1))	0.832496	0.285768	2.913190	0.0097
D(LCPI(-2))	0.798059	0.251338	3.175240	0.0055
D(LCPI(-3))	1.001982	0.239674	4.180599	0.0006
D(LCPISA)	4.460787	1.272253	3.506210	0.0027
D(LCPISA(-1))	-0.814474	1.099381	-0.740848	0.4689
D(LCPISA(-2))	-2.861541	0.991404	-2.886351	0.0103
D(LMAIZE)	-0.119275	0.138987	-0.858178	0.4027
D(LMAIZE(-1))	0.681528	0.268844	2.535034	0.0214
D(LMAIZE(-2))	0.650850	0.229164	2.840112	0.0113
D(LMAIZE(-3))	0.531518	0.203071	2.617393	0.0180
D(LRICE)	-0.217531	0.115905	-1.876809	0.0778
D(LRICE(-1))	-0.183055	0.165919	-1.103277	0.2853
D(LRICE(-2))	-0.160743	0.139448	-1.152707	0.2650
D(LRICE(-3))	-0.256835	0.112034	-2.292470	0.0349
D(LSOYBEAN)	-0.214600	0.207529	-1.034073	0.3156
D(LSOYBEAN(-1))	0.562248	0.162048	3.469639	0.0029
D(LSOYBEAN(-2))	0.170822	0.167572	1.019395	0.3223
D(LWHEAT)	0.079964	0.080130	0.997920	0.3323
D(LWHEAT(-1))	-0.089459	0.082037	-1.090476	0.2907
D(LWHEAT(-2))	0.023435	0.086204	0.271856	0.7890
D(LWHEAT(-3))	-0.160379	0.092982	-1.724844	0.1027

* p-value incompatible with t-Bounds distribution.
** Variable interpreted as Z = Z(-1) + D(Z).

Levels Equation
Case 5: Unrestricted Constant and Unrestricted Trend

Variable	Coefficient	Std. Error	t-Statistic	Prob.
LCPISA	5.022098	2.442596	2.056049	0.0555
LMAIZE	-1.273153	0.684264	-1.860617	0.0802
LOIL	0.092316	0.061578	1.499176	0.1522
LRICE	0.125980	0.259363	0.485728	0.6334
LSOYBEAN	-1.260174	0.528444	-2.384686	0.0290
LWHEAT	0.144635	0.121542	1.190002	0.2504

EC = LCPI - (5.0221*LCPISA -1.2732*LMAIZE + 0.0923*LOIL + 0.1260*LRICE
-1.2602*LSOYBEAN + 0.1446*LWHEAT)

F-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	6.592010	10%	2.53	3.59
K	6	5%	2.87	4
		2.5%	3.19	4.38
		1%	3.6	4.9
			Finite Sample: n=50	
Actual Sample Size	47			
		10%	2.75	3.944
		5%	3.229	4.536
		1%	4.31	5.881
			Finite Sample: n=45	
		10%	2.796	3.97
		5%	3.267	4.584
		1%	4.364	6.006

t-Bounds Test			Null Hypothesis: No levels relationship	
Test Statistic	Value	Signif.	I(0)	I(1)
t-statistic	-4.228584	10%	-3.13	-4.37
		5%	-3.41	-4.69
		2.5%	-3.65	-4.96
		1%	-3.96	-5.31