BINDURA UNIVERSITY OF SCIENCE EDUCATION

EXAMINING THE HYPOTHESIS OF MONEY NEUTRALITY IN ZIMBABWE FROM 1990-2017

SUBMITTED BY

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DECLARATION

I, **B1542479**, declare this research project herein is my own work and has not been copied or picked from any source without the acknowledgement of the source.

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DEDICATION

I would like to dedicate this dissertation to my father and mother Mr and Mrs Nyatsambo, all the Nyatsambo family, all the Hoshiki family and all friends and relatives. I would like to take this opportunity to thank Mr C Chandiwana who inspired me to become an economist.

I want to thank everyone who believed in me from the start and all those who supported me, not forgetting my fellow economists whom I spend 4 years with at Bindura University.

ABSTRACT

This research examines the hypothesis of money neutrality in Zimbabwe. After studying the relevant literature on the effects of changes in money supply on real variables, it outlines the research design for a macro level study on the impact of changes in money supply on real variables. The hypothesis is that there is a positive relationship between money supply and real variables (GDP). The objectives of the study were to establish how money supply affects GDP in Zimbabwe as well as to determine which policy is superior than the other in Zimbabwe between monetary policy and fiscal policy. The researcher used real GDP as the dependent variable whilst money supply (M3), interest rate and government expenditure were used as explanatory variables. A VAR model have been applied using the country's macroeconomic data from 1990 to 2017 which was obtained from ZIMSTATS and World Bank Open Data website. Impulse response functions and variance decomposition were used to analyse the impact of the explanatory variables on real GDP. The Impulse Response Functions and Variance Decomposition results suggest that money positively affects real GDP in the short run but in the long run it is insignificant in influencing real output. This means that in Zimbabwe, money is non-neutral in the short run, but neutral in the long run. Government expenditure has an insignificant influence on GDP both in the short and long run whilst interest rate has a positive effect on GDP in the long run. The recommendations are that the government; should use expansionary monetary policy to increase real GDP, ensuring that any increase in money supply must be matched by a corresponding increase in output so as to counter the problem of inflation. demonetise the bond note as well as the RTGS and adopting the Rand, and ensuring transparency in the manner in which loans are given.

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My heartfelt gratefulness goes to my mentor who regardless of his busy schedule managed to play a fundamental role in assisting me with this research work. I would also want to take this opportunity to thank my fellow classmates at Bindura University for their invaluable input.

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ACRONYMS

ADF	Augmented Dicky Fuller
AIC	Akaike Information Criterion
ARDL	Aautoregressive distributed lag
ARIMA	Autoregressive Integrated Moving Average
CBN	Central Bank of Nigeria
EMCCA	Economic and Monetary Community of Central Africa
EXR	Exchange Rate

GDP	Gross Domestic Product
GE	Government Expenditure
GNP	Gross National Product
INF	Inflation
INT	Interest Rate
LRN	Long Run Neutrality
LRSN	Long run super neutrality
MS	Money Supply
SEACEN	South East Asian Central Banks
USA	United States of America
USD	United States Dollar
VAR	Vector Autoregression Model
VECM	Vector Error Correction Model
ZIMSTAT	Zimbabwe Statistics Agency

CHAPTER 1

INTRODUCTION

1.0 Introduction

Even though there are many theories relating to the effectiveness of monetary policy, one such theory that is generally accepted among policy makers is the long-run neutrality of money hypothesis. This hypothesis outlines that changes in the amount of money in an economy affect the nominal, but not the real variables of the macroeconomy. According to S Horwitz (2016), neutrality for Hayek was best understood as the idea that monetary institutions were ideal if money, and changes in its supply, did not independently affect the process of price formation and thereby create false signals leading to economic discoordination, and especially of the intertemporal variety. Ufoeze, Odimgbe, Ezeabalisi and Udoka (2018) argue that movements of monetary aggregates and their influence on domestic economy are significant and essential to policy makers and researchers. The impact and the presence of special relationship between monetary aggregates and other macroeconomic variables are important in formulating policies such as to control inflation, stimulating economic growth and reducing unemployment. The objective of this study is to examine the hypothesis of long run money neutrality or to determine the existence of a relationship between Gross Domestic Product (GDP) and money supply in Zimbabwe. This means determining whether or not monetary policy is more effective than fiscal policy in trying to achieve macroeconomic goals of the Zimbabwean economy. Despite the fact that many studies have been done regarding the proposition of neutrality of money, no one has tested the hypothesis in the Zimbabwean economy. This chapter include different sections such as background of the study, statement of the problem, objectives of the study, research questions, statement of hypothesis,

significance of the study, assumptions, delimitation of the study, limitations of the study, definition of terms and the chapter summary.

1.1 Background of the study

The economic performance of any country including Zimbabwe, is affected either positively or negatively by its monetary systems or more specifically by money. It has been a debatable issue among many economists and financial experts whether or not money affects the real economy. Investopedia (2018) defines the neutrality of money hypothesis as an economic theory which states that changes in the aggregate money supply only affects nominal variables not real variables. This means that an increase in money supply for instance would result in an increase in price, and nominal wages but would have no impact on real variables such as Gross Domestic Product (GDP), consumption, unemployment and real wealth.

According to Investopedia (2018), theoretically, money neutrality grew out of the Cambridge tradition in economics between 1750 and 1870. The initial version suggested that the level of money could not affect output or employment even in the short run. Because the aggregate supply curve is presumed to be vertical, a change in the price level does not alter the aggregate output.
The expression "neutrality of money" was propounded by Austrian economist Friedrich A. Hayek in 1931, who initially defined it as a market rate of interest at which malinvestments (poorly allocated business investments) did not occur and did not yield business cycles. Later neoclassical and neo-Keynesian economists adopted the expression and used it to their general equilibrium framework thereby giving it its current meaning.

The Classical scholars were of the view that money has no substance role over the real sector, they viewed money as a veil over the genuine economy. The monetarists driven by Milton Friedman argued that money is non-neutral in the short run and neutral in the long run. The monetarists were of the view that a change in money supply will change the price level as long as the demand for money is stable, and such a change has a temporal effect on the real value of GDP and economic activity. The Keynesians rejected neutrality of money and expressed that adjustments in money supply can affect real macroeconomic variables. The monetarists believed that money is nonneutral only in the short-run hence they believed in long run money neutrality.

Like any other country, Zimbabwe has a long history with regard to its currency. The Zimbabwean dollar (Z$) was the official money of Zimbabwe from 1980 - 2009. Amid this period, it was liable to times of above-average inflation, trailed by a period of hyperinflation.

The Zimbabwean economy was severely hit by hyperinflation in 2008, this prompted the utilization of the Zimbabwean dollar as an approved money to be successfully relinquished in April 2009. The Zimbabwean dollar was replaced by monetary standards, such as, the South African rand, Japanese yen, the United States dollar, Botswana pula, Indian rupee, pound sterling, euro, Australian dollar and Chinese yuan.

According to Zimbabwe Coalition On Debt And Development (2017), the Zimbabwean economy has been hit with money deficiencies that have incredibly influenced the social and monetary prosperity of the general population. The government trait the deficiency of money to variations among imports and exports as well as over dependence on one currency that is the USD, in an economy that uses multi-currency system. The scarceness of the USD cash in the country is being confirmed by long queues at banks. Zimbabweans have demonstrated that they never again have fearlessness in the budgetary frameworks introduced by the monetary authorities regarding the introduction of Bond Notes as well as other related policies.

Despite the fact that Zimbabwe is facing cash shortages, broad money supply in the country is increasing as evidenced by the increase in the supply of bond notes by 101% from US$175 million in May 2017 to US$354 million in May 2018, The Zimbabwe Independent (2018). According to the same publication, the Reserve Bank Governor of Zimbabwe John Mangudya said, “The amount of bond notes in the market right now is about $390 million. When money is released in the economy, some of it remains in the banks and some is captured by people in circulation.”

The Bar graph below shows 2018 money supply (M3) values. From the graph it can be seen that money supply, starting from February, is increasing on a monthly basis.

Figure 1: Zimbabwe money supply from December 2017 to November 2018

Source: RESERVE BANK OF ZIMBABWE, 2018

Generally, since July 2018, annual growth in money supply has been on a downward trend, mainly indicating slowdown in accommodation to Government and fiscal consolidation. The growth in money supply is reflected by a 36.3% increase in narrow money, of which, transferable deposits grew by 35.62%; while currency in circulation gained by 48.65%.

1.2 Statement of the problem

Over the previous years, there has been a debate regarding the neutrality of money among monetary economists and financial analysts. Despite the fact that some economists concur that variations in money supply does affect the real sector, others emphatically oppose this idea. For example, some will contend that cash has been ceaselessly printed in Zimbabwe however economic growth is going down yet in certain nations, for example, South Africa, an expansion in cash supply is trailed by an increment in economic growth.

Long run neutrality of money has been affirmed to exist in countries such as Belgium, Netherlands, Germany and Italy by Korkmaz and Yılgör (2013). Chuku (2011) found that there was the presence of long-run money neutrality in Nigeria. On the other hand, some economists demonstrated that the proposition of long run money neutrality does not hold in countries such as Indonesia (Puah, Habibullah, and Mansor, 2008) and in USA (Atesoglu and Emerson, 2009).

Zimbabwe was once viewed as a quickly developing economy with a strong currency, however the economic meltdown which the nation faced since 1990 has brought about high unemployment, an expansion in poverty, negative GDP growth and the banking sector which is vital to the nation's economy is performing way below its capacity. Of significance in this study is to examine whether or not changes in money supply does affect macroeconomic real variables in Zimbabwe. This seeks to examine the extent to which money supply can explain the variations in gross domestic product.

1.3 Objectives of the study

The aim of the study is to ascertain whether money is neutral or not in the Zimbabwean economy. The following objectives will be addressed in the study:

- To determine the existence of the relationship between money supply and real GDP (to see if money is neutral or non-neutral in Zimbabwe).
- To establish how variables such as interest rate and government expenditure affect GDP in Zimbabwe.
- To determine which policy is superior than the other between monetary policy and fiscal policy in Zimbabwe.

1.4 Research questions

- What is the relationship between money supply and real GDP in Zimbabwe?
- What is the relationship between interest rate and real GDP in the Zimbabwean economy?
- What is the relationship between government expenditure and real GDP in Zimbabwe?
- Which policy is superior than the other between monetary policy and fiscal policy in Zimbabwe?

1.5 Statement of hypothesis

H_0: There is a positive relationship between money supply and GDP.

H_1: There is a negative relationship between money supply and GDP.

1.6 Significance of the study

Right now, Zimbabwe is facing liquidity crisis and difficulties in the whole economy due to disinvestment through the closure or relocation of companies, the withdrawal of potential investors and foreign currency shortages, Wolmer (2009). This has prompted the hoarding of cash and foreign currency by people but mostly by foreign exchange dealers who are operating in the parallel market illegally. The presence of foreign currency dealers has led to the ballooning of the price of goods and services in the economy. So as to address this issue, more consideration must be paid on the most proficient method to improve the execution of the financial sector and to decide if it is the issue of money shortage that is disturbing the economy or not. It is therefore significant to find solutions that stimulate the country's economic growth rate which may perhaps lead to the creation of more employment opportunities.

