University of Zimbabwe

Faculty of Social Studies

Department of Economics

The Impact of Global Commodity Price Shocks on Liquidity in Zimbabwe

By

Mabuka Stanley

(R121269P)

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Abstract

The study investigated the impact of global commodity price shocks on liquidity in Zimbabwe using monthly time series data spanning from 2009M01 to 2017M12. The study employed the first order VAR model based on impulse response functions and forecast error variance decomposition. Further, a two-step regression procedure was employed to determine the shock propagation mechanism. The results obtained confirmed that global commodity price shocks impact on liquidity in Zimbabwe. Within the period under review, commodity price shocks were found to be propagated into the economy through the fiscal performance transmission mechanism.

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LIST OF ACRONYMS

ADF	Augmented Dickey-Fuller
AFREXIM	African Export-Import Bank
CBZ	Commercial Bank of Zimbabwe
CFNF	Commodity Fuel and Non-Fuel
DSGE	Dynamic Stochastic General Equilibrium
ECM	Error Correction Model
FDI	Foreign Direct Investment
GFC	Global Financial Crisis
GVAR	Global Vector Autoregressive
IMF	International Monetary Fund
LCR	Liquidity Coverage Ratio
LRT	Likelihood Ratio Test
LSDV	Least Square Dummy Variable
MCS	Multi-Currency System
MoF	Ministry of Finance
OPEC	Organization of Petroleum Exporting Countries
RBZ	Reserve Bank of Zimbabwe
SVAR	Structural Vector Autoregressive
SWF	Sovereign Wealth Fund
TIMB	Tobacco Industry and Marketing Board
USD	United States Dollar
VAR	Vector Autoregressive

WCA	West and Central Africa
ZIMASSET	Zimbabwe Agenda for Sustainable Socio-Economic Transformation
ZIMSTAT	Zimbabwe National Statistics Agency

CHAPTER ONE

1.0 Introduction

Movements in world commodity prices can produce important financial consequences in commodity dependent economies (Ciang and Chang, 1989). This is because commodities can play a prominent monetary role. For instance Gold, Platinum, Diamond and Tobacco contribute to liquidity in Zimbabwe. Liquidity refers to the ability of financial institutions especially banks to meet its obligations when they fall due. For example banks must meet demand deposits withdrawals at any given time. Thus, in this context liquidity crisis is treated synonymous to cash crisis guided by the operational definition. Measures of liquidity in an economy are normally the monetary aggregates M1 and M2 depending on the level of financial development. Liquidity in Zimbabwe is explained as a function of export revenue, remittances, Foreign Direct Investment (FDI) and external loans. Statistical evidence from the Reserve Bank of Zimbabwe shows that commodities contributed about 80% of foreign exchange earnings in 2016 (About US$2.6 billion) an important source of liquidity in the dollarized economy (RBZ, 2016). However, global shocks in the prices of key commodities have a bearing on the Zimbabwe's foreign exchange earnings and therefore a direct impact on the liquidity position of the economy in the multicurrency regime.

Modern theories that reconcile the link between commodities and liquidity are hinged on transmission mechanisms that runs from plummeting commodity prices then massive withdrawals of commodity funds held as savings with financial institutions, overall financial panic that accelerates the liquidity crunch (Deaton, 1999). What puzzles the most is that despite facing persistent and uncertain terms of trade on primary commodities an anchor for liquidity, nothing has been done in terms of research in Zimbabwe to establish the impact of global commodity price shocks on liquidity. Existing literature the world over has been focusing on the impact of commodity price shocks on economic growth (Deaton, 1999) fiscal and monetary policy ((Bower *et al.*, 2007) , (Ajmera *et al*., 2017)) and financial sector fragility (Kinda *et al*., 2016) and (Ratti *et al*., 2017). However, the researcher holds a view that negative shocks in commodity prices contributes negatively to the current liquidity crisis in Zimbabwe. The working definition of liquidity for the purpose of this study is that it is the ability of financial institutions to meet their obligations when they fall due such as paying depositors on demand without encountering unacceptable losses. Therefore, a narrow definition of liquidity M1 shall be used for the purpose of this study.

Zimbabwe's liquidity position as of the first quarter of 2017 was such that the economy had an approximately 4% liquid cash to total deposits relative to the prudential 15% threshold that guarantees a stable financial system immune from bank runs (Kumah and Matovu, 2017). Further, Zimbabwe faces production and borrowing constraints to iron out liquidity challenges hence unending bank queues to withdraw cash that the nation witnesses by day. Thus, parallel to previous studies this study attempts to unravel the impact of global commodity price shocks on liquidity using Zimbabwe as a case during the multi-currency period. As such monthly data for the period spanning from 2009 to 2017 shall be used. The time chosen for the study period is of interest mainly because the economy is facing liquidity crisis and it is also dollarized such that the foreign exchange earned from commodities is used both as a domestic and foreign settlement instrument. Hence, it is against such a background that commodities play a pivotal monetary role in the Zimbabwean economy as a liquidity anchor.

1.1 Background to the Study

From the inception of the multi-currency system which was United States Dollar (USD) biased in 2009 after the collapse of the domestic currency, Zimbabwe's liquidity function has been subject to the dictates of external forces. It is since then that domestic liquidity has been a function of export revenue from commodities, diaspora remittances, aid and borrowing on the injection side. Whilst, the major source of leakage in liquidity has been the growing import bill (MoF, 2016). Major contributors to Zimbabwe's foreign exchange earnings among commodities have been gold, tobacco and platinum for the past four years (RBZ, 2017). However, the performance of these commodities in the global commodity markets has been worrisome due to random global commodity price shocks. Their prices have been volatile since the Great Financial Crisis (GFC) of 2008, to make matters worse where upward trends occur they do not last. Such downturns in commodity prices have been accompanied by a serious liquidity crisis in Zimbabwe since around 2014 up to the time of the study and beyond. The major sources of liquidity currently are exports, of which around 80% of export revenue (USD2.6 billion) is from five commodities, namely, tobacco, gold, platinum, diamonds and ferrochrome (RBZ, 2016). Thus, any negative shock on the price of these commodities is detrimental to Zimbabwe and may have far reaching consequences on the economy's liquidity position.

1.1.1 The Global Commodity Market and Random Shocks

The global commodity market forms a subset of the global financial market which controls the greater chunk of the world's liquid cash. Its structure mimics that of a perfectly competitive market with an exception of the crude oil producers which often form cartels (OPEC for instance) making the market more inclined to an oligopolistic one. However, like in any market commodity prices are determined through demand and supply mainly through an auction process. Commodity market players are mainly speculators, arbitrageurs and hedgers whose activities may tend to stabilize or destabilize commodity prices in a similar way they do in the foreign exchange market (Kinda *et al*., 2016). This is mainly so because commodities unlike consumer goods tend to have an elastic demand and an inelastic supply because their production cannot be adjusted overnight. Further, commodities are also used as instruments for hedging against risk if hard cash is depreciating in value and if alternative investment instruments are not performing well. Likewise, the US interest rates are a key determinant of the price of precious metals since they are two substitutable investment alternatives (Cody and Mills, 2017). In that vein, the Federal Reserve Bank is expected to revise interest rates in 2018 which may have a bearing on commodity prices (IMF, 2017). So it is from this background that the aforementioned players (which can be central banks, commercial banks and individuals) participate in the market. Therefore, the global commodity market is found to be volatile, characterized by fluctuations in prices of disproportionate amplitude and magnitude that is complicated to predict. Hence commodity prices in statistical parlance tend to follow a random walk due to unpredictable shocks.

The commodity market is the market for many developing countries that are net exporters of primary commodities, Zimbabwe included. The role of China in the global commodity market is also significant, China is found on the end user node as well as the supply side of commodities such as tobacco and copper. It is believed that China consumes about 50% of the world's base metals output per year (Kinda and Mlachila, 2016). Further, about 70% of exports products such as fuel, metals and minerals from Sub-Sahara region are exported to China. Thus, policy changes like the ongoing restructuring exercise and the general growth slowdown in China may present sizeable demand shocks in the global commodities market which further reduces the prices of commodities to the detriment of commodity dependent economies.

There was a reversal in commodity price boom due to the Global Financial Crisis (GFC) of 2008. The effect was heavily felt in countries that depend mostly on the exportation of

primary commodities to mention but a few such as; Zimbabwe (gold, platinum, tobacco among others), Venezuela (crude oil), Zambia (copper), Ethiopia (coffee) and South Africa (gold and platinum). A surge in the prices of several commodities after the GFC quickly reversed in the second quarter of 2011 largely due to global growth slowdown and the issues of sovereign debt in the Euro zone that kept the market tight with depressed commodity prices (IMF, 2017) (see figures 1, 3 and 4). For the purpose of this study, the following commodities were chosen for the case of Zimbabwe; Gold, Platinum, Tobacco and Oil

The four commodities were selected on the basis that they meet the following essential conditions:

1. Zimbabwe is the net exporter of these commodities except oil
2. Within the basket of exported commodities the first three commodities constitutes about 80% of Zimbabwe's export revenue a major source of liquidity
3. Oil constitutes a bigger fraction in the import bill for Zimbabwe (fuel import bill) which is a major liquidity leakage through depletion of nostro balances

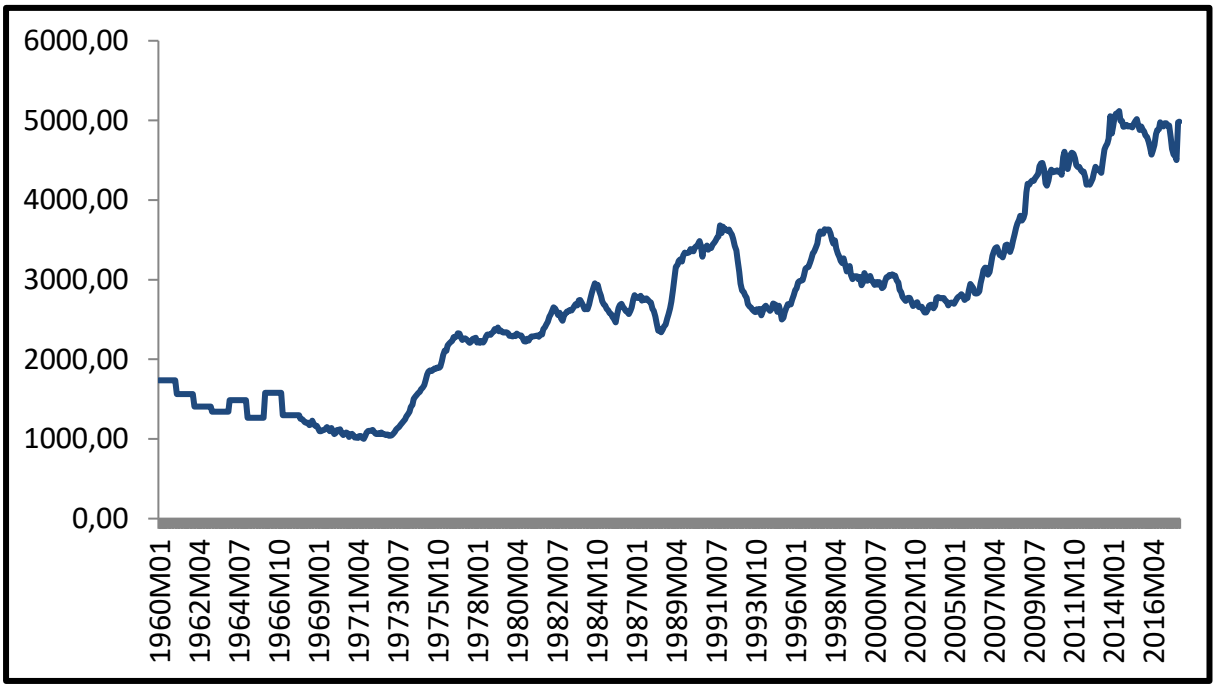
From condition 2, it suffices to say that given the fact that Zimbabwe derives its foreign exchange (a key source of liquidity) mainly from the three commodities, the impact of any shock on the price of these commodities deserves a thorough investigation in terms of magnitude since it is likely to have an unintended adverse effect on the financial sector. Below is a brief explanation of each of the commodities selected and how it affects liquidity in Zimbabwe.