The government need to be given a strategy on how to reduce the effects of cash shortages on the economic performance of the country. Thus, this study will help the government of Zimbabwe to achieve some of its macroeconomic objectives such as industrial expansion accompanied by an increase in GDP, employment creation and poverty alleviation.

The study is of paramount importance for the reason that it provides the opportunity for the improvement of more studies that aim to improve the effectiveness and efficiency of the monetary policy. The study also expands knowledge in the field of economics especially when studying about monetary economics.

The investigation will be an acknowledged and important wellspring of information for policy makers henceforth it will assist the government with coming up with proper strategies which attract industrial growth and to adjust current policies in order to have a sound economic environment that will pull in and advance positive changes in the economy. Therefore, it will also assist policy makers in the banking sector on how they can improve monetary policies so as to encourage industrialisation and improve economic growth in Zimbabwe.

1.7 Assumptions

In carrying out this study, the researcher assumed the following:

- All the information about the variables in question is correct and reliable. Hence, the data from ZIMSTAT and other sources is reliable and true.
- Real GDP is the dependent variable under the study and it is representing real variables.

1.8 Definition of terms

1.8.1 Money

Krugman and Obstfeld (2013) defines money as an asset that is widely used and accepted as a means of payment. Lipsey (2011) defines money as all assets that serve as a medium of exchange that is, paper money, coins, and deposits on which cheques can be drawn. Money is often defined in terms of the functions or services that it provides, Beardshaw (2011). This therefore means that it is anything that serves as a medium of exchange, as a store of value, as a unit of account and as a standard for deferred payments. Money's most important function is as a medium of exchange that is to facilitate the transactions of goods and services. To act as a store of value, money must be able to be reliably saved, stored, and retrieved and be predictably usable as a medium of exchange when it is retrieved. Money functions as a unit of account by providing a common measure of the exact value of goods and services being exchanged. By functioning as a standard for deferred payment, money makes credit transactions easier through determining future value of goods in monetary terms.

1.8.2 Money supply

According to Investopedia (2019), money supply is the total stock of currency and other liquid instruments circulating in a country's economy at a particular time. Money supply consist of cash, coins and balances held in checking and savings accounts. Money supply is normally measured using M1 (notes and coins + demand deposits), M2 (M1 + time deposits which can be withdrawn

within 30 days), M3 (M2 + time deposits which can be withdrawn after 30 days) and M4 (M3 + various money market instruments such as certificates of deposits).

1.8.3 Monetary policy

According to Hynkova (2013), monetary policy is part of and a tool of macroeconomic policy and it is a set of measures as well as policies that have to meet the required targets through monetary or currency policy instruments. CBN (2006) defines monetary policy as any policy measure designed by the government through the central bank to control cost availability and supply of credit and it is used by the government to combat unemployment, inflation and to control other economic downturns. It also referred to as the regulation of money supply and interest rate by the CBN in order to control inflation and to stabilize the currency flow in an economy. Lastly, according to Okwo *et al* (2012), monetary policy consists of a government formal effort to manage the money in its economy in order to realize specific economic goals.

1.8.4 Money neutrality

The neutrality of money is an economic theory that states that changes in the money supply only affect nominal variables and not real variables, Investopedia (2018). In other words, an increase or decrease in the money supply can change the price level but not the output or structure of the economy. According to BusinessDictionary.Com, neutrality of money is a situation where economic indicators such as level of employment and real output, are not affected by changes in the money supply.

1.8.5 Gross Domestic Product

Lipsey (2011) defines GDP as the total value of final goods and services produced in an economy over a certain period of time usually a year. BusinessDictionary.Com defines GDP as the value of a country's overall output of goods and services (typically during one fiscal year) at market prices,

excluding net income from abroad. The value of the output of the whole economy is the same as the income of all factors of production receiving factor rewards, Beardshaw (2011). GDP maybe calculated by any one of the three methods; the income, the expenditure and the output methods. GDP calculated at current prices is referred to as the nominal GDP whilst GDP calculated at historic prices is called real GDP.

1.9 Scope of the study

The study undertaken is going to focus on Zimbabwe and it covers the period from 1990 to 2017. The year 1990 has been taken as the initial point because at this period, the country had already started to carry out economic activities as an independent country. The researcher emphasises on the impact of changes in money supply on real GDP.

1.10 Organisation of the study

Chapter 2 comprises of review of related literature and studies which are related to the problem being examined (neutrality of money theories and different views about money supply and GDP) Chapter 3 consists of the procedures and methodology used to collect data for the study. The results of analysis and findings to emerge from the study will be contained in Chapter 4. Chapter 5 will contain the summary of the study, findings and conclusions drawn from the findings, a discussion, and recommendations for further study.

1.11 Summary

This chapter gave the introduction of the study and highlighted the significance of the study to the economy. It also includes background of the study, statement of the problem and purpose of the study. These sub-headings provide the importance of the study to the economics field and to policy makers. Research questions, statement of hypothesis and significance of the study show how the study is worth the effort and the benefits brought by it.

CHAPTER II

LITERATURE REVIEW

2.0 Introduction

This section reviews the concepts, theoretical perspectives, and empirical literature from previous researches about the topic of neutrality of money or simply put, on the impact of money supply on real variables (GDP).

2.1 Theoretical Literature

Monetary economists have focused on how changes in money supply can affect the real economy. The phrase "neutrality of money" was established by Austrian economist Friedrich Hayek in 1931. He initially defined it as a market interest rate at which malinvestments (poorly allocated business investments) did not transpire and did not cause business cycles. Later neoclassical and neoKeynesian economists adopted the phrase and applied it to their general equilibrium framework, giving it its current meaning. We will first look at the classical quantity theory of money and the related view of money neutrality as well as super neutrality.

2.2.1 Quantity Theory of Money/ Classical Dichotomy

For the classicals, quantity theory of money determines price level but real size is determined by relative price ratios. According to Handa (2009), money has no significant role to the classicals, it is seen as a shroud over the real sector. Money is only used as a medium of exchange that is, it facilitates the exchange of goods and services. Output is determined by capital and labour not by level of money in the economy. As a matter of fact, according to classical theory, the nominal

variables move in proportion to changes in the quantity of money, while real variables such as GNP, employment, real wage rate, real rate of interest remain unaffected, Guru (2013). Quantity of money cannot affect real variables (output and employment) since money supply is not an input in the classical production function. According to the classical theory, money plays out the capacity of only a mode of trade of merchandise and enterprises and is along these lines requested just for exchange purposes, Handa (2009).

According to Deev and Hodul (2016), there is a stronger version of neutrality of money known as the super neutrality of money. Super neutrality theory disregards short-run frictions and is relevant to an economy that is used to a constant money growth rate.

2.2.2 Monetarists Perspective on the Concept of Money Neutrality

The monetarists, under the guidance of Milton Friedman, had a similar view with the classicals but added a new dimension. They stated that an adjustment in money supply can change the price level given that the demand for money is constant or stable. Such a change has short run effect on the real value of GDP and economic activity. If the economy is operating below maximum capacity or at less than full employment level, an increase in money supply will result in an increase in output and employment since there will be a rise in expenditure, but this only happens in the short run. In the long run, the economy will return to less than full employment. Therefore, a long-lasting impact of changes in money supply falls on nominal values.

Monetarists ascribed short run non-neutrality of money to nominal inflexibilities or incorrect expectations, Moreira and Tabak (2016). In the long run, these inflexibilities disappear and mistakes in expectations are corrected thus making real variables independent of monetary changes. Effects of changes in money supply on income and total expenditure can be anticipated given that money demand is steady. According to the monetarists, the Central Bank is able to control the volume of expenditure by monitoring money supply using the monetary policy, The Market Monetarist (2013). Essentially, many economists accept short run money neutrality

meaning that they concur with the views of the monetarists as far as the concept of neutrality of money is concerned.

2.2.3 Keynes View on Neutrality of Money

John Maynard Keynes argued against the idea of neutrality of money and outlined that money supply is not merely a shroud but can certainly affect the real sector (The General Theory 1936). Keynes viewpoint was that money is non-neutral hence monetary policy can be implemented to influence the real economy, John (2013). Increasing money supply can increase the output level especially when the economy is at less than full employment level. However, when the economy is at full employment an increase in money supply raises the price level in a classical manner.

At the point when cash supply increases, this prompts an expansion in cash balances held by economic players. The players most likely purchase assets and then use surplus cash to acquire bonds, increasing bond prices, decreasing interest rates leading to an increase in investment. Eventually, this raises income level. In addition, when the cash balances held by economic players increases, this raises their consumption leading to more goods being produced and more people being employed.

2.2.4 David Hume and the Lag of Prices Behind Money

Hume when he expounded on money and interest rates argued that while a fixed total amount of money is not significant for influencing the level of output and employment, changes in the quantity of money have a real significance. According to Humphrey (1991), Hume ascribes these non-neutralities to the lag of prices behind money. He stated that, this lag causes money-induced variations in nominal spending which implies it increases output before being fully consumed by prices.

According to Arnon (2011), Hume attributes the price lag to the availability of unemployed labour which is prepared to work at prevailing wages. Prices and wages increase only after all the

available labour is fully employed. Hume distinguished between temporary and permanent nonneutrality, Paganelli (2006). Temporary non-neutrality is a result of one-time changes in the stock of money, changes to which prices eventually adjust. In contrast, permanent non-neutrality is caused by a continuous series of changes in the stock of money and in this case, prices never completely catch up. Hume gave an example of temporary non-neutrality that is the transitory stimulus to output caused by a one-time increase in the stock of money. Observing that the stimulus disappears as soon as prices adjust to the increased quantity of money, he concludes that money, despite its quantity, has no other effect than to raise the price of labour and commodities if it is fixed.

2.3 Empirical Literature

2.3.1 Empirical investigations about the neutrality of money

Fisher and Seater (1993) have come up with a rather structure free long run neutrality test in a bivariate ARIMA model. The test relies on a simple, reduced-form specification that assumes money supply is exogenous in the long run. The test is more robust when the data being used are integrated of a certain order (at least of order I). The order of integration is significant for two reasons. The first one is that, in order to make interpretations about long run neutrality in the absence of facts of the fundamental structure, the data must incorporate permanent stochastic changes in the quantity of the money supply. The second reason is that, the parameter restrictions suggested by long run neutrality relies heavily on the difference between the order of integration of money supply and the other variable used. When Fisher and Seater (1993) used their test on the Friedman and Schwartz (1982) U.S. annual data for prices, nominal and real income for the period 1869 to 1975, their outcomes supported long run neutrality with regard to prices and nominal income but declined it with regard to real income.

Tony Ekomie and Jean-Jacques (2013) examined the long run neutrality of money (LMN) in the Economic and Monetary Community of Central Africa (EMCCA) countries by applying Fisher and

Seater (1993) Autoregressive Integrated Moving Average (ARIMA) methodology, using different monetary aggregates, narrow money supply (M1), broad money supply (M2) and domestic credit (credit to private sector) during the period 1978-2008. The test rejected the LMN hypothesis. It is found that monetary aggregates have significant and positive impacts on real Gross Domestic Product (GDP) for all EMCCA countries. The results are robust under various sub-periods and the estimated coefficients are stable under two breakpoints corresponding to the dates of central bank reforms and devaluation of the local currency.

May-Jean Tang, Puah and. Dayang-Affizzah (2013), tested the monetary neutrality proposition in Singapore for the period of 1980-2009 by employing Fisher and Seater's (1993) long-run neutrality test. Empirical findings indicated that monetary neutrality does not hold in Singapore when both the simple-sum money and Divisia money are employed. As both the simple sum and Divisia monetary aggregates are non-neutral, monetary authorities may consider their use as a monetary policy tool affecting real economic activity.

Lee (2012) employed a nonparametric test on LRN in USA using the spectral approach. The sample period covering 1959 to 2009 was obtained from the division site at Federal Reserve Bank at St. Louis, USA. The researcher used real GDP and M2 as the variables in his study. The author used a different approach in testing LRN by employing kernel-based nonparametric cross spectral density estimator to carry out the research study. This estimator provided some information about correlations between money and real GDP in different forms. In other words, it was designed to detect unknown forms of cross correlations in the time series data applied. Through the empirical findings, he found out that there was a strong rejection in the case of M2 regardless of bandwidths and of kernels which also showed that nearly insensitive to the choice of bandwidths.

Mehdi Farahani and Marjan Deh Abadi (2012) have examined the hypothesis of money neutrality in Iran's economy. They concluded that, according to rational expectations hypothesis and flexibility of prices in macroeconomy, only unexpected changes of the quantity of money affect

real production. Simply put, their results show that anticipated money is neutral while unanticipated money is non-neutral (in the short-run).

Chuku (2011) conducted a study to test the LRN propositions in Nigeria. The period of study was from the first quarter of 1960 to the fourth quarter of 2008. By using King and Watson's (1997) eclectic methodology, he established that long-run money neutrality existed in Nigeria as the evidence was held under the assumptions of contemporaneous money exogeneity and contemporary money neutrality. Similar results were obtained by Chinaemerem and Akujuobi (2012) when they employed data from 1962:1 to 2010:4. They also found that the long-run Fisher relation was rejected for Nigeria because of the existence of cointegrating relationship between inflation and real interest rate.

Atesoglu and Emerson (2009) tested long-run monetary neutrality by employing cointegration and vector error-correction modelling methodology. Using quarterly data for the United States, they estimated the long-run relationships among money supply and output and other key macroeconomic variables. Their findings raised doubts about the long-run monetary neutrality proposition.

Koustas and Stenges (2009), examined the short-run neutrality of money in the economy of Canada. They applied an econometric methodology that relied on standard tested - hypothesis testing so that they can test the policy ineffectiveness suggestion with respect to some problems related to the non-tested hypothesis background used by other authors. The extensive openness of the Canadian economy is taken into account through the use of a Mundell Fleming aggregate demand side model. The supply response of the economy was modelled using the sergeant Wallace aggregate supply function. Empirical results based on a data sample covering the period of Canada's current experience with flexible exchange rates did not support the policy ineffectiveness suggestion.

Westerlund, and Costantini, (2009) were of the view that most econometric methods for testing the proposition of long-run monetary neutrality rely on the assumption that money and real output

do not cointegrate, a result that is usually supported by the data. Their study argues that these results can be attributed in part to the low power of univariate tests, and that a violation of the noncointegration assumption is likely to result in a non-rejection of the neutrality proposition. To alleviate this problem, two new and more powerful panel cointegration tests are proposed that can be used under quite general conditions. The empirical results obtained from applying these tests to a panel covering ten countries between 1870 and 1986 suggest money and real output are cointegrated, and hence that the neutrality proposition must be rejected.

Chew (2009) focused on the needed edge and the Phillips curve that is money neutrality and individual beliefs. His approach included an uncomplicated two-person action model with a seller and a buyer bidding in terms of money in a situation where the value of the money is not known. The study stated that; firstly, nominal impact will be experienced if a monetary revaluation is public knowledge. Secondly, making the value of money known by almost everyone enhances total gains from trade provided that the seller and the buyer have the same beliefs. Thirdly, monetary revaluations do not have net effect since both the seller and the buyer have equal knowledge and also have the same beliefs.

Puah, Habibullah, and Mansor (2008) employed an ARIMA model of a long-run monetary neutrality test proposed by Fisher and Seater (1993) to empirically examine the monetary neutrality hypothesis in Indonesia using different definition of monetary aggregates for the period of 1981: Q1 to 2011: Q4. Both monetary aggregates (simple-sum money and Divisia money) were found to be non-neutral, indicating that Divisia money can be considered to be used as a monetary policy variable in Indonesia.

Puah, Habibullah and Mansor (2008) tested the long run neutrality (LRN) and long run super neutrality (LRSN) propositions using annual observations from 10 member countries of the South East Asian Central Banks (SEACEN) Research and Training Centre. They applied the Fisher and Seater (1993) methodology to carry out the study. The authors gave special attention in identifying the number of unit root and cointegrating vector, since a meaningful LRN (LRSN) test critically depends on such properties. Empirical results show that LRN can be deviated from the case of

Asian developing economies. In particular, monetary expansion appears to have long run positive effect on real output in the economies of Indonesia, Taiwan and Thailand.

Tawadros (2007) examined the hypothesis of long-run money neutrality for Egypt, Morocco and Jordan using seasonal co-integration methods. He tested the neutrality of money proposition for three Middle Eastern countries, using data on money, prices and real income. The advantage of using this method lies in the ability to differentiate between co integration at different frequencies. The observed results indicated that money is co integrated with prices, but not with output at the zero frequency for these three countries. This means that money only affects nominal not real variables in the long run indicating that money is neutral in Egypt, Morocco and Jordan.

Wallace and Cabrero- Costelleaos (2006) used the fisher and Seater (1993) procedure against Guatemala data (1950-2002) to test for long-run neutrality of money with respect to Real GDP, consumption, investment and public expenditure. The monetary base and money supply were found to be integrated of order 1. Given this order of integration, they found evidence of M2 neutrality with regard to GDP, consumption and expenditure in Guatemala economy.

2.3.2 Empirical investigations about the relationship between money supply and real GDP.

Elsheikh and Ahmed (2019), studied the long-run relationships between GDP, MS and price level for the Sudan economy using yearly data over the period 1960 to 2005. Granger Causality test has been used to establish the short-run direction of causality between the variables used in the study. In order to explore the presence of long-run association, co-integration analysis has been applied. The study found out that the direction of causation between real GDP and prices was unidirectional from real GDP to CPI that is without any feedback. The study suggests that causation between money and prices runs from money supply to prices, however price level does not cause money supply. Lastly, there is no causal relationship between real GDP and money supply in the economy of Sudan.

Haroon and Hasan and Tarique (2018), examined the relationship between MS, real income, price level and INT using data for period 1998 to 2014 in India. The researchers used VAR approach to scrutinize the dynamics of the relationship among variables. The results indicate that lags of all dependent variables except real income are significant. The Granger causality suggests that bidirectional causality exists between money supply and price level. Money supply causes the rate of interest. Nevertheless, the research could not find any causal relationship between real income and money supply in either direction.

Mukhtar and Muhammad (2017) did a study to establish the effect of money supply on Economic Growth in Nigeria. The study made use of annual time series data for the period spanning from 1981 to 2015. The researchers used Johansen co-integration approach to check the long run relationship among the variables while Vector Error Correction Model (VECM) was used to evaluate the short run dynamics and Pairwise Granger causality test was used to check the direction of the interconnection or causality between the variables. The empirical result confirmed long run relationship amongst the variables where money supply and interest rate have positive substantial impact while real exchange rate has negative significant impact on the economy. However, in the short run lagged value of MS has negative significant effect, also lagged value of EXR has negative significant effect while lagged value of GDP and lagged value of INT do not have any significant effect on the economy. Moreover, the causality test reveals bidirectional causality between MS and GDP, unidirectional causality running from EXR to MS and INT to MS while there is no causality between EXR and GDP, INT and GDP, and also INT and EXR. In the conclusion, the study recommends expansionary monetary policy for achieving economic growth in Nigeria in addition to greater emphasis on the improvement of monetary policies and institutions for ensuring effective and efficient monetary system in Nigeria.

Dingela and Khobai (2017) investigated the impact of broad money supply (m3) on economic growth (GDP) per capita in South Africa by using time-series data from 1980 to 2016. Their study utilised the autoregressive distributed lag (ARDL)-bounds testing method to cointegration. Error correction model was employed to examine the impact of m3 on GDP per capita. The researchers used four macroeconomics variables which are; Gross Domestic Product (GDP) per capita, Broad

money supply (M3), Inflation rate (INF) and Interest rate (INT). Their results show that there is statistically significant positive relationship between money supply and economic growth both in the short run and long run.

Hussain and Haque (2017), studied about the empirical analysis of the relationship between money supply and per capita GDP growth rate for Bangladesh. The researchers applied vector error correction model (VECM) model. Their findings reveal that the money supply has significant role on the growth rate.

Yugang He (2017) used annual series data from 2000 to 2016 to analyse the relationship between the money supply (M2) and the macroeconomic variables (the real GDP, the inflation rate & the interest rate) under the vector auto regression (VAR) model in China. The objective of his study was to examine the impact of these variables on money supply in China. The author concluded that an increase in the real GDP can result in an increase in the money supply; Also, an increase in the inflation rate can lead to an increase in the money supply; Conversely, an increase in the interest rate can cause a decrease in the money supply.

Suna Korkmaz and Metehan Yılgör (2013), did a research study to establish whether or not money supply had effect on economically important variables such as general level of prices, interest rate and GDP. The authors tested the impact of money supply on the above-mentioned variables by using panel data for 9 European countries (Belgium, France, Finland, Germany, Italy, Turkey, Netherlands, Hungary and Portugal). The annual data of 2000-2010 was used. As a result of the test, it was seen that a change in the money supply of 9 European countries had effect on inflation and interest rates. In other words, the results indicated that money supply only affects nominal variables not real variables in the chosen 9 European countries hence money is neutral in those countries.

2.3.3 Empirical investigations about the effectiveness of monetary policy and fiscal policy.

Srithilat and Sun (2017), examined the effect of monetary policy on economic development by applying annual time series data from 1989-2016. All the variables were stationary at first difference hence the Johansen Cointegration and Error Correction Model were utilised to analyse the relationship between variables. The results showed that money supply, interest rate and inflation rate have negative impact on real GDP per capita in the long run and only the real exchange rate has a positive sign. The error correction model outcome indicated the presence of short run causality between three variables that is money supply, real exchange rate and real GDP per capita.

Chowdhury and Afzal (2015), studied the effectiveness of monetary policy and fiscal policy in Bangladesh. Their results indicate that monetary and fiscal policies are equally effective as far as stimulating economic growth in Bangladesh is concerned.

Chipote and Makhetha-Kosi (2014) investigated the role of monetary policy in stimulating economic growth in South Africa over the period 2000-2010. The authors used Johansen cointegration and the Error Correction Mechanism to identify the long-run and short-run dynamics between the variables. The results of the study showed that a long run relationship exists between the variables. The study concluded that money supply, repo rate and exchange rate are insignificant monetary policy instruments that drive growth in South Africa whereas inflation is significant. The recommendations of the study were that monetary policy should be used to promote sustainable economic growth, and the government should increase government expenditure on the manufacturing sectors of the economy in order to increase economic growth given that monetary policy on its own is unable to successfully stimulate economic growth.