1.1.1.1Tobacco

Better known as the golden leaf, it is the major contributor of foreign exchange among all the commodities in Zimbabwe. Small holder farmers and large scale farmers deliver the crop to the auction floors each year around April. In 2016 the agriculture sector contributed 49% to the GDP buoyed by the tobacco output (RBZ, 2016). In the 2017 tobacco marketing season, a kilogram was selling at an average price of $4.30 up to $4.80 for the highest quality grade. Domestic actors in the tobacco industry include TIMB, Boka and Millennium tobacco among others which then export the commodity to the rest of the world mainly China. It is through the financial inclusion strategy that the tobacco industry contributes directly to liquidity in the banking sector. The Reserve Bank of Zimbabwe gave a directive that tobacco farmers should at least have bank accounts thereby accessing their proceeds through the main

stream banking system. Thus, shocks in tobacco prices will have a direct effect on the liquidity function for Zimbabwe given such a scenario. Below is a graph showing the trend in tobacco prices.

Figure 1: Trend in Tobacco Prices in $US per Metric Tonne



Source: Author's drawing using IMF data set

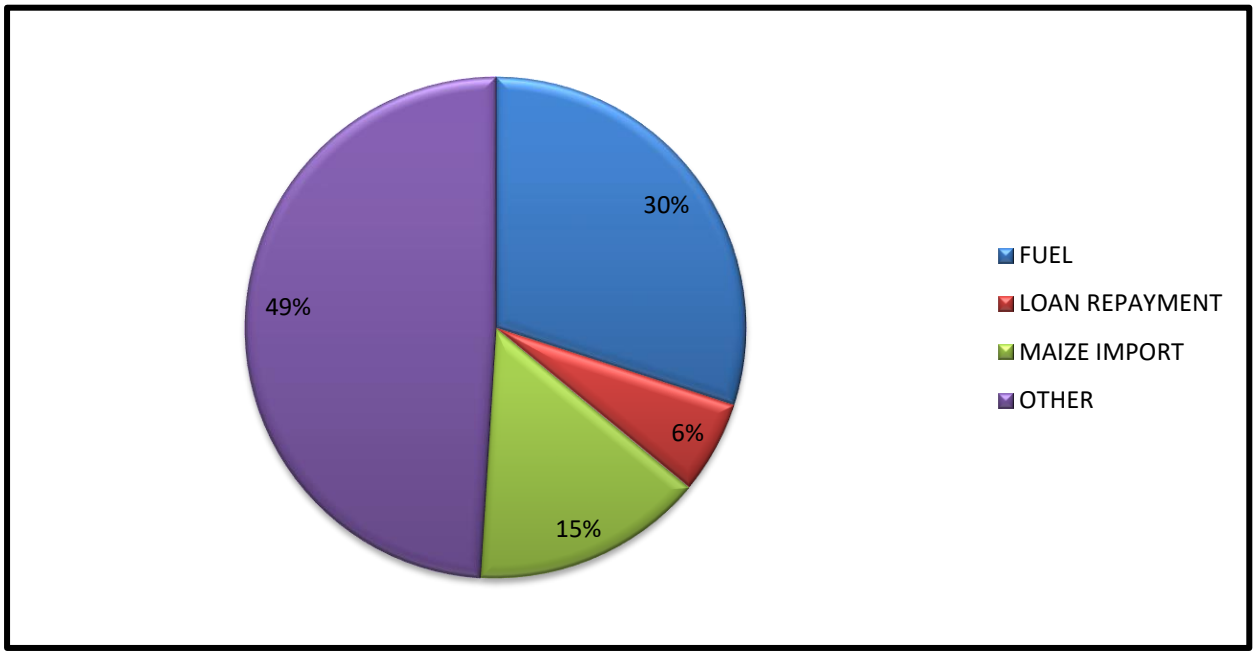
The trend above portrays that negative shocks are more pronounced than their positive counterparts in the golden leaf price as evidenced by high frequency in downward spikes. There is evidence of recovery in tobacco prices from the slump induced by the global financial crisis of 2007/2008 and the price is expected to be firm in 2018 at levels slightly above $4 per kilogram (IMF, 2017) compared to the 1960s prices of below $2 per kilogram. The ongoing trend gives a modicum of hope to agro based economies like Zimbabwe whose key cash crop is tobacco. Hence, shocks in tobacco prices may have far reaching consequences in the economy and thus an investigation on the impact is of paramount importance for Zimbabwe.

1.1.1.2Oil

Zimbabwe is an importer of oil which is used for fuel a critical resource used in production. Statistical data suggest that fuel gobbles the largest chunk of foreign currency in Zimbabwe. It is also in the first category of the RBZ foreign payments priority list. Although crude oil

prices have been low after a fall by more than 50% in 2014 to rest at a price of about $36 per barrel, Zimbabwe did not benefit much from the subdued crude oil prices due to the fact that it imports the final product rather than the crude oil itself. Further, going into 2018 the oil prices are projected to increase further (IMF, 2017). This exerts pressure on the economy's nostro[1] balances due to increased foreign exchange demand which impacts on the liquidity position of the nation. Illustrated below is the proportional representation of foreign exchange utilization on external payments which is a major liquidity leakage.

Figure 2: Proportional Representation of Nostro Balances Utilization

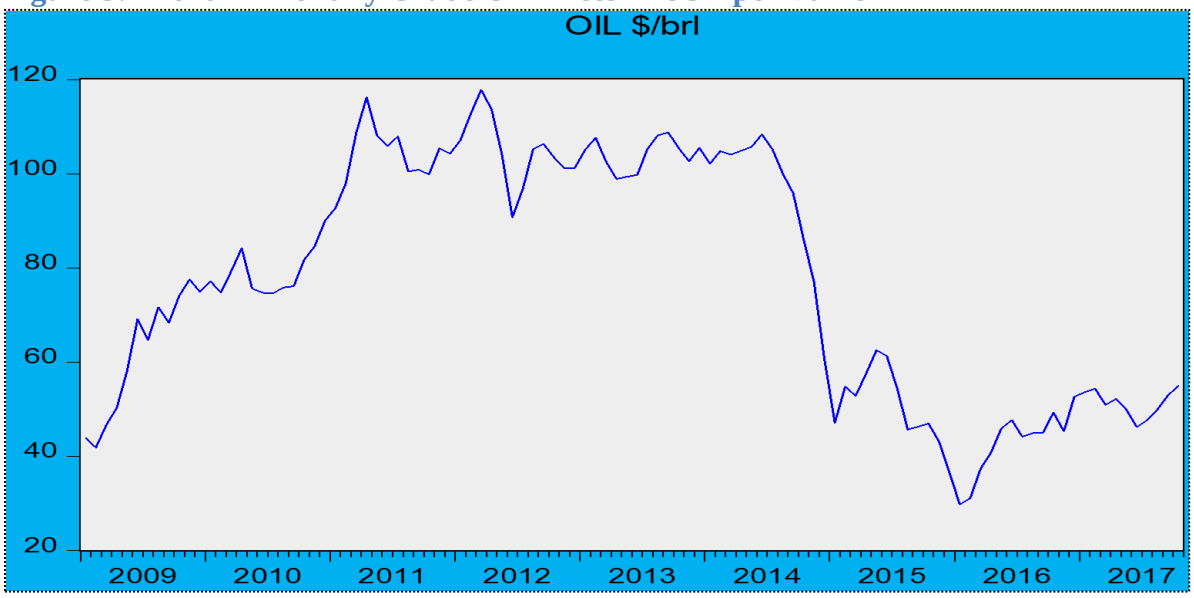


Source: Author's drawing using (RBZ, 2017) *Monetary Policy Statement Figures*

As illustrated in the pie chart, fuel import on its own claims 30% of the available foreign exchange. This makes it the major source of liquidity leakage within the system among single items and hence making oil price a key variable in modeling the impact of commodity price shocks on liquidity since it is a leakage within the system. Therefore, the impact of positive shocks to oil prices should not be down played because of the direct effect they might have on the liquidity position on Zimbabwe. Illustrated below is a trend in monthly oil prices in USDs per barrel.

[1] Nostro balances are units of foreign currency that are available to a nation to facilitate international trade, these balances are held with foreign banks in nostro accounts.

Figure 3: Trend in Monthly Crude Oil Prices in USD per Barrel



Source: Author's drawing using IMF data set

As shown on the graph, a sharp decline in oil prices occurred in 2014 but however the secondary benefits of such a drop were minimal for Zimbabwe because of the reason cited earlier above. It could have saved much in foreign exchange if it was importing crude oil itself rather than the final product. A recovery in the price of this commodity should be closely watched not only for the purpose of safeguarding liquidity but also in the best interest of price stabilization. Increased Oil prices tend to result in inflation upticks in oil importing countries via the pass through effect or in simpler terms imported inflation in the name of cost push inflation (Kavilla and Roux, 2016).

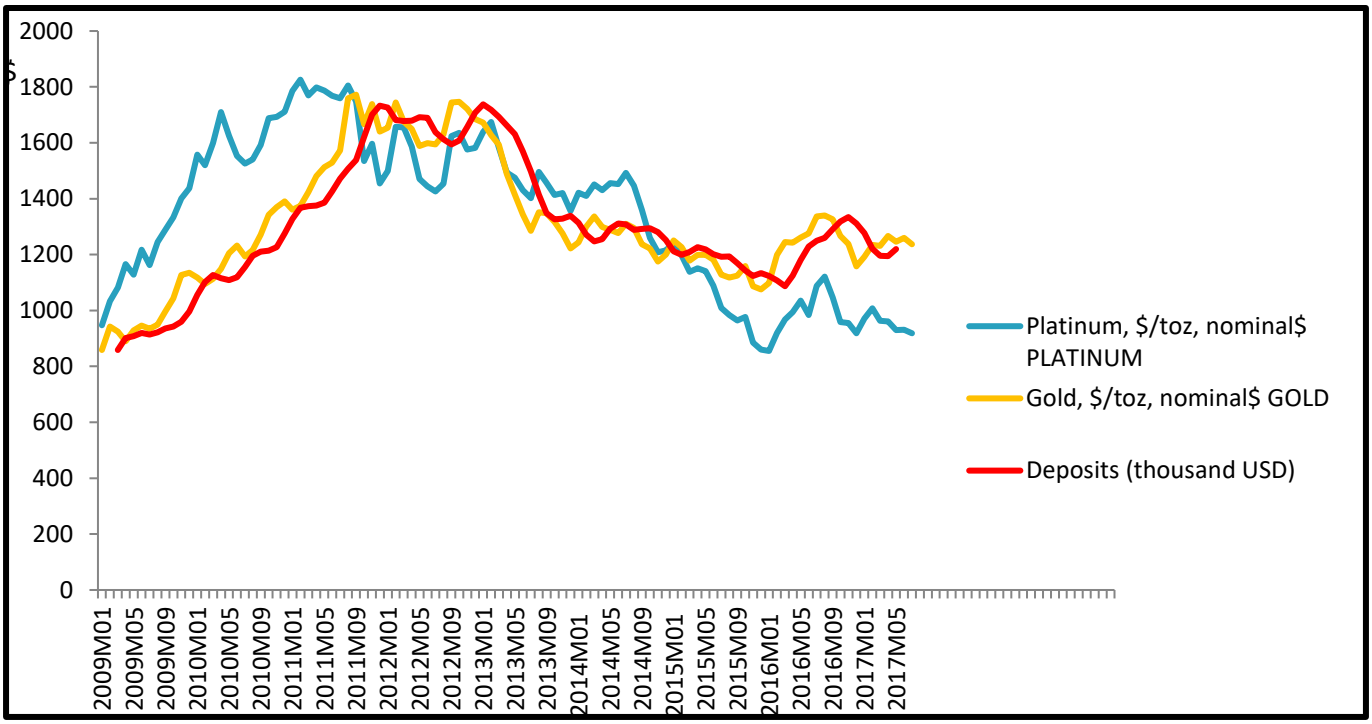
1.1.1.3Precious Metals: Gold and Platinum

Price of precious metals (Gold and Platinum) has been firmer than during the times of GFC, their major source of shocks has been the returns on alternative investment instruments. Thus, changes in returns on alternative investment instruments presents sizeable shocks on the price of these two commodities. The Federal interest rates yet to be revised in 2018 may have a bearing on the global commodity market, investors tend to reorganize their portfolios in response to the new information availed in the market (Chen, 2018). They will shift away from precious metals to other favorable instruments resulting in subdued commodity prices which hurt commodity dependent economies. The underpinning theory to this effect is well known as the Tobin's portfolio reorganization. Revenue contributions from gold has been improving largely due to the Reserve Bank of Zimbabwe's approach of nation-wide buying

centres of gold through its subsidiary Fidelity Printers and Refiners but subject to sizeable price shocks on the external sector that affects Zimbabwe's liquidity position negatively.