2.4 Gap Analysis

From the above empirical literature, it is clear that research on whether money supply affects real variables have been studied by many researchers worldwide. The hypothesis of long run money

neutrality has been examined in both developed and less developed countries. Nevertheless, many researchers applied the Fisher and Seater (1993) model which is a bivariate autoregressive integrated moving average (ARIMA) model. The model only make use of two variables which are; money supply and real GDP. This increases the chance of coming up with biased results because of the exclusion of other relevant variables which affect real GDP or real output. In addition, there is no one who tested the proposition of money neutrality in the economy of Zimbabwe. This study is going to answer questions such as; is there a correlation between money supply and real GDP in Zimbabwe and does money supply affect real variables in Zimbabwe (real GDP). Also, the significance of this study is to establish whether monetary policy is superior or inferior than fiscal policy in the Zimbabwean economy.

2.5 Summary

There is extensive literature on the hypothesis of neutrality of money or on the impact of changes in money supply on real variables mainly GDP. Several views were mentioned, these include the view of classical economists, the Keynesians view, the monetarists view and other views concerning the neutrality of money and the role of money in affecting the real economy. However, there is no literature of such a study being done on the Zimbabwean economy. The literature provides a basis to look at the technique or method to use so as to make inferences on the findings.

CHAPTER III

RESEARCH METHODOLOGY

3.0 Introduction

The aim of this chapter is to describe the research method to be used, instruments to be used, the techniques as well as statistical treatment applied in analysing data. Both qualitative and quantitative research methods are utilised to achieve all the objectives of the study. These consist of stationarity tests, impulse response functions and variance decomposition.

3.1 Research Design

It is a detailed plan or procedure for carrying out the study, which permits the researcher to translate the theoretical hypothesis into an active one, Akhtar (2016). The type of the design a researcher chooses for a study has a significant impact on the accurateness of the results, Creswell (2014). The researcher is going to use a combination of descriptive and correlation designs in this study and these are anticipated to give internal and external validity to the study.

3.1.1 Descriptive Research

Creswell (2014) suggested that a quantitative kind of research design tries to describe and explain conditions for the current study by making use of many subjects and to describe a phenomenon. Descriptive research usually takes unprocessed data and summarizes it in a usable form. It is

therefore suitable for this study because it includes manipulation of unprocessed data in to a better usable form to make it easier for prediction and estimation without changing the nature of the respondent's working environment.

3.1.2 Correlation Research Design

Correlation research design is a technique in which two or more quantitative variables from the same group of subjects in which one is attempting to determine if there is a relationship or covariation between the variables, Simon and Goes (2011). Correlation research design is suitable and appropriate for this study as there is need to find the type of relationship, regression and covariation between money supply, interest rate, government expenditure and GDP. The advantage of this design is that it is reliable even though its main criticism is about its failure to bring out the causality effect.

3.2 Hypothesis

H_0: There is a positive relationship between money supply and GDP.

H_1: There is no relationship between money supply and real GDP.

3.3 ESTIMATION METHOD

3.3.1 Regression Model

Regression analysis is a statistical tool for the examination of relationships between variables. Generally, the researcher seeks to establish the causal effect of one variable upon another for instance the effect of changes in money supply on gross domestic product.

3.3.2 Theoretical model (Quantity Theory of money/Classical Dichotomy)

The Quantity theory of money (QTM) was developed in the 18^{th} century and can be viewed as a response to the mercantilist identification of money with wealth. Fisher (1911) propounded the theory through the following equation of exchange:

$$MV = PQ \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (1)$$

Where M = Money Supply, P = Price, Q = Full employment output and V = velocity of circulation (The number of times money changes hands). The ratio can also be rewritten as:

$$M=PQ/V \text{ or } P = MV/Q \ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \ (2)$$

Q and V are assumed to be constant such that an increase in money supply will lead to a proportionate increase in price (inflation), leaving real variables (Output) unaffected. The quantity theory of money outlines that there is a linear relationship between money supply in an economy and the level of prices of goods and services (inflation). According to QTM, if the amount of money in an economy doubles, price levels also double, causing inflation.

3.3.3 Empirical Model (Vector Autoregressive Model [VAR])

The VAR model is a general framework that is used to describe the relationship among stationary variables. Time series data can be stationary at different levels. When time series is not level stationary, then VAR will need to be modified to allow consistency in the relationship. The VECM is a special case of VAR for variables that are stationary in their differences. VECM does take account of cointegration among variables.

The researcher is going to utilise the Vector Autoregressive Model (VAR). The number of cointegrating vectors is detected through the two likelihood ratio test statistics (trace and maximum test). Chinaemerem and Ezeji (2013) conducted an empirical study using the VAR model in their study of “money neutrality controversy in a developing country (Nigeria). They used GDP as their dependent variable and total government expenditure, money supply and prices as their explanatory variables. The authors used VAR test to estimate relevant equations.

Mukhtar and Muhammad (2017) utilised the VAR model in their study of examining the effect of money supply on Economic Growth in Nigeria. The researchers used GDP as their dependant variable, exchange rate, money supply and interest rate as their explanatory variables.

The VAR method avoid the need for structural modelling by means of treating all the variables as endogenous in the system as a function of the lagged values of all endogenous variables in the system. The robustness of structural VAR is as a result of relative ease of estimation and interpretation, as compared to large simultaneous models.

The mathematical representation of a VAR system is given by:

$[Y]_t = [A]_0 + [A_1][Y]_{t-1} + \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots + [A_p][Y]_{t-k} + [e]_t$

Where *p* is the number of variables in the system, *k* is the number of lags considered in the system, [Yt], [Yt-1], …, [Yt-k] are 1 x p vector of variables, [A]…[Ap] are p x p matrices of coefficients to be estimated, [e]t is 1 x p vector innovations.

The equations for the VAR model in the study are as follows:

$GDP_t = C_1 + \sum^{n}_{k=1} \beta 1 GDPt - k + \sum_{K}^{n}{}_{=1} \beta 2 MS\ t - k + \sum^{n}_{k=1} \beta 3 INTt - k + \sum^{n}_{k=1} \beta 4 GEt - k + e_{1t}$

$MS_t = C_2 + \sum^{n}_{k=1} \alpha 1 MSt - k + \sum_{K}^{n}{}_{=1} \alpha 2 GDP\ t - k + \sum^{n}_{k=1} \alpha 3 INTt - k + \sum^{n}_{k=1} \alpha 4 GEt - k + e_{2t}$

$INT_t = C_3 + \sum^{n}_{k=1} \lambda 1 INTt - k + \sum_{K}^{n}{}_{=1} \lambda 2 GDP\ t - k + \sum^{n}_{k=1} \lambda 3 MS - k + \sum^{n}_{k=1} \lambda 4 GEt - k + e_{3t}$

$GE_t = C_4 + \sum^{n}_{k=1} \theta 1 GEt - k + \sum_{K}^{n}{}_{=1} \theta 2 GDP\ t - k + \sum^{n}_{k=1} \theta 3 MS - k + \sum^{n}_{k=1} \theta 4 INTt - k + e_{4t}$

Where GDPt is the real gross domestic product, MSt is money supply, INTt is annual interest rate and GEt is government expenditure. Ci, βi, αi, λi and θi are parameters to be estimated whilst ei's are the stochastic error terms.

3.4 Diagnostic Tests

Because the researcher is going to use time series data, there are some tests which need to be carried out for the results to be meaningful. The problems that need to be corrected for the regression model to be BLUE (Best Linear Unbiased Estimators) include stationarity, autocorrelation, heteroscedasticity and multicollinearity.

3.4.1 Stationarity Test

Regression on non-stationary series produces a spurious regression. Stationarity is a situation whereby the mean and the variance do not change over time and the value of the covariance between the two time periods relies only on the distance or lag between the two time periods and not the exact time at which the covariance is calculated, Adhikari and Agrawal (2013). Augmented Dickey-Fuller Test will be used to test for stationarity.

3.4.2 Heteroscedasticity

It refers to a situation whereby the variances of the error terms are not equal. Heteroscedasticity affects confidence intervals, t-test, F-test because variances of error terms are not the minimum variances. White general test is mostly used to test for the presence of heteroscedasticity.

3.4.3 Autocorrelation

It is a situation where that error terms from different time periods are correlated. This occurs in time series studies where the error associated in the given period comes over to future time period. The problems associated with autocorrelation are that estimators are inefficient, if its positive autocorrelation, standard errors will be biased downwards leading to an increase in the probability of type 1 error and R^2 is likely to be magnified. The researcher will use Durbin Watson to test for the presence of autocorrelation.

3.4.4 Multicollinearity

Multicollinearity exists when some or all of the explanatory variables in a model are highly correlated with another. Some of the causes of multicollinearity are the use of lagged variables and co-integration (the tendency of variables to move together with time). The consequences of multicollinearity include; coefficients may have very high standard errors, wider confidence intervals, high R^2 but few significant t ratios and if there is perfect multicollinearity the estimators do not exist. To test for the presence of multicollinearity, the researcher will compute matrix of correlations between the individual variables.

3.5 Lag length

Before estimation, the optimal lag length will be determined using the lag length selection criteria by utilising the Akaike Information Criterion (AIC) so that we do not end up with a spurious VAR.

3.6 Impulse Response Functions and Variance Decomposition

These computations are useful in assessing how shocks to economic variables reverberate through a system. Impulse Response function is used to produce a time path of dependent variables in the VAR, to shocks from all independent variables. Given a situation where the system equation is stable, any shock should decrease to zero whist an unstable system produces an explosive path. Impulse response functions allow one of the variables in the system to shocked and define its path on the system whilst holding everything else constant.

Variance Decomposition is another method for investigating the effects of shocks on the dependent variable. This technique determines how much of the prediction error variance of variable in the system is explained by changes to each explanatory variable over a series of time shocks. Individual series are more likely to explain much of the shocks of the error variance, even though the shock will also affect other variables.

3.7 Model Specification Tests/ Measures of goodness of fit

Specification tests will be carried out to enable the researcher to decide which model best fits the data. The R-squared test and the F-test will be applied in this model. The R-squared measures the

proportion of variation in the regressand as explained by the regressors. R^2 lies between 0 and 1 with 0 indicating total lack of fit and 1 indicating a perfect fit. A drawback of using this test is that by adding more regressors in the model we will be increasing the R^2 value. The F-test determines the significance of the whole model. The F-test and R^2 give the same results.

3.8 JUSTIFICATION OF VARIABLES

3.8.1 Real Gross Domestic Product (GDP)

According to Lipsey (2011), GDP is the total final value of all goods and services produced in a country over a given period of time. It refers to the final value of goods and services produced within the country's borders by both residents and non-residents. Real GDP means GDP at constant prices or it simply means GDP adjusted for inflation. The gross domestic product variable is included in this model because it is representing real variables in an economy. Almost any researcher who wants to test the hypothesis of money neutrality uses real GDP as the dependant variable. Scholars such as Mukhtar and Muhammad (2017) and Yugang He (2017), just to mention a few, used real GDP in their empirical studies of money neutrality. Real GDP is measured in billion dollars.

3.8.2 Money Supply (MS)

Money supply refers to the total amount of monetary assets (total stock of currency and other liquid instruments) available in an economy at a given period of time, Investopedia (2019). Increasing money supply can lead to an increase in inflation and this have a negative impact on GDP. Money supply has been used as an explanatory variable in money neutrality studies by many researchers which include Yugang He (2017), Lee (2012) and Chuku (2011). In this study, money supply is measured in dollars.

3.8.3 Interest Rate (INT)

Interest rate (Bank lending rate) is the rate at which interest is paid by borrowers (debtors) for the use of money that they borrow from a lender (creditor). Simply put, interest rate refers to the cost of borrowing money. Interest rates are typically noted on an annual basis, Investopedia (2017), High interest rate reduces private investment leading to reduced GDP. On the other hand, it may attract foreign capital inflows which may result into increased debts. Researchers such as Mukhtar and Muhammad (2017), Korkmaz and Yilgor (2013) and Chuku (2011) used interest as one of their explanatory variables in their studies. Interest rate is being measured in percentages.

3.8.4 Government Expenditure (GE)

Government expenditure simply means money spend by the government over a specific time period, R Lipsey (2013). It includes things such as the cost of new schools, new roads, new hospitals, salaries of civil servants and the purchase of goods such as cars, medicine and office equipment (Beardshaw 2011). It can be split into government consumption (e.g. wages) and capital formation (i.e. investment. Wallace and Costelleaos (2006) as well as Atesoglu H. S and Emerson J (2009) used **GE** as one of the explanatory variables in their studies. **GE** is measured in dollars.

3.9 Data Source

In this study, data for money supply, interest rate and government expenditure were obtained from ZIMSTAT whilst data for GDP was obtained from World Bank Open data website. These sources give updated statistics on estimates of the variables. In choosing the material for use as secondary data in the study, special note was taken to assess the accuracy, reliability and objectivity of the information.

3.10 Data Choices

The researcher chose secondary data.

3.11 Data collection

The dataset which is going to be used in this analysis will be time series of GDP, money supply, interest rate and government expenditure for Zimbabwe from 1990 - 2017 from ZIMSTAT and World Bank Open Data website.

3.12 Summary

This chapter explained the research method used in carrying out the study. It described the research design, method of estimation, models to be estimated and justification of variables used. The chapter paved the way for data presentation and analysis. Chapter four makes an analysis of the data and the data is presented in the form of tables. The software to be used by the researcher for regression analysis will be Econometric views (e-views) Version 7.1

CHAPTER IV

DATA PRESENTATION, ANALYSIS AND DISCUSSION

4.0 Introduction

This chapter focuses on data presentation and analysis according to estimation of the model in order to establish the impact of money supply on GDP in Zimbabwe. The chapter will present summary statistics, results of appropriate tests undertaken as well as final results to be used to conclude the study. The researcher used Econometric Views (E-View, Version 7.0) to perform different Econometric procedures.

4.1 Summary Statistics

Table 4.1 Summary Statistics

	GDP	GE	INT	MS
Mean	14.81396	4.61E+09	481.73	2.04E+18
Median	15.347	1.17E+09	34.7	2.55E+10
Maximum	17.986	5.01E+10	10600	5.68E+19
Minimum	8.982	26024000	6.4	1381247
Std. Dev.	2.615688	1.12E+10	1991.387	1.07E+19
Skewness	-0.61686	3.349036	4.937735	5.003282
Kurtosis	2.243483	12.91587	25.60187	26.03433
Jarque-Bera	2.443437	167.0535	709.7645	735.8303
Probability	0.294723	0	0	0
Sum	414.791	1.29E+11	13488.44	5.72E+19
Sum Sq. Dev.	184.7292	3.40E+21	1.07E+08	3.11E+39
Observations	28	28	28	28

Source: Own estimation using EViews version 7.

The above table shows summary statistics of variables to be used in the model. The table shows that there is much variability in the interest rate owing to high inflation which started to prevail in

the country in the 2000s as shown by a standard deviation of 1991.387%. The Jaque-Bera test for normality which tests the null hypothesis that variables are normally distributed against an alternative that they are not normally distributed shows that GDP is normally distributed because its p value is greater than 0.1 thus, we fail to find evidence to reject the null hypothesis.
Nevertheless, the rest of the variables are not normally distributed.

4.2 Diagnostic Tests

The costs of model mis-specification in regression analysis can be serious in terms of the negative consequences on the sampling properties of estimators and tests. There are likewise equivalent ramifications for forecasts and for other interpretations that may be drawn from the fitted model. Accordingly, the econometrics literature places a good deal of emphasis on procedures for interrogating the quality of a model's specification. These techniques center around the basic determination of the model, regarding its functional form, the decision of regressors, and conceivable estimation mistakes. The researcher tested for multicollinearity, autocorrelation, heteroscedasticity and unit roots.

4.2.1 Multicollinearity Test

Multicollinearity is a situation where there is correlation between independent variables. The researcher is going to use the correlation matrix to test for the presence of multicollinearity.

Table 4.2 Correlation Matrix

	GDP	GE	INT	MS
GDP	1	0.376445	-0.48529	-0.43919
GE	0.376445	1	-0.09201	-0.07948
INT	-0.48529	-0.09201	1	0.996236
MS	-0.43919	-0.07948	0.996236	1

Source: Own estimation using EViews version 7.

The table above indicates the correlation between independent variables used in this study. The table shows that interest rates and money supply are highly correlated as indicated by a correlation of 0.996236. However, other variables are not correlated as indicated by having a correlation which

is below 0.8. The researcher is not going to drop one of the variables as a way of solving the problem of multicollinearity between interest rates and money supply. This is because removing one of the variables can lead to the problem of exclusion of relevant variables. In short, the researcher is going to use the do-nothing approach.

4.2.2 Heteroscedasticity Test

This refers to a situation whereby the variances of the error term are not equal. Heteroscedasticity increases the risk type II error, estimates will no longer be efficient and all hypothesis tests will be invalid. The ARCH heteroscedasticity test was used to test for the presence of heteroscedasticity.

Table 4.3 Arch Heteroscedasticity Test

Heteroskedasticity Test: ARCH

F-statistic	1.922149	Prob. F (1,25)	0.1779
Obs*R-squared	1.927707	Prob. Chi-Square (1) 0.1650	

Source: Own estimation using EViews version 7.

Given the null hypothesis that there is homoscedasticity and an alternative that there is heteroskedasticity, there is no evidence to reject the null hypothesis since the P value is greater than 0.1. The table above indicates that there is no autoregressive conditional heteroskedasticity (ARCH) element in the residuals thus homoscedasticity.

4.2.3 Autocorrelation Test

It is also known as serial correlation, and it refers to a mathematical representation of the extent of similarity between a given time series and a lagged version of itself over successive time intervals. The researcher used the Breusch Godfrey LM test for correlation to test for the presence of autocorrelation.

Table 4.4 LM Autocorrelation Test

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	5.755173	Prob. F (2,22)	0.0098
Obs*R-squared	9.617617	Prob. Chi-Square (2)	0.0082

Source: Own estimation using EViews version 7.

The table above indicates a P-value which is less than 0.1. Thus, there is evidence to reject the null hypothesis that there is no autocorrelation between the error terms implying that our variables are suffering from autocorrelation. When there is correlation, R^2 is overestimated, the estimated variances of the regression coefficients will be biased and inconsistent, hence hypothesis testing will no longer be valid. The problem of autocorrelation is solved by creating a variable which will be one period lag of dependent variable (GDP).

Table 4.5 LM Autocorrelation Test (When using one period lag of the dependent variable)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	0.679436	Prob. F (2,20)	0.5182
Obs*R-squared	1.717767	Prob. Chi-Square (2)	0.4236

Source: Own estimation using EViews version 7.

The table above indicates a P-value which is greater than 0.1. Therefore, we fail to gather evidence to reject the null hypothesis that there is no autocorrelation between the error terms.

4.3 Stationarity Tests

Table 4.6 ADF unit root test in levels

Variables	ADF Test Statistic	MacKinnon Critical Values			Decision
		1%	5%	10%	
GDP*	-3.479999	-3.769597	-3.004861	-2.642242	Stationary
MS*	-5.160218	-3.699871	-2.976263	-2.627420	Stationary
GE*	-3.201099	-3.699871	-2.976263	-2.627420	Stationary
INT*	-4.877467	-3.699871	-2.976263	-2.627420	Stationary
Lag GDP*	-1.797147	-3.724070	-2.986225	-2.632604	Non-Stationary

Source: Own estimation using EViews version 7. The null hypothesis is that there is a unit root

Normally, time series data is non-stationary that's why the data was tested for unit roots. Test for stationary is a prerequisite for reliable and valid inference of time series models and co-integration analysis. Tables 4.7, above shows the results of the Augmented Dickey-Fuller (ADF) unit root tests at levels. The results indicate that all the variables except Lag GDP are stationary at level. This is shown by the ADF test statistic which is greater than the MacKinnon critical value even at 1% (for MS and INT) hence there is enough evidence to reject to reject H0 at 5%. The researcher is going to perform the ADF test again at first difference to identify if we can obtain stationarity of the variable Lag GDP.

Table 4.7 ADF unit root test at first difference

Variables	ADF Test Statistic	MacKinnon Critical Values			Decision
		1%	5%	10%	
Lag GDP*	-3.029839	-3.724070	-2.986225	-2.632604	Stationary

Source: Own estimation using EViews version 7.

The table above indicate that the variable lag GDP is integrated of order 1 i.e. I (1). We reject H_0 at 5% level.

4.4 Model Significance

Given that our R squared is 0,911458 (see appendix 9), we can conclude that the model is correctly specified. This indicates that approximately 91% of variations in gross domestic product are explained by the independent variables and only 9% are in the error term. High adjusted R-squared of 0.869791 also shows that the model is fit.