Presented below is the graphical presentation of the evidence on how the prices of these commodities have been fairing in the global commodity market and how they interact with the liquidity variable.

Figure 4: Trend in Prices of Precious Metals and Liquidity (M1)



Source: Author's drawing using IMF data set

From the above graphical presentation, it is apparent that there is a co-movement between commodity prices and liquidity with variables taking a sharp rise between 2009 and 2011 reflecting a recovery from the GFC. It is also apparent that negative shocks dominates the positive shocks for the precious metals, a total of 35 negative shocks were recorded within the period under review. The liquidity proxy (M1) tends to be responsive to the changes in commodity prices though approximately by a lag of a quarter. The choice of the proxy for liquidity was guided by the fact that hard cash is the most liquid asset one can imagine of and it is the physical cash that the economy has in deficit currently. The highest peak was realized in the fourth quarter of 2011 followed by a quick reversal. The price reached its all-time low by the turn of 2017 following a downward trajectory since the third quarter of 2016 at a time when the liquidity crisis was worsening in Zimbabwe. Platinum prices are dipping low and

are projected to continue tumbling going into 2018, while gold price is also projected to stay within the USD1200/ troy ounce (toz) threshold in the next two quarters(IMF, 2017). Thus, the outlook of the global commodity market paints a gloomy picture as far as Zimbabwe's liquidity situation is of concern since it depends on these commodities under consideration.

1.1.1.4 Genesis of the Liquidity Crisis

Zimbabwe in February 2009 adopted a Multi-Currency System (MCS) which saw a basket of currencies ushered-in to perform the basic expected functions of money. Even though the commodity prices had tumbled due to a shock prior to the MCS, there were signs of recovery in the majority of commodities around 2009. Zimbabwe has been using the United States Dollar (USD) a vehicle currency, at a time when the source was persistently under threat emanating from fluctuations in commodity prices. With a limited monetary role, Zimbabwe's liquidity position depends more on the behavior of commodity prices because revenues earned are used as domestic currency as well an international settlement instrument. Further, the Reserve Bank of Zimbabwe (RBZ) admitted that the major sources of liquidity were external namely; remittances, exports of commodities, offshore lines of credit, and Foreign Direct Investment (FDI) (RBZ, 2016). A re-examination into the sources will always come to a conclusion that receipts from commodity exports forms the key and fundamental source of liquidity given the following challenges that confronts Zimbabwe:

1. Persistent donor fatigue
2. Constrained external borrowing capacity due to perceived country risk and a junk credit rating status
3. Poor ratings on ease of doing business and weak institutions that militate against efforts to attract FDI.

The end result is that shocks in commodity prices directly translates to massive cash shortages in the economy, foreign exchange shortages that compromise the country's nostro balance position, shrinking in the domestic lines of credit, three-tier pricing system and rent seeking behavior in the parallel foreign exchange market (RBZ, 2016). To guarantee a stable financial system that is not vulnerable to liquidity stress, the hard cash or liquidity to total deposits should be at a minimum threshold of 15% (IMF, 2016). Loosely interpreted, a dollar deposited should be at least matched by a corresponding fifteen cents of hard cash in circulation. However, the mismatch between the two is further compounded by the issuance

of toxic treasury bills by the government to finance budget deficit. This has the effect of creating excess electronic money balances. Thus, if this optimal liquidity to deposit prescription is not satisfied then the situation will culminate into a cash crisis or the liquidity crisis. This is likely to be the situation obtaining in Zimbabwe where bank queues to withdraw money has been the norm of the day even in major commercial banks like Barclays Zimbabwe, Standard Chartered and CBZ among others.

The Reserve Bank of Zimbabwe in 2016 had to intervene in order to iron out the binding liquidity challenges by issuing bond notes. The bond notes were issued as an export incentive backed by a US$ 200 million AFREXIM bank facility. These bond notes ended up being used as a medium of exchange together with other currencies. But nonetheless, bank queues continued to persist and there is a back log on foreign payments on the nostro accounts due to foreign currency shortages. To counteract the challenges, the RBZ recommended a cash lite economy characterized by electronic and mobile money payment systems but *alas,* cash seems to be the king still.

Economic agents revealed their preference for hard cash as witnessed by the queues that they make at banks day and night to withdraw hard cash. The perverse demand for hard cash have some confidence connotations with the financial institutions. Further, the retail sector also revealed their appetite for hard cash by setting a three tier pricing system that is biased towards cash transactions while disadvantaging Point of Sale (POS) and mobile money transactions. In a study on commodity price shocks and financial sector, Ratti (2013) argued that in an ideal economy that is not under liquidity stress, the observed differences in terms of prices across the modes of the national payments system should be negligible or zero. This must be so because it will be costless and frictionless to switch assets or wealth from one mode to the other in a liquid economy. Thus, it is evident that the cash crisis in Zimbabwe is further worsened by the high appetite for hard cash by economic agents (RBZ, 2017).

To stabilize the nostro account, an initial USD 70 million nostro stabilization facility was put in place and lately a USD 200 million nostro stabilization facility was disbursed to deal with a backlog in foreign payments (RBZ, 2017) and a further USD 600 million facility is also on the pipeline. But what is clear from all these efforts is that it is difficulty for the Central bank to stabilize its nostro account in a sustainable manner given an unfortunate scenario of falling commodity revenues due to persistent commodity price shocks.

The Reserve Bank of Zimbabwe has also noted with concern the widening Bond Note-USD premiums that have gone to as high as 140 Bond Notes per every USD 100 in the parallel foreign exchange market. The widening of these premiums is a mere reflection of the scarcity of the US dollar, the few US dollars have competing uses between domestic and foreign payments hence driving up the premiums. Ordinarily, a nation obtains foreign currency from exports and for Zimbabwe commodities contributes significantly to total foreign exchange earnings but against a background of persistent global commodity price shocks.

Therefore, it is apparent that Zimbabwe's liquidity position is subject to the dictates of external forces especially shocks in commodity prices given the *status quo*. Thus, given the current state of the economy characterized by illiquid financial institutions, unending bank queues, foreign exchange shortages, shrinking in lines of credit and where they exist they are often transitory in nature. It is therefore imperative to investigate the impact of global commodity price shocks on liquidity, in an attempt to come up with a lasting solution to the liquidity crisis guided by the interaction between the external and internal factors.

1.2Statement of Research Problem

The performance of commodity prices in the global markets has an important link with liquidity in a dollarized Zimbabwean economy. This is because the foreign exchange generated from commodity exports is also used in settling domestic and foreign payments. The current cash shortages manifested by long bank queues for cash, the devastating foreign exchange shortages and limited domestic lines of credit are a cause for concern at a time when the major source of liquidity is under pressure of fluctuating commodity prices. Further, prices of commodities that contribute to liquidity for Zimbabwe (Gold, Platinum and Tobacco) are projected to further decline in 2018 while oil price is projected to increase from the all-time lows of about US$36 up to US$60 per barrel in 2018 (IMF, 2017). Thus, the turbulence in the global commodity market (persistent shocks rather than transitory shocks[2]) suggest that economies that rely on commodity receipts are yet to experience tough times ahead and Zimbabwe a dollarized economy is not spared. As if that is not enough, the current liquidity crisis is fast graduating into a perpetual vicious circle characterized by widening of Bond note-USD premiums, an increase in mobile money to hard cash exchange premiums of about 30% and a three-tier pricing system that in the extreme fuels inflation. This was evidenced by an inflation spike of about 5% in September 2017 which marked a

[2] Transitory shocks are shocks which tend to normalise or die out quickly; they do not usually last for a quarter.

turning point (from deflation to positive inflation figures) in the inflation dynamics in Zimbabwe. Of further risk is the fact that if the existing cash crisis continues unabated, it will in the limit results in excessive bank runs induced by financial panic and ultimately collapse of the financial system due to the contagion[3] effect and systemic risk (Shin, 2014).

To the best of the researcher's knowledge, there is a literature dearth focusing specifically on the impact of global commodity price shocks on liquidity on Zimbabwe. Much of the existing literature has focused on either the impact of shocks in commodity prices on monetary and fiscal policy [(Ajmera *et al*, 2017); (Tober and Zimmermann, 2009); (Bower *et al*, 2007)], or on economic growth [(Deaton, 1999); (Berument et al., 2017)or on financial sector fragility [(Kinda *et al*., 2016; (Mupunga and Ngundu, 2016); (Ratti *et al*., 2017)]. Hence, this study's interest in investigating on the impact of global commodity price shocks on liquidity in Zimbabwe. Thereby, attempting to fill the literature gap at the same time addressing the current liquidity crisis the country and economic agents are grappling with.

The study uses an approach similar to that of (Kinda *et al*, 2016) and (Mupunga and Ngundu, 2016). The two studies are similar to the current study in the sense that the key interest is on the financial variables. However, this study unlike the two studies disaggregates the impact of commodity price shocks guided by the understanding that shocks that influence tobacco prices do not necessarily influence the price of precious metals. The concept was borrowed from (Pedersen, 2015) who characterized shocks into various categories one of which is the commodity specific shocks. If successful, the disaggregated impacts will help the policy maker in implementing policies pertaining to each commodity separately rather than a blanket policy approach that has been a common place in the literature. Further, the current study differs from the two studies with regards to the choice of the liquidity variable in that the previous studies used a broader monetary aggregate M2 but this study uses a narrow definition M1 in line with the economic problem that the study sought to address. On the theoretical front, there has been mixed facts with regards to how shocks are propagated into liquidity crisis. The savings-withdrawals channel and the Fiscal performance channel are two conflicting explanations surrounding the shock propagation. In Zimbabwe the knowledge on the propagation of these shocks is unavailable because no research has been focusing on the issue. Without the knowledge of the propagation mechanism of shocks it is difficult for the

[3] Contagion effect is a phenomenon in which financial institutions usually banks pass on risk of collapse to one another because of interrelationships that exists in doing business with each other, such that the collapse of one bank may result in domino effects on the entire financial system. Such a scenario is called systemic risk.

Central bank to formulate meaningful policies that addresses the existing liquidity crisis arising from commodity price shocks.

1.3 Objectives of the Study

The broad objective of the study is to investigate the impact of global commodity price shocks on the liquidity crisis in Zimbabwe.

In particular the study seeks to determine the individual magnitude of the impact of shocks on prices of; gold, platinum, tobacco and oil on liquidity. Unlike other studies, this study attempts to disaggregate the impact of shocks because of the suspicion that commodity prices are subject to commodity specific shocks in addition to global demand and supply side shocks.

Further, the study seeks to determine the transmission mechanism through which commodity price shocks are propagated into liquidity crisis. This stems from the lack of understanding of how commodity price shocks culminate into cash crisis in Zimbabwe.

1.4 Research Questions

The major question of concern is:

- What is the impact of global commodity price shocks on liquidity?