4.5 VAR Model

GDP = C(1,1)*GDP(-1) + C(1,2)*GDP(-2) + C(1,3)*GE(-1) + C(1,4)*GE(-2) + C(1,5)*INT(-1) + C(1,6)*INT(-2) + C(1,7)*MS(-1) + C(1,8)*MS(-2) + C(1,9)

4.5.1 VAR Model - Substituted Coefficients:

GDP = 1.05201493548*GDP(-1) - 0.374407977247*GDP(-2) + 1.42007063132e-11*GE(-1) + 1.51930819374e-12*GE(-2) - 0.00232610303704*INT(-1) - 0.00311094184815*INT(-2) + 4.6198851719e-19*MS(-1) + 5.73541610137e-19*MS(-2) + 5.27010678877

Table 4.8 VAR model results

Variables	Coefficient	Std. Error	t-statistic	Prob.
GDP (-1)	1.052015	0.276644	3.802771	0.0003
GDP (-2)	-0.374408	0.206197	-1.815778	0.0738
GE (-1)	1.42E-11	1.97E-11	0.722202	0.4726
GE (-2)	1.52E-12	2.00E-11	0.076121	0.9395
INT (-1)	-0.002326	0.002820	-0.824937	0.4123
INT (-2)	-0.003111	0.003339	-0.931759	0.3548
MS (-1)	4.62E-19	4.84E-19	0.954042	0.3434
MS (-2)	5.74E-19	6.19E-19	0.927154	0.3571
C	5.270107	2.511522	2.098372	0.0396

R-squared 0.911458 Mean dependent var 14.80977 Adjusted R-squared0.869791 S.D. dependent var 2.715894

S.E. of regression 0.980017 Sum squared resid 16.32735
Durbin-Watson stat 1.857690

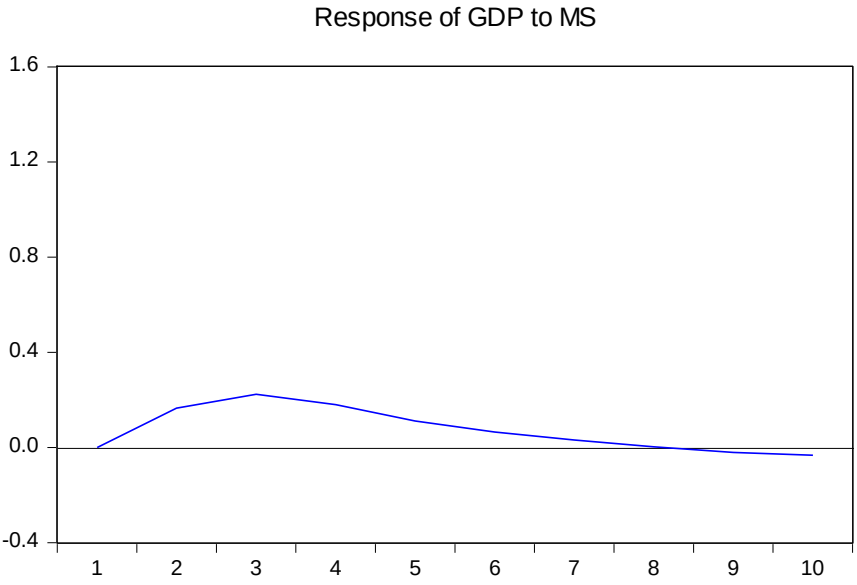
Source: Own estimation using EViews version 7.

The table above shows the coefficients, standard error, t-statistic and p-values of independent variables which were used to explain the variations of GDP in the model.

$$GDP = 5.27 + 4.62E\_19MS(-1) + 5.74E\_19MS(-2) - 0.002326\,INT(-1) - 0.003111INT(-2) + 1.42\text{E}\_11GE(-1) + 1.52E\_12GE(-2)$$

4.6 Impulse Response Functions

FIGURE 2



Key

X-axis = Time period (in years)

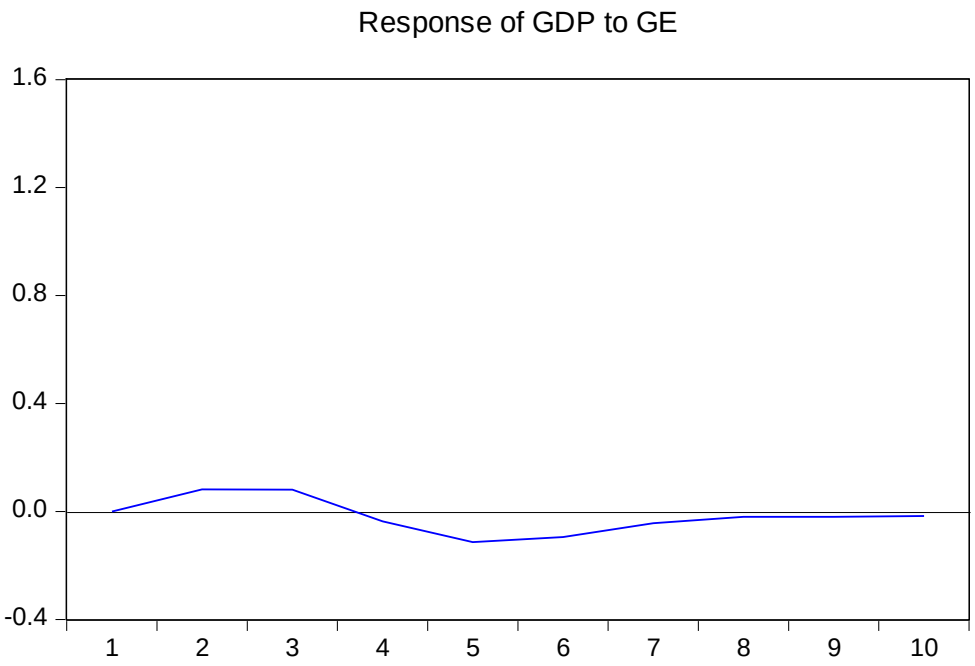
Y-axis = Response of GDP to MS

Source: Own estimation using EViews version 7.

The above graph shows that a one standard deviation shock to money supply initially increases real GDP that is from period 1 to period 3. From 3rd, the response sharply declines until the 8th period when it hits its steady state value. Beyond the 8th period, GDP declines and remains in the negative region. This implies that shocks to money supply will have a positive impact on GDP in

the short run and a negative impact on GDP in the long run. These results are the same with those found by Tawadros (2007), when he examined the hypothesis of long-run money neutrality for Egypt, Morocco and Jordan. He found out that that money only affects nominal not real variables in the long run.

FIGURE 3



Key

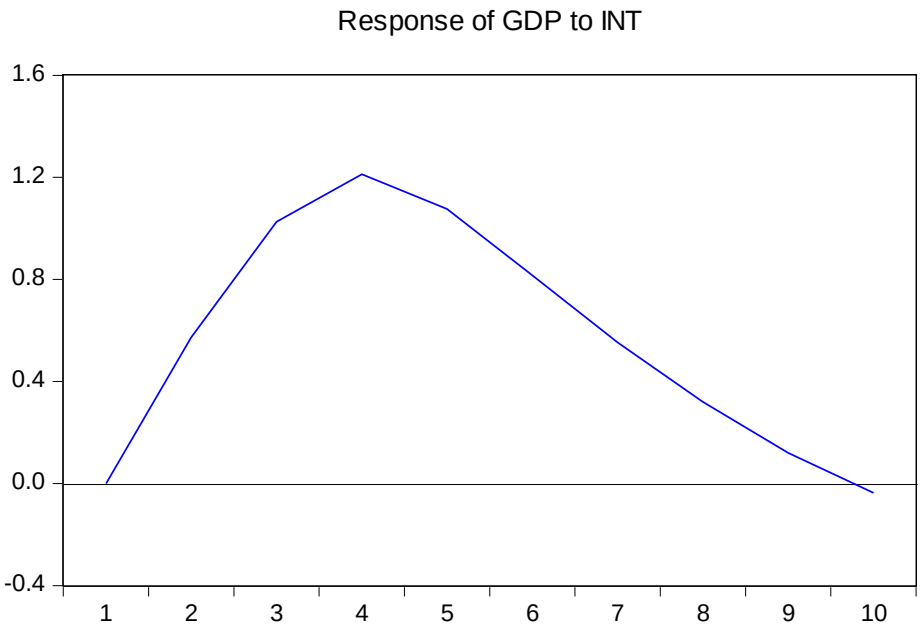
X-axis = Time period (in years)

Y-axis = Response of GDP to GE

Source: Own estimation using EViews version 7.

The above graph illustrates that a one standard deviation shock to government expenditure firstly increases GDP until the 2nd period when it hits a steady state value. Beyond the 3rd period, GDP decreases and enters the negative region. After the 5th period, GDP start to increase until the 8th period when it hits a steady value again, but remains in the negative region. This indicates that shocks to government expenditure will have a negative impact on GDP both in the short and long run.

FIGURE 4



Key

X-axis = Time period (in years)

Y-axis = Response of GDP to INT

Source: Own estimation using EViews version 7.

The above graph shows that a one standard deviation shock to interest rate initially causes a sharp increase in GDP that is from period 1 to period 4. Beyond the 4th point, GDP experiences a sharp decline up to point 10. This implies that shocks to interest rates will have a strong positive impact in the short run and a strong negative impact in the long run.

4.7 Variance Decomposition

Table 4. 9 Variance Decomposition of GDP

Period	S.E.	GDP	GE	INT	MS
1	0.980017	100.0000	0.000000	0.000000	0.000000
2	1.576976	85.46527	0.266182	13.17595	1.092605
3	2.206767	69.81746	0.270536	28.32421	1.587801

4	2.761999	61.04266	0.190379	37.32680	1.440157
5	3.131302	57.63159	0.280095	40.84177	1.246541
6	3.323097	56.22666	0.330856	42.29803	1.144453
7	3.401643	55.56268	0.332286	43.00429	1.100742
8	3.424526	55.27750	0.331259	43.30511	1.086129
9	3.427079	55.21468	0.334216	43.36289	1.088217
10	3.428513	55.22944	0.336491	43.33784	1.096228

Source: Own estimation using EViews version 7.

- Periods 1, 2 and 3 in **table 4.9** represent the short run whist periods 7, 8, 9 and 10 represent the long run.

4.7.1 Gross Domestic Product

Table 4.9 shows that in the short run, that is in periods 1, 2 and 3, impulse or shock to GDP account for 100%, 85.46% and 69.82% respectively, variation of the fluctuation in GDP. This is known as own shock. This means that other variables in the model do not have a strong influence on real GDP in the short run. These variables have strong exogenous impact in the short run. GDP strongly predicts itself in the short run. In the long run, that is in periods 8, 9 and 10, the shock to GDP can cause 55.27%, 55.21% and 55.23% respectively, variation in GDP. Interest rate is the other variable that strongly influences GDP in the long run.

4.7.2 Government expenditure

Table 4.9 shows that in the short run, that is in periods 1, 2 and 3, impulse to government expenditure account for 0%, 0.27% and 0.27% respectively, variation of the fluctuation in GDP. In the long run, that is in periods 8, 9 and 10, the shock to government expenditure contributes 0.33%, 0.33%, and 0.34% respectively, in the variation of GDP. Government expenditure is showing weak influence on GDP both in the short and long run.

4.7.3 Interest Rate

Table 4.9 shows that in the short run, that is in periods 1, 2 and 3, shock to interest rates account for 0%, 13.17% and 28.32% respectively, variation of the fluctuation in GDP. In the long run, that is in periods 8, 9 and 10, the shock to interest rates account for 43.31%, 43.36% and 43.34% respectively, in the fluctuation of GDP. The influence of interest rate on GDP is weak in the short run but however, it becomes strong in the long run.

4.7.4 Money Supply

Table 4.9 shows that in the short run, that is in periods 1, 2 and 3, the shock to money supply account for 0%, 1.09% and 1.59% respectively, variation of the fluctuation in GDP. In the long run, that is in periods 8, 9 and 10, the shock to money supply can cause 1.09%, 1.09% and 1.1% respectively, variation in GDP. Money supply is very insignificant in predicting GDP both in the short and long run.

4.8 Interpretation and discussion of results

4.8.1 GDP

The VAR model shows that GDP is positively affected by itself in the first lag. An increase in GDP by a $1 in the first lag induces GDP to increase by $1.052015. However, an increase in GDP by a $1 in lag 2 reduces GDP by $0.374408. This is supported by the impulse response function which showed that, shocks to GDP will have a weak positive impact on GDP in the short run and strong negative impact on GDP in the long run. Also, according to variance decomposition, GDP strongly predict itself in the short run. This implies that an increase in GDP in 2018, will most likely result in an increase in GDP in 2019. However, this is in contrast with the findings of Mukhtar and Muhammad (2017). They studied the effect of money supply on economic growth in Nigeria and established that lagged value of GDP does not have any significant effect on the economy.

4.8.2 Money supply

According to the VAR model, money supply both in lag 1 and in lag 2 has a positive impact on GDP. We therefore accept our null hypothesis that there is a positive relationship between GDP and money supply at 5% level of significance. The results of a study by S Korkmaz and M Yılgör (2013), indicate that money supply only affects nominal variables not real variables in the chosen 9 European countries. However, Dingela and Khobai (2017) who investigated the impact of broad money supply (M3) on economic growth (GDP) per capita in South Africa found out that there is statistically significant positive relationship between money supply and economic growth both in the short run and long run.

This answers our research objectives of wanting to find out if money supply affects real variables in Zimbabwe and to determine how money supply affects GDP. We found that money supply affects real variables in a positive manner, though mainly in the short run. This is supported by theory in that, an increase in money supply lowers the interest rates in the economy, leading to increases in consumption and lending/borrowing. In the short run, this ought to, associate with an increase in total output as well as spending and, probably, GDP. However, this is in contrast with variance decomposition which indicated that money supply is very insignificant in predicting GDP both in the short and long run. This means that the government can use monetary policy to achieve its macroeconomic objectives.

4.8.3 Interest rate

The VAR model indicates that there is a negative relationship between GDP and interest rates. This is supported by economic theory which states that there is a negative relationship between interest rates and real GDP. This is because an increase in interest rates encourages more people to save and at the same time it discourages people and businesses from borrowing hence consumption is reduced leading to low output being produced thus GDP decreases. Variance decomposition indicated that, interest rate is the other variable that strongly influences GDP in the long run. This implies that the government of Zimbabwe can make use of monetary policy to

influence the real economy. These results are the same with the findings of a study by K Srithilat and G Sun (2017), who found out that interest rate have negative impact on real GDP per capita in the long run.

4.8.4 Government Expenditure

There is a positive relationship between GDP and government expenditure in the estimated VAR model. Generally, economic theory supports the notion that there is a positive relationship between GDP and government expenditure. However, a country's GE might be high as a result of transfer payments such as payment to pensioners and donations. These transfer payments do not influence GDP. The variance decomposition and impulse response functions on GDP showed that, government expenditure has weak influence on GDP both in the short and long run. This implies that, the government of Zimbabwe cannot utilize fiscal policy in order to influence the real economy.

CHAPTER V

RECOMMENDATIONS AND CONCLUSION

5.0 Introduction

The purpose of this chapter is to outline a comprehensive conclusion of the study, highlighting policy recommendations as drawn from the results of the previous chapter. To augment, the chapter will as well suggest other possible areas of future research.

5.1 Summary

The study principally investigated the impact of money supply on real GDP. Data for money supply, real GDP, interest rates and government expenditure from 1990-2017 was used. Inflation is a macroeconomic problem which mainly affects developing countries like Zimbabwe. According to monetarists, inflation is everywhere and always a monetary phenomenon. This is what influenced the researcher to examine whether or not changes in money supply in the Zimbabwean economy affects nominal variables such as inflation or it also affects real variables such as real GDP. VAR model, impulse response functions and variance decomposition were used to establish the long run and short run relationship between real GDP and money supply.

Stationarity tests of the variables included in the model were done using ADF test, and the result disclosed that all variables were stationary at level.

The following conclusions were drawn:

5.2 Conclusions

The empirical results from the study indicate that money supply has a significant positive short run effect on GDP. GDP has a strong positive effect on itself in the short run whilst government expenditure has an insignificant influence on GDP both in the short and long run. Interest rate has a positive effect on GDP in the long run. The study achieved its objectives of establishing the relationship between GDP and money supply as well as other variables.

The findings provide evidence for us to accept the null hypothesis that there is a positive relationship between GDP and money supply. These findings concur with theory as explained by the monetarists which said that money is non-neutral in the short run. As indicated by Friedman, money is non neutral in the short run, for the reason that, economic agents confused by money illusion, will at all times respond to changes in money supply. If the government increases money supply, agents will be unable to distinguish between real and nominal changes, thus they will consider the increase in nominal wages as real wage increases hence labour supply will increase. Nevertheless, this is only temporary because agents will soon realize what is really going on. If higher wages are accompanied by higher prices, then there are no real changes in income meaning that people will reduce their labour supply. In long run, the economy returns back to its natural rate.

However, the causes of money neutrality in the long run in Zimbabwe are different from what was explained by Milton Friedman. This is because given that Zimbabwe has high levels of unemployment, it means that even if wage increases are accompanied by high prices, workers will not reduce their labour supply. Long run money neutrality in Zimbabwe might be as a result of high levels of inflation as well as the hoarding of money by money changers.

As such it is upon policy makers to ensure that the country's production capacity is improved and to make sure that inflation is dealt with. The same conclusions were drawn by Tawadros (2007) when he tested the long run money neutrality for Egypt, Jordan and Morocco.

This study proves that money supply only affects real output in the short run. This means that the government should utilise other instruments in order to influence the real economy in the long run.

5.2 Policy Implications

Given that high levels of real GDP improve the living standards of people and assist the government in achieving other macroeconomic objectives such as low inflation, low unemployment and BOP equilibrium, the government can positively affect GDP through the following:

- In order to increase GDP, the government through the central bank can use expansionary monetary policy that is increasing money supply which consequently lead to a reduction in the rate of interest. This will be more effective if the government come up with laws and regulations which prohibit the practise of illegal money changing since these people are reducing the velocity of circulation resulting in changes in money supply only affecting real output in the short run.
- The government should increase government expenditure on the industrial sectors of the economy in order to stimulate economic growth since monetary policy on its own is unable to successfully improve economic growth.
- Demonetising the bond note as well as the RTGS and adopting a stronger currency such as the Rand. The Rand is good for the Zimbabwean economy as compared to the US Dollar because the latter over prices the Zimbabwean economy thus making its exports expensive and its imports cheaper leading to BOP deficits and shortages of foreign currency. Adopting the Rand will make illegal money changers jobless. Also, an increase in money supply of a stronger currency such as the Rand will have a significance influence on real GDP.
- The government must ensure that, any increase in money supply must be matched by a corresponding increase in output so as to counter the problem of inflation.

- Ensuring transparency in the banking sector such that loans are given to potential investors and individuals on the basis of their ability to pay back not on the basis of nepotism. This means that an expansionary monetary policy will lead to an increase in investment, consumption and hence an increase in real output.

5.3 Future areas of research

For purposes of future research, it would be of paramount importance for the economy of Zimbabwe, to identify the impact of other factors besides money supply on real variables. Some researchers can include other explanatory variables such as inflation and use unemployment or consumption as the dependent variable as this might yield different inferences. Also, one can make use of a different model such as ARIMA as this might lead to different conclusions.

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APPENDICES

Appendix 1: Data Series

Observations and Variables (Data for GDP is in Billions whilst Interest Rate is in percentage)

Obs	GDP	MS	GE	INT
1990	14.468	3803000000	64457000	13
1991	15.269	5858000000	83555000	36.7
1992	13.892	7153000000	110731000	39.3
1993	14.038	1028500000	134084000	31.8
1994	15.335	22171000000	158108000	30.3
1995	15.359	28820000000	218135000	34.7
1996	16.95	36812000000	26024000	33.6
1997	17.404	49652000000	36454471000	34.7
1998	17.907	56628000000	50107268000	49.3
1999	17.76	73519000000	1220102000	68
2000	17.217	1.17559E+11	1623341000	68.5
2001	17.465	2.38301E+11	1199102000	31.3
2002	15.911	6.3097E+11	1136730000	45.8
2003	13.207	3.24027E+13	1026170000	346
2004	12.44	1.04544E+13	1219212000	202.5
2005	11.73	6.48161E+13	875441400	415
2006	11.324	9.82865E+14	320246200	500
2007	10.91	4.10799E+17	169775000	775
2008	8.982	5.68313E+19	90394800	10600
2009	10.062	1381247.2	850279309.8	35.2
2010	12.042	2327608.5	2106949096	22.5
2011	13.751	3318173.5	2895847905	19.3
2012	16.042	3886672.1	3568320027	14.7
2013	16.362	3932325.2	4026636518	9.74
2014	16.751	4403418.8	3911555182	9.5
2015	17.049	4765422.4	3861623081	8.5
2016	17.178	5050882.1	4923194611	7.1
2017	17.986	6787012.6	6568065512	6.4

Appendix 2: Summary Statistics

	GDP	GE	INT	MS
Mean	14.81396	4.61E+09	481.73	2.04E+18
Median	15.347	1.17E+09	34.7	2.55E+10
Maximum	17.986	5.01E+10	10600	5.68E+19
Minimum	8.982	26024000	6.4	1381247
Std. Dev.	2.615688	1.12E+10	1991.387	1.07E+19
Skewness	-0.61686	3.349036	4.937735	5.003282
Kurtosis	2.243483	12.91587	25.60187	26.03433
Jarque-Bera	2.443437	167.0535	709.7645	735.8303
Probability	0.294723	0	0	0
Sum	414.791	1.29E+11	13488.44	5.72E+19
Sum Sq. Dev.	184.7292	3.40E+21	1.07E+08	3.11E+39
Observations	28	28	28	28

Diagnostic tests Appendix 3: Multicollinearity

	GDP	GE	INT	MS
GDP	1	0.376445	-0.48529	-0.43919
GE	0.376445	1	-0.09201	-0.07948
INT	-0.48529	-0.09201	1	0.996236
MS	-0.43919	-0.07948	0.996236	1

Appendix 4: Heteroscedasticity

Heteroskedasticity Test: ARCH

F-statistic	1.922149	Prob. F (1,25)	0.1779
Obs*R-squared	1.927707	Prob. Chi-Square (1)	0.1650

Test Equation:
Dependent Variable: RESID^2
Method: Least Squares
Date: 04/06/19 Time: 12:51
Sample (adjusted): 1991 2017 Included observations: 27 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	2.185031	1.194073	1.829898	0.0792
RESID^2(-1)	0.266958	0.192552	1.386416	0.1779

R-squared	0.071397	Mean dependent va r	2.934954
Adjusted R-squared	0.034252	S.D. dependent var	5.628711
S.E. of regression	5.531472	Akaike info criterion	6.329972
Sum squared resid	764.9297	Schwarz criterion	6.425960
Log likelihood	-83.45463	Hannan-Quinn criter.	6.358515
F-statistic	1.922149	Durbin-Watson stat	1.916000
Prob(F-statistic)	0.177861		

Appendix 5: Autocorrelation

Breusch-Godfrey Serial Correlatio ɲ LM Test:

F-statistic	5.755173	Prob. F (2,22)	0.0098
Obs*R-squared	9.617617	Prob. Chi-Square (2)	0.0082

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/06/19 Time: 12:52
Sample: 1990 2017 Included observations: 28
Presample missing value lagged residuals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.051458	0.384297	0.133901	0.8947
GE	-8.76E-12	2.74E-11	-0.319520	0.7523
INT	0.000424	0.001751	0.241980	0.8110
MS	-9.10E-20	3.25E-19	-0.280262	0.7819
RESID (-1)	0.690809	0.214752	3.216773	0.0040
RESID (-2)	-0.180067	0.218147	-0.825436	0.4180

R-squared	0.343486	Mean dependent va r	2.39E-15		
Adjusted R-squared	0.194279	S.D. dependent var	1.723431		
S.E. of regression	1.546986	Akaike info criterion	3.897903		
Sum squared resid	52.64962	Schwarz criterion	4.183375		
Log likelihood	-48.57064	Hannan-Quinn criter.	3.985175		
F-statistic	2.302069	Durbin-Watson stat	2.054950	Prob(F-statistic)	0.079559

Appendix 6: Autocorrelation Test (When using one period lag of the dependent variable)

Breusch-Godfrey Serial Correlation LM Test:

F-statistic	3.370461	Prob. F (2,21)	0.0538
Obs*R-squared	6.388387	Prob. Chi-Square (2)	0.0410

Test Equation:
Dependent Variable: RESID
Method: Least Squares
Date: 04/06/19 Time: 12:57
Sample: 1991 2017
Included observations: 27
Presample missing value lagged re
siduals set to zero.