Of further interest are the questions of;

1. What is the individual impact of a shock in gold price, platinum price, tobacco price and oil price on liquidity?

2. By what transmission mechanism (s) are commodity price shocks propagated into liquidity crisis in Zimbabwe?

1.5 Research Hypothesis

Within the estimation period the following research hypotheses are maintained;

- Negative shocks on commodity prices pose a negative impact on liquidity.
- Shocks are propagated through the fiscal performance transmission mechanism.

1.6 Significance of the Research

Shocks in commodity prices requires more attention than ever before in Zimbabwe, this is because the contribution of commodities on liquidity has significant influence. With such a

background where commodities play a critical monetary role, it is important to investigate on the impact of the shocks on commodity prices on liquidity situation in Zimbabwe through this research. Even though commodities play an important role to Zimbabwe, the existing studies in the literature had not paid special attention to the impact of commodity price shocks on liquidity specifically on Zimbabwe. Rather the studies focused on the impact of commodity price shocks on monetary policy, fiscal policy, economic growth and financial sector hence leaving a vacuum that the current study seeks to fill. Therefore, the research if successful will be important to the monetary authority in addressing the existing liquidity challenges from a commodities view point. Thus, if the research is not carried out the countrywide long bank queues to withdraw cash will not disappear any time soon causing untold suffering to depositors and all the economic agents both in terms of additional costs to acquire hard cash, inflation costs and time cost.

Further, with the widening of premiums on Bond note to USD exchange transactions as well as the persistent three tier-pricing systems, fears are that in the limit inflation spiral will be inevitable. Given that the impact of these shocks is amplified by the existing linkages between commodity sectors and the entire economy the consequences of these shocks can be deleterious to the wider economy. Hence, there is a need to study on their impact in an attempt to come up with an appropriate remedy to the existing cash crisis that confronts the economy and the possible challenges that comes with the cash crisis.

In addition the analysis of the impact of commodity price shocks specifically on liquidity is quite modern and an imperative for Zimbabwe and other commodity dependent economies. The study if successful will be very useful to commodity dependent economies that often face liquidity challenges specifically on Zimbabwe. Further, given the objective of the study to determine the impact of shocks on commodity prices going forward, such information is key specifically for monetary policy formulation and prioritization of certain commodities guided accordingly by the extent to which shocks on these commodities affect liquidity in Zimbabwe. Hence, the study will contribute immensely to the existing body of knowledge especially by establishing the transmission mechanism through which shocks are transmitted into the economy.

1.7 Outline of the rest of the Study

Chapter two reviews the literature on and related to the impact of global commodity price shocks on liquidity. Chapter three specifies and qualifies the empirical model used in the

study and further outlines the tests and diagnostics that are involved. In Chapter four empirical results are presented and interpreted, while Chapter five summarizes the whole study and policy recommendations derived from empirical results are provided.

CHAPTER TWO

Literature Review

2.0 Introduction

Booms and busts in commodity prices are proven to be important drivers of fluctuations in liquidity in a dollarized economy (Qiu, 2017). Moreover, the slump in precious metals prices during 2011-2015 increased concerns about possible cash shortages in Zimbabwe since the source of cash was subject to random fluctuations due to shocks. For policy makers, it is essential to understand the impact of global commodity price shocks on the macro economy and more specifically on liquidity. This chapter focuses on reviewing both the theoretical and empirical literature surrounding the shocks on commodity prices and liquidity discourse. But due to the fact that the literature precisely focusing on the impact of commodity price shocks on liquidity is scant. Previous work done related to the study is reviewed in this chapter to inform the methodology and to enlighten further on the impact of commodity price shocks on liquidity and various economic issues such as economic growth, monetary policy, fiscal policy and the financial sector.

2.1 The liquidity Concept

There are various definitions to the liquidity concept and these include accounting liquidity, market liquidity and funding liquidity. Liquidity in banking refers to the ability of banks to meet obligations when they fall due for example paying depositors on demand without encountering unacceptable losses. This is normally referred as the accounting definition of liquidity. Market liquidity is defined as the ease with which an asset can be converted into cash timeously and without loss of value while funding liquidity is the easiness with which firms and individuals obtain credit.

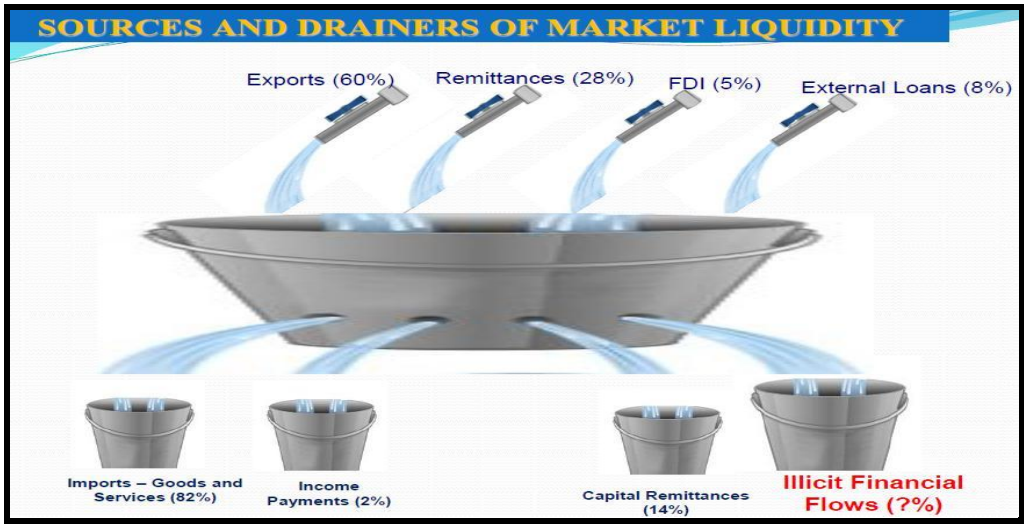
However, for the purpose of this study the accounting liquidity shall be used as the operational definition. This is because this narrower definition resonates well with the issue under investigation. Further, the motivation behind the use of this narrow definition is that it is puzzling to note that the prudential Liquidity Coverage Ratios[4] (LCR) for the majority of banks in Zimbabwe are well above the RBZ prescribed ratio but against a background of a cash crisis. Therefore, the study is focusing on liquidity as physical cash balances embedded in M1 monetary aggregate in an attempt to proffer a lasting solution to the persistent cash

[4] The average LCR for banks was at 62.62% in Zimbabwe against a prudential LCR threshold of 30% that is in line with Basel 2 implementation (RBZ, 2018). This is contrary to the existing cash crisis hence the use of a narrower definition of liquidity (M1).

shortages in the wider economy. Having also realized that commodity price shocks may have an influence on the broader monetary aggregate, the M2 measurement shall also be included as was the case in other studies by (Kinda et al., 2016), (Mupunga and Ngundu, 2016) and (Xinshen *et al.*, 2002) among others.

In the Zimbabwean context, the liquidity concept can also be explained in the form of injections and leakages. This is because as highlighted before, Zimbabwe is using a basket of currencies whose sources are mainly external such as foreign exchange earnings, remittances, FDI among others. For the purpose of illustration, injections represent the major sources of liquidity in the multicurrency regime and leakages represent the ways in which the economy loses its liquidity or cash. The illustration is shown in Figure 5 below

Figure 5: Liquidity Injections and Leakages Illustration



Source: (Chizema, 2016)*; Poverty Reduction Forum Trust (PRFT)*

It is apparent that the major source of liquidity in Zimbabwe are exports with 60% contribution for which commodity receipts are the chief contributor hence there is need to examine any shock that threatens the major source of liquidity for Zimbabwe with regards to its impact. Further, Zimbabwe's appetite for foreign goods is causing incessant current account deficit which presents a huge leakage in liquidity. Further, the illicit financial flows are causing excessive hemorrhaging of cash in Zimbabwe mainly through externalization. However, the concept is much more complex to incorporate in the study because of definition and unavailability of reliable data problem. In principle, where leakages exceeds the inflows the economy is exposed to liquidity stress which is likely to be the existing scenario in

Zimbabwe. The study focuses mainly on shocks that may have a bearing on the injection side in an attempt to proffer a solution to the cash crisis that the economy is currently facing.

2.2 Theoretical Framework

Traditional explanation on commodities back dates to the Prebisch and Singer (1950) thesis, the landmark thesis was based on the finding that a decline in the terms of trade of primary commodities relative to prices of manufactured commodities will frustrate the development efforts of commodity dependent economies. This analysis was based on the deterioration of the net barter terms of trade which sees primary commodities fetching lower value in the global commodity markets. However, though prices of several primary commodities tended to have declined in line with the predictions by Prebisch and Singer (1950) the central question was left unanswered in their analysis. That is; what is the magnitude impact of these commodity price shocks on various economic aggregates that stalls growth and development according to their predictions. Therefore, the current research seek to answer the empirical question learning also from other modern developments within the context of commodities after the landmark Prebisch and Singer (1950) thesis.

The modern theoretical ground underpinning the commodity price shocks and liquidity crisis interplay is based on several transmission mechanisms. For the purpose of this study two transmission mechanisms were reviewed since they are closely related to the developments unfolding in the Zimbabwean economy and so may explain the phenomenon better. The two mechanisms are; Savings and Withdrawals transmission mechanism and the fiscal performance transmission mechanism.

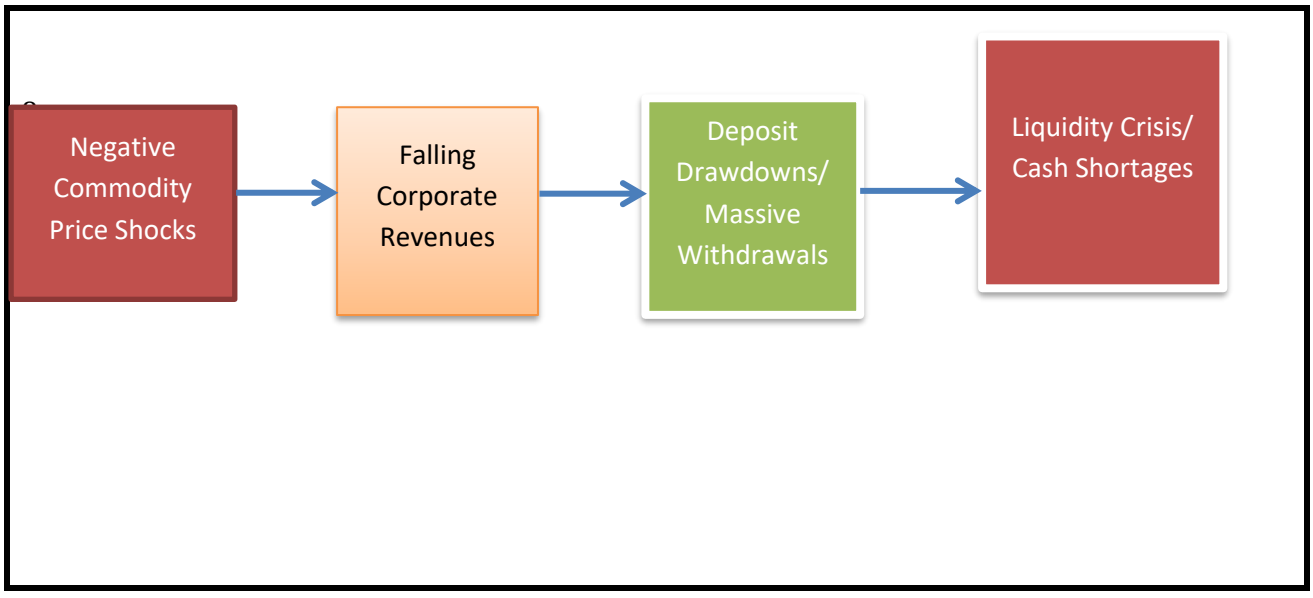
2.2.1 Savings and Withdrawals Transmission Mechanism

Christensen (2016) highlighted that banks tend to accumulate large sums of deposits in the form of resource funds as a result of a windfall emanating from a commodity price boom. This is because commodity exporters are believed to treat commodity price booms as transitory and as such cushion themselves against future uncertainties through savings with banks. However, in the event of an adverse shock in commodity prices, commodity producers tend to make large draw-downs of their deposits or savings to meet debt and production costs obligations. This result in banks failing to withstand those large withdrawals and may prejudice other depositors hence a financial panic and liquidity crisis which destabilizes the

financial system. Bank failures can be as a result of a mismatch between lending[5] and unforeseen massive cash withdrawals by corporates and individuals. In the Zimbabwean context, banks have been receiving transitory deposits against their appetite to extend long term loans to reap high profits (RBZ, 2017).

The transmission mechanism was empirically tested in Kuwait, where savings in the form of cash deposits were observed to rise from 27% to 42.6% of GDP due to a commodity price boom between 1997 and 1998 and a fall in 2014 from 56.6% to 51.9% due to commodity price declines (Kinda *et al*., 2016). The empirical test conforms to the predictions of the savings and withdrawals transmission mechanism. However, (Kinda *et al*., 2016) argued that during times of commodity price booms, individuals and corporates are perceived as credit worth due to the appreciation of the currency. Banks therefore lend excessively to these players who may withdraw cash excessively resulting in cash crisis. A key observation was that the cash crisis is likely to develop through this channel in a country with weak governance, high public debt and lower levels of financial development and these characteristics are typical to Zimbabwe as well. The transmission mechanism is illustrated as follows;

Figure 6: Savings-Withdrawals Transmission Mechanism



Source: Author's Illustration

[5] Banks prefer lending over long horizons as dictated by the term structure concept that loans of long term maturity tends to have higher interest rates and hence high profits to banks.

It is from the above transmission mechanism (shown in Figure 6 above) that the study also sought to empirically examine its applicability to the Zimbabwean economy.

2.2.2 The Fiscal Performance Transmission Mechanism

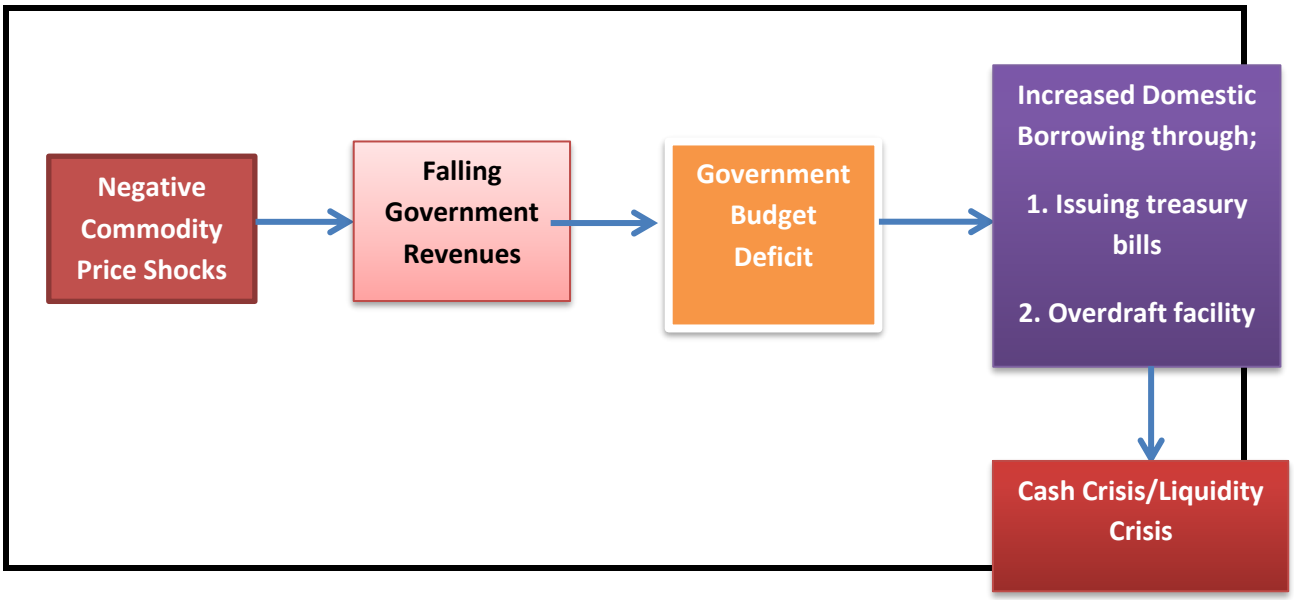
The fiscal performance transmission mechanism is another channel through which shocks in commodity prices affects the wider economy and ultimately liquidity and the entire financial sector. Alesina *et al* (2008), Medina (2010) and Gangelhof (2015) highlighted that fiscal performance in commodity dependent economies is tide to changes in commodity prices. Royalties, taxes and other revenue streams tend to perform better when commodity prices boom. Therefore, in the absence of fiscal buffers such as Sovereign Wealth Fund (SWF) the fiscal position tend to worsen when commodity price shocks ensue. In the Zimbabwean context, incessant budget deficit has been problematic owing to revenue underperformance. Therefore, the government has been financing its high spending appetite on recurrent expenditure by issuing treasury bills and by using the overdraft facility with the Central Bank. Effectively, the government has been borrowing domestically hence destabilizing the financial sector. The issuance of treasury bills has a *sterilization*[6] *effect* just like the issuance of bonds and other government securities has on monetary policy (Bower *et al*, 2007).

The Government budget deficit is reflected by a rise in net credit to government by 70.45% in 2017 (RBZ, 2018). The percentage compares unfavorably to other regional countries borrowing levels which are within the 60% of GDP IMF threshold. Domestic government borrowing has an effect not only of crowding out private players in the debt market but creates excess liquidity (electronic balances) that is not matched by physical money balances and therefore propels the cash crisis (Chizema, 2016).

Some economists argue that the over-reliance of the government on the financial sector in financing budget deficit is fueling the cash crisis that the economy is facing. Yet the root cause is traced back from the shocks in commodity prices that results in falling government revenues against a high spending appetite on non-productive activities, this results in the liquidity crisis that is being experienced in Zimbabwe. The transmission mechanism is illustrated in Figure 7 below.

[6] Sterilization refers to the intervention by the government through the Central bank into the financial market by various measures to achieve a certain monetary policy outcome. Selling of securities has the effect of mopping the available liquidity hence retarding money supply growth (Bower et al, 2007)

Figure 7: The Fiscal Performance Transmission Mechanism



Source: Author's Illustration

From the illustration in Figure 7 above, government budget deficit causes the government to borrow in the domestic financial market through the issuance of treasury bills. This has the effect of creating additional electronic balances that are not matched by corresponding physical cash balances hence the cash crisis. Zimbabwe has been relying on domestic sources of funding due to huge sovereign debt with international financiers such as the World Bank, Paris Club among others which makes borrowing offshore a non-event.

2.3 Empirical Literature Review

There exists a literature dearth, particularly focusing on the impact of global commodity price shocks on liquidity. The majority of the studies were focusing on the impact of global commodity price shocks on; macroeconomic performance, economic growth, fiscal policy, monetary policy and financial sector fragility among others. Hence, this study stands as a wedge that fills the literature gap. In so doing, the researcher shall tap from the related existing literature to inform the appropriate econometric approach necessary to pursue the objectives of the current study. This study is unique in the sense that it focuses on the impact of commodity price shocks on liquidity and is based on a country specific model and has treated commodities in isolation rather than lumping-up into a single index. This allows the researcher to isolate the individual impact of each commodity on Liquidity for policy purposes.

To motivate on the empirical literature review, the impact of oil price shocks on Venezuela's economy is a major case that is worth reviewing because the impact has gone beyond the liquidity (cash) crisis. Venezuela is among the largest oil producers and exporters in the world, around the 1920s it was the world's richest commodity dependent economy. That status reversed owing to shocks in the oil prices which resulted in unprecedented fall in oil prices by more than 50% in 2014 (Kahn and Tananbaum, 2016). In 2015, Venezuela was hit by massive cash shortages coupled with falling foreign exchange reserves, sovereign debt default and current account deficit owing to falling commodity revenues, inflation spiral and massive shortages of consumer goods which triggered civil unrest.

Zimbabwe is also endowed with a number of minerals just like Venezuela is endowed with oil deposits and is experiencing similar challenges to those obtaining in Venezuela such as liquidity *cum* cash crisis and foreign exchange shortages. This is a result of depleted foreign currency reserves that are estimated at three weeks of import cover relative to the IMF threshold of at least three months of import cover. This has resulted in the failure to stabilize the nostro account sustainably leading to worsening foreign payments backlog which has seen companies failing to secure raw materials abroad. If this continues, production cuts in a few industries that are still thriving will exist and most obviously price escalations will be inevitable. It then raises the issue of whether the impact of commodity price shocks is known or not in these economies that have been labeled in the literature as the '*natural resource curse*[7]*'* phenomenon.

Related to the current study's empirical question is a research by (Kinda *et al.*, 2016). Using a sample of 71 commodity exporters among emerging and developing economies, the researchers investigated the impact of global commodity price shocks on financial sector fragility focusing on variables such as liquidity, bank profitability and non-performing loans. They used the fixed effects model and the conditional fixed effects model augmented by a battery of robustness checks such as sensitivity analysis for the period 1997 to 2013. The key finding was that negative shocks to commodity prices tend to weaken the financial sector by increasing non-performing loans, decreasing bank profits and liquidity crisis. Larger shocks were found to have more pronounced impacts on countries with weak governance and with no sovereign wealth funds. Likewise, countries which do not implement macro-prudential policies and do not have a diversified export base were also found to have fragile financial

[7] A phenomenon in which countries endowed with a vast of natural resources are expected to be better in terms of welfare but tends to be extremely poor despite the abundance of their resources.

systems. However, the definition of liquidity used (ratio of M2 to foreign exchange reserves) is too broad to use in the context of cash crisis like the one being experienced in Zimbabwe. Though the results were plausible to the tune that poor countries are severely affected by commodity price shocks, it is crucial to use a much narrower definition of liquidity in modeling the cash crisis phenomenon and further to decompose the impact of shocks on each commodity on targeted macroeconomic aggregates

In a similar study Mupunga and Ngundu (2016) investigated on the impact of commodity price shocks on financial sector stability in seven[8] commodity dependent countries in Southern Africa. Using a multivariate panel regression with fixed effects for the period 2000 to 2015, the researchers concluded that negative commodity price shocks causes financial instability through high non-performing loans and low bank profitability. The researchers also sought to assess the transmission mechanism through which shocks are propagated into the entire economy. They found economic growth, fiscal revenue, savings and the fiscal deficit as the key transmission variables through which shocks are propagated into the financial sector. However, the study could not establish the magnitude by which shocks were impacting on NPLs and profitability. Further, the financial conditioning index used left out a key financial variable liquidity and was biased towards banking sector variables thereby excluding stock market variables such as stock turnover ratio, market capitalization among others. Further, the findings of the study might be misleading in that countries included in the sample have similar shock propagation mechanism which is likely to be untrue. These countries may in actual fact have different economic fundamentals like sovereign debt, foreign reserves and growth rates.

Therefore, it is prudent to examine through this particular study the commodity price shocks transmission mechanisms for Zimbabwe since different countries are likely to have different propagation mechanisms. In so doing, a procedure in (Kinda et al, 2016) and that in Mupunga and Ngundu (2016) was adopted.

Studies focusing on the impact of commodity price shocks on economic growth include that of (Tiawara, 2015), (Deaton, 1999), (Xinshen *et al.*, 2002) among others.