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GE	-8.48E-12	1.80E-11	-0.470203	0.6431
INT	0.000792	0.001151	0.688710	0.4985
LAGGDP	-0.003591	0.016548	-0.216981	0.8303
MS	-1.56E-19	2.15E-19	-0.727476	0.4750
RESID (-1)	0.426726	0.217400	1.962856	0.0630
RESID (-2)	0.184949	0.227077	0.814477	0.4245

R-squared 0.236607 Mean dependent va r 0.091923 Adjusted R-squared 0.054847 S.D. dependent var 1.019678
S.E. of regression 0.991321 Akaike info criterion 3.013573
Sum squared resid 20.63706 Schwarz criterion 3.301537

Appendix 7: Unit root tests at levels

Null Hypothesis: GDP has a unit root				
Exogenous: Constant				
Lag Length: 5 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.479999	0.0187
Test critical values:	1% level		-3.769597	
	5% level		-3.004861	
	10% level		-2.642242	

Null Hypothesis: MS has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-5.160218	0.0003
Test critical values:	1% level		-3.699871	
	5% level		-2.976263	
	10% level		-2.627420	

Null Hypothesis: INT has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-4.877467	0.0006
Test critical values:	1% level		-3.699871	
	5% level		-2.976263	
	10% level		-2.627420	

Null Hypothesis: GE has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.201099	0.0310
Test critical values:	1% level		-3.699871	

	5% level		-2.976263	
	10% level		-2.627420	

Null Hypothesis: LAGGDP has a unit root				
Exogenous: Constant				
Lag Length: 1 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-1.797147	0.3732
Test critical values:	1% level		-3.724070	
	5% level		-2.986225	
	10% level		-2.632604	

Appendix 8: Unit root test at first difference

Null Hypothesis: D(LAGGDP) has a unit root				
Exogenous: Constant				
Lag Length: 0 (Automatic - based on SIC, maxlag=6)				
			t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic			-3.029839	0.0457
Test critical values:	1% level		-3.724070	
	5% level		-2.986225	
	10% level		-2.632604	

Appendix 9: VAR Model

GDP = C(1,1)*GDP(-1) + C(1,2)*GDP(-2) + C(1,3)*GE(-1) + C(1,4)*GE(-2) + C(1,5)*INT(-1) + C(1,6)*INT(-2) + C(1,7)*MS(-1) + C(1,8)*MS(-2) + C(1,9)

GE = C(2,1)*GDP(-1) + C(2,2)*GDP(-2) + C(2,3)*GE(-1) + C(2,4)*GE(-2) + C(2,5)*INT(-1) + C(2,6)*INT(-2) + C(2,7)*MS(-1) + C(2,8)*MS(-2) + C(2,9)

INT = C(3,1)*GDP(-1) + C(3,2)*GDP(-2) + C(3,3)*GE(-1) + C(3,4)*GE(-2) + C(3,5)*INT(-1) + C(3,6)*INT(-2) + C(3,7)*MS(-1) + C(3,8)*MS(-2) + C(3,9)

MS = C(4,1)*GDP(-1) + C(4,2)*GDP(-2) + C(4,3)*GE(-1) + C(4,4)*GE(-2) + C(4,5)*INT(-1) + C(4,6)*INT(-2) + C(4,7)*MS(-1) + C(4,8)*MS(-2) + C(4,9)

Vector Autoregression Estimates
Date: 04/04/19 Time: 22:04
Sample (adjusted): 1992 2017
Included observations: 26 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	GDP			
GDP(-1)	1.052015	5.18E+09	728.2155	4.36E+18
	(0.27664)	(3.0E+09)	(438.455)	(2.6E+18)
	[3.80277]	[1.70029]	[1.66087]	[1.70701]
GDP(-2)	-0.374408	-2.37E+09	-433.5707	-2.64E+18
	(0.20620)	(2.3E+09)	(326.802)	(1.9E+18)
	[-1.81578]	[-1.04434]	[-1.32671]	[-1.38352]
GE(-1)	1.42E-11	0.421921	-7.74E-09	-47220942
		GE	INT	MS
	(2.0E-11)	(0.21648)	(3.1E-08)	(1.8E+08)
	[0.72220]	[1.94905]	[-0.24834]	[-0.25991]
GE(-2)	1.52E-12	-0.463651	-1.22E-08	-69720755
	(2.0E-11)	(0.21973)	(3.2E-08)	(1.8E+08)
	[0.07612]	[-2.11005]	[-0.38693]	[-0.37806]
INT(-1)	-0.002326	21248829	10.07308	5.56E+16
	(0.00282)	(3.1E+07)	(4.46901)	(2.6E+16)
	[-0.82494]	[0.68449]	[2.25399]	[2.13429]
INT(-2)	-0.003111	-2737591.	3.214301	1.33E+16
	(0.00334)	(3.7E+07)	(5.29165)	(3.1E+16)
	[-0.93176]	[-0.07448]	[0.60743]	[0.43151]
MS(-1)	4.62E-19	-3.58E-09	-1.86E-15	-10.16851
	(4.8E-19)	(5.3E-09)	(7.7E-16)	(4.47430)
	[0.95404]	[-0.67165]	[-2.41798]	[-2.27265]
MS(-2)	5.74E-19	6.85E-10	-5.72E-16	-2.324573

	(6.2E-19)	(6.8E-09)	(9.8E-16)	(5.71577)
	[0.92715]	[0.10060]	[-0.58366]	[-0.40669]
C	5.270107	-3.97E+10	-5307.951	-3.11E+19
	(2.51152)	(2.8E+10)	(3980.52)	(2.3E+19)
	[2.09837]	[-1.43531]	[-1.33348]	[-1.34183]
R-squared	0.911458	0.409641	0.615342	0.550917
Adj. R-squared	0.869791	0.131825	0.434326	0.339584
Sum sq. resids	16.32735	1.98E+21	41012991	1.39E+39
S.E. equation	0.980017	1.08E+10	1553.232	9.06E+18
F-statistic	21.87486	1.474505	3.399387	2.606864
Log likelihood	-30.84409	-632.0161	-222.4193	-1166.265
Akaike AIC	3.064930	49.30893	17.80149	90.40503
Schwarz SC	3.500425	49.74443	18.23698	90.84053
Mean dependent	14.80977	4.95E+09	516.8746	2.20E+18
S.D. dependent	2.715894	1.16E+10	2065.158	1.11E+19

Determinant resid cova riance (dof adj.)	3.20E+61
Determinant resid covariance	5.85E+60
Log likelihood	-1966.559
Akaike information criterion	154.0430
Schwarz criterion	155.7850

Appendix 10: VAR model substituted Coefficients

GDP = 1.05201493548*GDP(-1) - 0.374407977247*GDP(-2) + 1.42007063132e-11*GE(-1) + 1.51930819374e-12*GE(-2) - 0.00232610303704*INT(-1) - 0.00311094184815*INT(-2) + 4.6198851719e-19*MS(-1) + 5.73541610137e-19*MS(-2) + 5.27010678877

GE = 5178480234.47*GDP(-1) - 2370723690.81*GDP(-2) + 0.421921173437*GE(-1) - 0.463651299023*GE(-2) + 21248828.9228*INT(-1) - 2737590.87339*INT(-2) - 3.58066068599e-09*MS(-1) + 6.85096515894e-10*MS(-2) - 39686216739.8

INT = 728.215523952*GDP(-1) - 433.570675968*GDP(-2) - 7.73937305825e-09*GE(-1) - 1.22400039753e-08*GE(-2) + 10.0730805105*INT(-1) + 3.21430062616*INT(-2) - 1.85575230021e-15*MS(-1) - 5.72240061413e-16*MS(-2) - 5307.9505762

MS = 4.36334908074e+18*GDP(-1) - 2.63590403992e+18*GDP(-2) - 47220942.4049*GE(-1) - 69720754.9123*GE(-2) + 5.56062559163e+16*INT(-1) + 1.33119581357e+16*INT(-2) - 10.168508766*MS(-1) - 2.32457252969*MS(-2) - 3.11383815108e+19

Appendix 11: Regression results of GDP

Estimation Method: Least Squares
Date: 04/06/19 Time: 15:46
Sample: 1992 2017
Included observations: 26

	Coefficient	Std. Error	t-Statistic	Prob.
C(1)	1.052015	0.276644	3.802771	0.0003
C(2)	-0.374408	0.206197	-1.815778	0.0738
C(3)	1.42E-11	1.97E-11	0.722202	0.4726
C(4)	1.52E-12	2.00E-11	0.076121	0.9395
C(5)	-0.002326	0.002820	-0.824937	0.4123
C(6)	-0.003111	0.003339	-0.931759	0.3548
C(7)	4.62E-19	4.84E-19	0.954042	0.3434
C(8)	5.74E-19	6.19E-19	0.927154	0.3571
C(9)	5.270107	2.511522	2.098372	0.0396

Determinant residual cova riance 5.90E+60

Equation: GDP = C(1)*GDP(-1) + C(2)*GDP(-2) + C(3)*GE(-1) + C(4)*GE(-2)
+ C(5)*INT(-1) + C(6)*INT(-2) + C(7)*MS(-1) + C(8)*MS(2) + C(9)
Observations: 26

R-squared	0.911458	Mean dependent var	14.80977
Adjusted R-squared	0.869791	S.D. dependent var	2.715894
S.E. of regression	0.980017	Sum squared resid	16.32735
Durbin-Watson stat	1.857690		

Appendix 12: Variance Decomposition of GDP

Period	S.E.	GDP	GE	INT	MS

1	0.980017	100.0000	0.000000	0.000000	0.000000
2	1.576976	85.46527	0.266182	13.17595	1.092605
3	2.206767	69.81746	0.270536	28.32421	1.587801
4	2.761999	61.04266	0.190379	37.32680	1.440157
5	3.131302	57.63159	0.280095	40.84177	1.246541
6	3.323097	56.22666	0.330856	42.29803	1.144453
7	3.401643	55.56268	0.332286	43.00429	1.100742
8	3.424526	55.27750	0.331259	43.30511	1.086129
9	3.427079	55.21468	0.334216	43.36289	1.088217
10	3.428513	55.22944	0.336491	43.33784	1.096228