Deaton (1999) used panel data modeling for forty nine African countries combined with Vector Autoregressive (VAR) modeling. Though the coefficients were statistically

[8] The seven countries are Angola, Botswana, Mozambique, Namibia, Tanzania, Zambia and Zimbabwe.

insignificant and the results inconclusive, impulse response functions for the period 1999 to 2014 confirmed that positive shocks in commodity prices are more likely to benefit African countries than hurting them. Since the fixed effects model was used, the researcher made a fundamental error in modeling by overlooking the country specific heterogeneity that is likely to exist. However, the study by Deaton (1999) shall be emulated for the purpose of modeling, especially the standard VAR model because of its compatibility with analysis tools such as impulse response profiling and forecast error variance decomposition necessary for structural shocks identification using the Cholesky decomposition.

Tiawara (2015) closely followed Deaton (1999) in terms of sample and methodology and found inconclusive results with statistically insignificant coefficients when he sought to investigate the impact of commodity price shocks on economic growth of selected African countries. The researcher used a panel data model for 49 African countries with impulse response functions. The model performed poorly perhaps because of the categories within which countries were grouped that are Commodity Fuel and Non Fuel (CFNF), agriculture, beverage, meat, fuel and metal. It was naïve to expect countries within the same category to experience similar impact of commodity price shocks. This is because of different insulation mechanisms and the fact that some countries exported more than one commodity and could well fit in other groups. Thus, with inconclusive results and statistically insignificant coefficients our understanding of the knowledge of the impact of shocks on liquidity is still shallow. Therefore, a country specific model was adopted in the current study using Zimbabwe as a case to enlighten on the issue of the impact of global commodity price shocks while avoiding a panel data model which seem to perform poorly as evidenced by the two studies of (Deaton, 1999) and (Tiawara, 2015) on economic growth.

The following countries; China, Turkey, Zimbabwe, and Malawi were considered in a similar study by (Xinshen *et al.*, 2002) in investigating the effect of declines in the price of tobacco on economic growth of the four countries. In contrast to the modeling approaches of (Deaton, 1999) and (Tiawara, 2015) the Computable General Equilibrium (CGE) modeling technique complemented by simulations was used. Simulation results for Zimbabwe confirmed that a shock in tobacco price will affect the entire economy through its link to production and trade. The same was concluded for Zambia (copper) and Malawi (Coffee). The results were plausible on grounds that countries were treated in isolation avoiding the common pitfall of overgeneralizations when one uses a Least Square Dummy Variable (LSDV) or fixed effects panel data technique that does not account for country specific factors. The findings also gave

an impetus for the inclusion of the tobacco price in the current study since it proved that the commodity has been important to Zimbabwe even before independence and shocks on its price might have an impact on the wider economy.

However, the model only considered the impact of shocks in tobacco prices thereby leaving out other commodities such as gold, platinum and Ferro chrome that are important to Zimbabwe. The researchers failed to acknowledge the need for a country to refrain from depending on a single commodity. A well-diversified commodity export basket is a powerful insulation against shocks, thus the current study fills the gap by considering four commodities that are key to Zimbabwe.

In West and Central Africa, (Bower *et al.,* 2007) concluded that positive shocks in commodity prices if well managed stabilizes the financial sector and ultimately leads to economic growth of Western and Central African (WCA) countries. But since the study used a sample of WCA countries such as Congo, Chad and Cameroon to mention a few, no general policy conclusions can suit individual countries. This is due to the notion of diversity of WCA countries, with some being oil exporters and others importers. Thus, with the lack of convergence in terms of structural fundamentals overall assessments are unsuitable a hindsight to specific countries. Hence, based on that caveat there is a need to investigate the impact of global commodity price shocks at individual country level. Though the above studies are different in terms of focus they are relevant in terms of informing the econometric approach that is appropriate pursuant to the objectives of the current study.

However, the economic fundamentals of the majority of West African countries cannot be matched with that of Zimbabwe. At the time of the study by (Bower *et al., 2007),* the majority of the countries had excess reserves, stable inflation rates and fixed exchange rates. These favorable fundamentals were a strong insulation against commodity price shocks, but this is contrary to what is obtaining in Zimbabwe hence making it more vulnerable to commodity price shocks because of a weaker reserve position.

A similar study to that of Kinda and Mlachila was conducted by (Tober and Zimmermann, 2009), they investigated on the effects of commodity price shocks on monetary policy with special emphasis on the monetary policy goal of inflation targeting. Using the Dynamic Stochastic General Equilibrium (DSGE) modeling augmented by impulse response analysis, the results confirmed that targeting expected headline inflation as practiced by most central banks is a viable practical alternative to the core- inflation target. Their study included four

commodities which are crops, animals, oil and gas. Using an input-output analysis, the results confirmed that oil and gas contributed to inflation via the pass-through effect. These studies give an exposition that the choice of commodities differs across countries and how they are linked to a phenomenon being modeled. Thus, the study will use the commodities spelt out in the previous chapter because of their direct impact on monetary policy in Zimbabwe.

(Ciang and Chang, 1989) investigated on the relationship between commodity price shocks and international finance. The research was mainly focused on the historical experience of China in the 1930s. China then was a small developing country whose monetary policy was commodity dependent. Further, it was at that time that China was using the silver standard but subject to commodity price shocks. Because its currency was tied to the price of silver, the sharp increase in the price of silver in 1934 and 1935 led to the appreciation of its currency hence a fall in net exports and price instability. This is synonymous to the Zimbabwean context, where the appreciation of the United States Dollar (USD) (a major component of Zimbabwe's currency basket) results in chronic balance of payment disequilibria which drains liquidity out of the financial sector to cover the import bill. This is because Zimbabwe has no influence over the exchange rate of the USD against other currencies. However, even though the researchers concluded that external shocks in commodities have far reaching consequences on commodity dependent small economies. There is no clear econometric procedure that justifies such a conclusion. The findings do not quantify the impact of shocks on small commodity dependent economies. Hence, the need to investigate on the impact of commodity price shocks on Zimbabwe specifically focusing on the impact on liquidity using a standard VAR model with impulse response functions and forecast error variance decomposition.

In an attempt to find out the impact of commodity price shocks on Asian economies, (Inoue and Okimoto, 2017) used a Global Vector Autoregressive (GVAR) model as an extension to the work of (Lombardi, 2009) which was focusing on the impact of commodity price shocks on European countries. The study included a sample of 23 countries[9] with special emphasis on Asian countries with the role of China being emphasized in terms of the impact of its trade on Asian countries and the Euro zone. Generalized impulse response functions were

[9] The countries that were included in the study were Korea, Rep. of Malaysia, Mexico, Norway, Peru, Philippines Saudi Arabia, Brazil, Canada, Chile, China, Euro, India, Indonesia Japan, Singapore, South Africa, Sweden Thailand, Turkey, UK and US

constructed for a one time shock on oil and food price and their impact on the overall price level and production for the period 2001M01 to 2015M12. Results indicated that increased integration and dependence on exports intensified the Asian region's vulnerability to global commodity price shocks which are absorbed within the system. It suffices to say that advanced economies tend to have insulation mechanisms against negative commodity price shocks compared to their underdeveloped counterparts that rely on exports.

Asian countries like China are well insulated because of well-diversified economies and a strong foreign exchange reserve positions which act as buffers. The key message from the findings is that a strong foreign exchange position is a necessary insulation against commodity price shocks, but this is not the scenario in Zimbabwe. Zimbabwe is characterized by a weaker reserve position which is estimated at around three weeks of import cover against the prescribed threshold of at least six months of import cover (IMF, 2017). Hence, in the absence of insulation mechanisms in place Zimbabwe remains vulnerable to global commodity price shocks. The reserve position of Zimbabwe compares unfavorably to that of the Asian countries for example China whose reserve position is estimated at above US $3.1 trillion plus other US$ denominated assets.

In a study of the Sectorial Impact of Commodity price shocks in Australia, (Knop and Vespignani, 2014) used a Structural Vector Autoregressive (SVAR) model based on quarterly data from 1993Q3 to 2013Q3, a sample of 81 observations. Commodities were disaggregated into three categories that are rural commodities, base metals and bulk commodities. The results confirmed that commodity price shocks affect the mining sector, manufacturing sector and construction sector in Australia. Financial sector and insurance sector paradoxically were relatively unaffected by shocks in commodity prices in Australia. The results can be explained by the availability of anchors in the financial system that makes commodities play a trivial monetary policy role in developed countries. Further, the ability to value-add primary commodities into valuable items is a powerful insulation against shocks in commodity prices for Australia. This is contrary to the results found in other studies for commodity dependent low income countries for example (Deaton, 1999) and (Tiawara, 2015). These researchers found out that primary commodities still play a key monetary role and contribute to economic growth and Zimbabwe is not an exception. Thus, there exist mixed conclusions on the impact of commodity price shocks in different countries which spark the desire to carry out a study focusing on Zimbabwe.

Another key finding was that a flexible exchange rate was helpful in stabilizing the economy in the face of commodity price shocks. But the circumstances in Australia are contrary to what is obtaining in Zimbabwe. The financial sector in Zimbabwe is vulnerable, characterized by a tied monetary role of the central bank with little power to act upon the exchange rate and a limited lender of last resort function due to dollarization. Therefore, commodities still play a much significant role in Zimbabwe. With little intervention tools at the disposal of the Reserve Bank of Zimbabwe to manage the exchange rate, it is difficult to deal with the current account deficit which is also draining liquidity out of the economy and hence the cash crisis.

Although (Pedersen, 2015) used the same econometric approach as (Knop and Vespignani, 2014) the SVAR. The researcher stressed emphasis on finding out the source of global shocks in copper prices for Chile. Chile was the highest producer of copper in 2015. Its production contribution was one third of the world's copper production. Using quarterly data spanning from 1996Q1 to 2012Q1, the researcher applied the sign restriction test on impulse response functions. The results concurred with the findings in other jurisdictions that economic activity declines as a result of negative commodity price shocks. The researcher acknowledged that in addition to demand and supply shocks there might be shocks that are specific to copper only. This resonates well with the view with regards to commodity specific[10] shocks that this current study upholds and hence the disaggregation of commodity price shocks.

However, it seemed paradoxical from the findings that copper specific demand shocks had no direct impact on Chile but it impacted on Chile's monetary policy via the decline in world economic activity. Such a paradoxical conclusion led to the interest of this study to determine the transmission mechanism through which commodity price shocks are actually transmitted into a liquidity crisis phenomenon within the Zimbabwean economy.

2.4 Conclusion

The literature has generally revealed that commodity price shocks have a bearing on the financial sector and various macroeconomic aggregates through several transmission mechanisms. However, the magnitude of the impact of price shocks on liquidity remains unknown. Notable in the literature is the fact that several studies were encompassing a number of countries in their samples by employing fixed effects panel data regressions, these

[10] A commodity specific shock is one that runs contrary to the dictates of economic fundamentals, for instance a rise in copper price due to speculative attacks when global incomes are actually falling ((Pedersen, 2015). Speculation entails buying (selling) an item today in anticipation of a rise (fall) of that same item in the near future.

present the challenge that if countries are treated in isolation the general conclusions for the entire group may crumble. Further, the literature coverage on the impact of commodity price shocks on liquidity is scant as evidenced by the focus of the majority of studies in existence. This raises the question of whether the impact is known or not especially in countries that are experiencing cash crisis like Zimbabwe and Venezuela.

In those studies that focused on the impact of commodity price shocks on financial sector (Kinda *et al* (2016) and Mupunga and Ngundu (2017), the use of a commodity price index entails that the individual impact of a shock on each commodity is lost. This study will treat the four commodity prices in isolation so as to assess their individual impact specifically on Zimbabwe using impulse response functions and variance decomposition within a VAR. The rationale being that shocks that affect say tobacco prices are not necessarily the ones affecting gold and platinum prices. Further, the majority of the previous studies applied panel data regressions for various countries which make it difficult to apply overall policy recommendations at individual country level. This makes the current study unique by being country specific and therefore a wedge that fills the literature gap by using a country specific model that is more precise and therefore reliable to monetary authorities for policy formulation in the face of cash crisis with falling commodity prices.

Of a truth, the existing literature has enlightened on how commodity price shocks impact on several macroeconomic aggregates but not on the liquidity variable specifically. A few studies that included the liquidity variable preferred a broader context (M2) which is normally used in the case of developed countries due to their high levels of financial development. This is contrary to what is obtaining in developing countries where financial instruments are highly concentrated in the narrower context of liquidity (M1) and Zimbabwe is not an exceptional case. Therefore, this motivates the use of a narrower definition of liquidity and further to that Zimbabwe is experiencing a cash crisis and thus a narrower context of liquidity is more appropriate. In addition, the majority of the previous studies could not establish how commodity price shocks were transmitted into the economies. Even if they had done so in other countries, our understanding of the propagation mechanism of shocks for Zimbabwe could not be any better because the mechanisms to some extent depends on the structural issues of the country under consideration. Hence, this gave an impetus for the current study to consider establishing the transmission mechanism through which commodity price shocks are propagated into cash crisis in Zimbabwe.

CHAPTER THREE

Methodology

3.0 Introduction

The previous chapter has laid the basis upon which the impact of commodity price shocks on liquidity can then be modelled. This chapter explains on the methodological framework that was followed in meeting the core objective of the study, which is to determine the impact of commodity price shocks on liquidity in Zimbabwe. It is therefore in this chapter that the estimable econometric model is specified, pre-estimation tests are outlined, variables included in the model are defined and justified, data choice, sources and period is explained and further the econometric tests and diagnostics *ex-post* to be carried out in chapter four are laid down and justified. Having done so, a two-step regression procedure for shock propagation mechanism determination is outlined. The chapter also covers the procedure for computing the country specific commodity price index that shall be used in determining the shock transmission mechanism.

3.1 Model Specification

3.1.1 Theoretical Model Specification

For the purposes of determining the impact of economic variables on another with shocks involved, the Vector Autoregressive (VAR) framework is the most appropriate because of its ability to explain the shock propagation mechanism within a system through innovation accounting. The VAR[11] modelling is the brain child of (Sims, 1980). It is superior to simultaneous equation models in that it captures system dynamics in macroeconomics data. Each variable is treated as an endogenous variable that makes a VAR model an n-equation and n-variable linear model. It is mainly used to show interrelationships among various time series variables. In the absence of a solid theoretical ground to justify the underlying structural dynamics among variables, the unrestricted VAR is used and where theoretical justification exists the structural VAR will be appropriate. An unrestricted VAR was used in this study and its main advantage is that of having no restrictions imposed on the parameters thereby conserving the degrees of freedom. Further, the VAR model does not require variables to be integrated to the same order as with the case with the Error Correction Model (ECM) thus making it a less stringent modelling technique (Enders, 2015). In addition, it accounts for innovations within a system. Innovation accounting is carried out using two

[11] The VAR model is the brain Child of Sims (1980) which he used in his empirical work on Macroeconomics and Reality.

essential tools that are the Impulse Response Functions (IRF) and the Forecast Error Variance Decomposition (FEVD). However, though the unrestricted VAR model is less stringent in terms of imposing restrictions it may suffer from the problem of over-parameterization which may render impulse response functions unreliable. Further, as an autoregressive system it is bound to suffer from serial correlation emanating from lagged variables. To minimise the problems, an optimal lag length compatible with the model used shall be determined.

The theoretical VAR model in its standard form is specified as follows:

For a set of n time series variables given by; $x_t = (x_{1t}, x_{2t}, ..., x_{nt})'$ ..... (1)

a VAR model can be expressed as $x_t = A_0 + A_1 x_{t-1} + A_2 x_{t-2} + ...+ A_p x_{t-p} + \varepsilon_t$ …(2)

where $A_i's$ are (n × n) coefficient matrices and $\varepsilon_t = (\varepsilon_1, \varepsilon_2, ..., \varepsilon_{nt})$ ..... (3)

(3) is an unobservable zero mean error term expressed in other terms as $\varepsilon_{it} \sim iid(0, \sigma^2)$ and

$\text{cov}(\varepsilon_{it}, \varepsilon_{jt}) = 0$ ..... (4)

where: cov means covariance with i=1,2…n and j=1,2…n

3.1.2 Empirical Model Specification

Closely following (Kinda et al, 2016) and Mupunga and Ngundu (2017) the empirical model used for the purpose of this study expresses the liquidity function as follows:

$L_t = f(PP_t, GP_t, TP_t, OP_t, GDP_t, BD_t)$ ..... (5)

where: **Lt** is the Liquidity variable; PPt is the platinum price; GPt is the gold price; TPt is the tobacco price; OPt is oil price; GDPt is Gross Domestic Product, BDt is the budget deficit and *f* denotes 'a function of'. Commodity prices enter the liquidity function so as to analyse the individual impact of shocks on the price of each of the commodity on liquidity.

The equation used for estimating the Impact of commodity price shocks on liquidity is correctly specified as follows:

$$L_t = \alpha + \beta \,\text{Price\_Shocks}_t + \sum_{i=1}^{k} \gamma_i Z_{t-i} + \varepsilon_t \text{.....(6)}$$

Equation (6) is the fundamental equation in the modelling of the problem at hand. It shall also be used specifically in the two-step regression procedure for determining the transmission mechanism through which commodity price shocks impact on liquidity. The part which contains Zt represents lagged and current control variables. Z is a vector of control variables as justified by theory and the economic dynamics obtaining in Zimbabwe. Random errors as usual are represented by epsilon as in equations (6) and (8) respectively.

$$Z_t = (GDP_t, BD_t, SAV_t, IR) \quad \text{.....(7)}$$

$$\varepsilon_t = (\varepsilon PP_t, \varepsilon GP_t, \varepsilon TP_t, \varepsilon OP_t, GDP_t, \varepsilon BD_t) \quad \text{.....(8)}$$

where in equation (7) SAV and IR represent savings and interest rates respectively. The two variables shall be used as supporting variables in the transmission mechanism and their influence on the liquidity variable shall not be sought through this research. IR represents average monthly commercial lending rates and SAV is measured as national savings to GDP.

ε_t in equation (8)represents shocks or innovations to each of the exogenous variables which shall be quantified through impulse response profiling and forecast error variance decomposition. Having observed that all the variables within the system are in large amounts for example the liquidity variable is in millions and commodity prices in thousands dollars. Therefore, in order to minimize the extreme value problem that is inherent in most time series variables, a logarithmic transformation to all variables was applied. This has the effect of compressing the scale to which variables are measured hence minimising the likelihood of the extreme value problem.

3.2 Innovation Accounting

Innovation accounting was the most important procedure in the modelling process of the problem at hand since the unrestricted VAR results are less useful because of weak theoretical basis. The tools applied were the Impulse Response Functions (IRF) and the Forecast Error Variance Decomposition (FEVD). Application of these tools helped in meeting the core objective of the study.

3.2.1 Impulse Response Functions

Traces out the responsiveness of the dependent variables in the VAR system to shocks or innovations to each of the variables in the system (Enders, 2015). This is the most powerful tool that shall be used to determine the response of the liquidity variable (Lt) to shocks in

commodity prices and other control variables such as GDP and budget deficit (BDt). In other words, IRF approach determines how a variable responds over time to an earlier shock in that variable and to shocks in other variables (Roache, 2012). Thus, the impact of commodity price shocks on liquidity shall be determined using impulse response functions as was the case in studies by (Deaton, 1999), (Kinda et al, 2016), (Berument et al, 2017), (Jones et al, 2017) among others. The determination of the forecast horizon within which the time path shall be traced is based on the researcher's discretion after reasonable considerations that financial variables are quick to respond to new information hence a shorter forecast horizon will be appropriate. The impulse response functions are presented in the form of graphs Values below the zero line are represent negative response and those above represent positive response.

3.2.2 Forecast Error Variance Decomposition

Is another tool that is used in VAR models to show system dynamics, variance decomposition helps to determine the proportion of movement in the dependent variable that is attributed to its "own" shocks and shocks to other variables. FEVD decomposes variations in the endogenous variable (Lt) into component shocks of its own and shocks to other variables within the system. In other words it assesses the proportion of the endogenous variable itself and other variables that is attributed to the forecast error variance of that particular endogenous variable. The FEVD results are presented in the form of a table and the interest of this study is to determine the percentage variation of the liquidity variable that is attributed to changes in commodity prices due to shocks. Hence the need to disaggregate commodity prices rather than using a composite index.

3.3 Tests and Diagnostics

3.3.1 Stationarity Test

It is customary to subject time series data to stationarity tests because they have a tendency to trend together with time. The consequences of non-stationarity in time series are spurious regressions, these are regressions which are meaningless and are irrelevant for economic policy. The widely used test is the Augmented Dickey Fuller test. However, the use of stationary series in VAR modelling has been controversial since the inception of the VAR. Sims (1980) and other VAR proponents argued that data should be used in their levels so as to allow the variables to co-move in their original state. Further, Sims (1980) argued that since VAR models are used to study interrelationships among variables and the interest is not on the coefficients there is no risk of spurious regressions even if the data is non-stationarity.

However, for the purpose of assessing the transmission mechanism through which commodity price shocks impact on liquidity, variables shall be subjected to stationarity test. Further, to enhance the reliability of IRFs and FEVD variables shall be subjected to stationarity test contrary to Sims (1980)'s argument.

3.3.2 Optimal Lag Selection Criteria

The optimal lag is determined either by using the test based approach or alternatively by using the information criterion approach. The Likelihood Ratio Test (LRT) is a common test based approach which is grounded on asymptotic theory while the Akaike Information Criterion (AIC), Hannan Queen Information Criterion (HQIC) and Schwartz-Bayesian Criterion (SBC) are the widely used information criteria because they are amenable with small samples that characterises macroeconomic variables. The optimal lag is the one which corresponds to the minimum value among all the criteria used. However, the AIC is believed to be the most appropriate choice when dealing with monthly time series data (Enders, 2015) and was applied in this study because of the monthly frequency of the data used in this study.

The essence of the optimal lag is to reduce serial correlation to acceptable levels across the equations within a VAR system (Maddala, 1992). Further, the selection of an optimal lag ensures that the impulse response functions and forecast error variance decomposition are consistent Braun and Mittkin (1993). As a word of caution, the more lags involved in a model the more degrees of freedom are lost and the more likely is the risk of over-parameterization and if the lag length is too small relative to the true lag the model becomes under fitted.

3.3.3 The Lagrange Multiplier (LM) Test

To confirm that the above selected lag is optimal, there has to be no residual autocorrelation at that particular lag. In order to test that, the LM test shall be used. The null hypothesis of no residual autocorrelation is rejected when the probability chi square is less than the critical 5% significance level. The consequence of rejecting the null hypothesis is that there is residual correlation at the lag order. With residual autocorrelation the impulse response functions can be spurious and unreliable (Enders, 2015). Failure to reject the null hypothesis results in the model being used based on the selected optimal lag, the existing autocorrelation among variables may not cause any harm to the model and results. The LM test is more preferable to graphical approaches such as the Autocorrelation function (ACF) or the Partial Autocorrelation Function (PACF) in that it is more precise.

3.3.4 Cointegration Test

When variables share a common stochastic trend and therefore integrated to the same order, they might have a long run equilibrium relationship (Enders, 2015). So the pre-condition for Cointegration is the integration to the same order. If there is a reasonable suspicion of a long run relationship based on integration to the same order, the best model is the Vector Error Correction Model (VECM) and if not the VAR model is the most appropriate. To test for Cointegration the DF or the ADF test can be used. However, for the purpose of this study the Johansen test for Cointegration shall be used. The Johansen test is superior to the DF because it is able to distinguish between a unit root and a near unit root. The decision criterion for Johansen test for Cointegration is based on the trace statistic. The null hypothesis of no Cointegration is rejected when the trace statistic is greater than the conventional 5% critical value. Failure to reject the null hypothesis results in the application of the VAR model in answering the empirical questions.

3.4 Transmission Mechanism Determination

The study examines the two transmission mechanisms considered under literature review so as to determine the one which best explains the propagation of commodity price shocks to the liquidity variable within the period under review. As such the variables reviewed as control variables were used as indicator variables in the two-step regression approach. The two Channels reviewed are; fiscal performance transmission mechanism using budget deficit as the transmission variable and the savings-withdrawals transmission with GDP being the transmission variable. These transmission variables shall be regressed against a shock variable which for this purpose is generated jointly based on the country specific composite commodity price index using contribution to exports as weights.

In determining the transmission mechanism, a country weighted commodity price index shall be employed. Because of the need to apply negative shocks the oil variable becomes redundant (a fall in oil price is liquidity conserving) and so a three commodity Price Index (PI) is computed by adopting the Paasche Price Index formula as shown below in equation 9.

$$PI = \frac{P_i Q_{i,0}}{\sum_{i=1}^{3} P_i Q_{i,0}} \times 100 \quad \text{.....(9)}$$

PI is the price index, P*i* represents the price of commodity *i* and Q*i0* is the quantity of commodity *i* exported in the base year. The base year chosen in this study is 2009m02, the

economic justification of the choice of base year is that the period marks a transition into the multicurrency regime hence making it an important period in the study. The essence of fixing the quantities to base period was solely to attribute variations in the liquidity variable to shocks that affect prices only *ceteris paribus.*

The shocks are then generated by regressing the commodity price index (PIt) against its lagged values (PIt-i) and a time trend (t). As argued by Musavey (2014), the procedure makes the shock indices stationary and removes predictability hence making them random price shocks. The shock generating equation is expressed as follows;

$$\ln PI_t = \beta_0 + \beta_1 t + \beta_2 t^2 + \sum_{p}^{k} \varphi_p \ln PI_{t-p} + \varepsilon_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(10)$$

With variables expressed in natural logarithms, the residuals generated are the shocks which shall be normalised to account for the impact of negative shocks on the liquidity variable via the transmission mechanism considered. The normalisation process entails that zero represents positive values while one represents the negative values observed as was the case in Collier and Dehn (2001). The procedure was carried out to analyse the impact of negative shocks which are more deleterious to the liquidity variable than their positive counterparts.

The first step was to check the impact of commodity price shocks on each transmission channel represented by an indicator variable. Having done so, the ensuing procedure will be to check whether the shock generated have an influence on the transmission variable by running a regression using the following equation;

$$\ln Tr_t = \beta_0 + \ln PI_t + \sum_{m}^{M} \gamma_m Z_{m,t-1} + \mu_t \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(11)$$

Where Tr is the transmission variable, lnPI is the commodity price shock (negative shock) variable and Zt represents control variables included in the regression. The control variables are not necessarily important for the purpose of this study but they ensure that a correctly specified model is estimated but paying attention to the variable of interest. Other variables that shall be used include interest rates (average monthly lending rates), savings, debt and GDP as justified earlier on. For this purpose, the debt variables shall be treated as changes rather than in levels to observe the interaction with commodity price shocks. However,

applying logs (as a way to manage interpretations) results in several missing observations since logarithms of negative changes will be treated as missing values in the stata software.

Then finally, we shall check if the transmission variable matters in explaining the liquidity variable. Each transmission channel (represented by an indicator variable) was regressed against the liquidity variable using the following simple equation;

$$\ln L_t = \beta_{i,0} + \rho Tr_{i,t} + \mu_{i,t} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (12)$$

LnL represents the liquidity variable, Tri,t represents a transmission channel represented by the indicator variable *i*. The transmission mechanism with significant coefficient is the one that better explains how negative commodity price shocks are propagated into the economy and onto the liquidity variable. However, this procedure can be skipped since the impulse response functions will have shown the impact of transmission variables on M1 already, thus repeating it will make the process tantamount to duplication. Hence, the decision can be made based on results in equation (11) presented earlier on.

3.5 Definition and Justification of Variables

3.5.1 Liquidity (Lt)

Liquidity in this context refers to a narrow measure of monetary aggregates M1, emphasis is given to physical cash balances available in the financial system to meet domestic and foreign transactions. It is the dependent variable used in modelling the problem at hand and is the indicator variable of the existing cash crisis in Zimbabwe. Other studies preferred the broader monetary aggregate M2 as a proxy for liquidity but however the main focus of this study requires a narrow definition of monetary aggregates with a bias towards physical cash balances contained in M1[12] that is lacking in the economy. This is likely to be more responsive to commodity price shocks compared to M2[13] (a broader monetary aggregate) because M2 contains less liquid items such as time deposits which cannot be converted into cash immediately. Further, the researcher anticipates M1 to be more responsive to shocks for Zimbabwe because broader monetary aggregates are widely used in economies with developed financial markets. The variables are measured in levels as opposed to ratios of

[12] M1 is a narrow definition of money that includes base money that is the notes and coins in circulation, demand deposits among other liquidity assets of immediate to short term maturity.

[13] M2 comprises of M1 plus other instruments of medium to long term maturity such as savings deposits, time deposits (90 day and 128 day deposits), 3 months treasury bills among others.

GDP for the purposes of analysing the impact of shocks on the quantity and to avoid using GDP which in most cases will be inaccurate in many developing countries for which Zimbabwe is not an exception. Monthly data on the Liquidity variables (M1) were obtained from the Reserve Bank of Zimbabwe and the variable was obtained in millions of $US.

Exogenous Variables

3.5.2 Commodity Price Shocks

Is the key variable whose impact on liquidity the study sought to establish, shocks were analysed guided by four commodity prices and their impact on liquidity ascertained. The four commodity prices included are Platinum Price (PP), Gold Price (GP), Tobacco Price (TP) and Oil Price (OT). The first three commodities were included on grounds that they are the key contributors to liquidity in Zimbabwe within the export basket. While the Oil Price variable was included as a variable that captures liquidity leakage since it is a claim on the economy's nostro balances. Further, it is cultural to include the oil variable in modelling the impact of external shocks as a global variable for small economies (Frankel, 2006). The choice of commodity prices to investigate is entirely dependent on how strategic is that particular commodity to the economy and to the problem under investigation and less likely on theoretical basis. The researcher maintains the view that negative shocks on commodity prices impact negatively on liquidity in Zimbabwe except for oil which is an import.

Control Variables were chosen based on literature and the developments in the economy which raises the suspicion that these variables may have a significant impact on liquidity in Zimbabwe.

3.5.3 Gross Domestic Variable (GDPt)

GDP is the market value of all the goods and services produced by residents of a nation within a certain period of time (usually a year) regardless of the ownership of the factors of production. The Volume of Manufacturing Index (VMI) was used as a proxy for GDP to counteract the frequency of measurement problem associated with GDP. The VMI is obtained in monthly basis hence conforming to the frequency of data used in this study. The inclusion of GDP is based on the fact that it is a scale variable that is used to capture the level of economy activity. A productive economy is a requirement for currency and financial stability. Hence, a productive economy is less likely to suffer from cash crisis because its economy will be well diversified rather than depending on commodity exports for liquidity.

Further, high GDP translates to higher average per capita income which can be saved through commercial banks hence contributing to liquidity in the financial market.

3.5.4 Government Budget Deficit (BDt)

Budget deficit occurs when total government expenditures exceed total government revenues. The inclusion of this variable resonates with the fiscal performance transmission mechanism highlighted above. Falling commodity prices due to global shocks translates to falling government revenues which results in budget deficit. In an ideal economy, budget deficits are normally financed by borrowing offshore and less of domestic to avoid the crowding-out effect[14]. The government of Zimbabwe used to monetise the deficits but this is not the case in a dollarized regime. Rather it resorts to issuing treasury bills that has the effect of creating imbalances between liquidity in electronic form and physical cash balances that economic agents prefer, hence the cash crisis that the economy is experiencing. Since budget deficit figures are not available on monthly basis, Government domestic debt as measured by domestic claims on the government shall be used as a proxy since they are available on monthly basis. A claim on government reflects the government borrowing activities in the financial market through the central bank which in many cases will be to finance its spending deficit. The government borrows by issuing treasury bills or through the overdraft facility with the central bank. This has been the norm in Zimbabwe since the government abandoned the cash budgeting system in 2013. The net claims to the government were obtained from the central bank of Zimbabwe in the monthly economic review statistics. The variable is measured in USDs per month. As a matter emphasis, it is the domestic debt and not total debt that the study used as a proxy for budget deficit for reasons cited above.

3.6 Data Choice, Sources, Type and Period

For the purpose of estimation, monthly time series data on commodity prices was obtained from the World Bank and International Monetary Fund's Commodities Division. Data on liquidity proxies preferably M1 was obtained from the Reserve Bank of Zimbabwe (RBZ). The choice of time series data was on grounds that it captures the behavior of economic aggregates over a long time horizon, hence making it easier to analyze dynamics in macroeconomic aggregates. The study period resonates well with the problem at hand; it is a difficulty time in the monetary aspects of the economy in which liquidity is dictated largely

[14] Crowding-out effect occurs when government heavily borrows from the domestic financial market such that interest rates are driven up which deters private players from borrowing. The net result is that private investment declines due to high cost of borrowing.

by external factors due to dollarization against weak economic fundamentals that culminates in the current cash crisis.

3.7 Conclusion

This chapter has outlined the framework within which the impact of global commodity price shocks on liquidity was modelled. The key procedures are that of carrying out innovation accounting (IRFs and FEVD) and determining the shock propagation mechanism in line with the core objectives of the study. The researcher did not employ the structural VAR because of weak theoretical grounds. The theories reviewed do not infer the functional form that variables of interest conform to rather they only explain the causal relationships among the variables. Hence, the coefficients estimated using the VAR model are less informative and more value is only derived from innovation accounting. The choice of variables was premised on the existing theoretical grounds as well as the developments obtaining in the Zimbabwean economy. The results of all the tests, procedures and diagnostics stipulated in this chapter are presented in chapter four.

CHAPTER FOUR

Estimation and Interpretation of Results

4.0 Introduction

This chapter presents the empirical results from the estimations following the procedures laid down in chapter Three. Presented hereunder are the descriptive statistics, results of pre-estimation tests, VAR model results, impulse response functions and variance decomposition. Results of the transmission mechanism determination are also presented in this chapter building the basis upon which policy recommendations presented in Chapter Five are drawn.

4.1 Descriptive Statistics

Table 1: Summary of Descriptive Statistics

	logM1	**logDEBT**	**logGDP**	**logGP**	**logOP**	**logPP**	**logTp**
Mean	15.39969	12.46937	4.074802	7.157671	4.278318	7.161303	8.43815
Median	15.34275	12.60740	3.937689	7.132649	4.330353	7.248147	8.43648
Maximum	18.36685	15.14678	4.969119	7.479943	4.768861	7.509828	8.59265
Minimum	15.17649	9.985367	3.387774	6.755408	3.393837	6.751394	8.25036
Std.Dev.	0.418364	1.604135	0.430446	0.165495	0.365214	0.226596	0.06875
Skewness	6.801578	-0.11677	0.055439	0.059990	-0.38662	-0.24824	-0.1102
Kurtosis	48.53881	1.674305	1.675801	2.875290	1.850731	1.671595	1.97742
Jarque-Bera	9976.495	8.003019	7.798935	0.132268	8.474360	8.882570	4.83304
Probability	0.000000	0.018288	0.020253	0.936005	0.014448	0.011781	0.08923
Sum	1632.367	1321.754	431.9290	758.7131	453.5018	759.0981	894.444
Sum Sq	18.37800	27.1912	19.45480	2.875797	14.00504	5.391288	0.49626
Observations	106	106	106	106	106	106	106

Source: Author's Computation using stata software

The sample size is based on 106 observations as shown in table 1 above. After the logarithmic transformation, all the variables were found to be negatively skewed except for logM1, logGDP and logGP. LogDEBT had the largest observed deviation from the mean while logTP had the minimum deviation from the mean. Based on the kurtosis values which are less than three, all the variables have short tailed distribution functions except for logM1. Such distribution functions are said to exhibit the platykurtic property and the distribution function for the logM1 variable is said to exhibit the mesokurtic property, where tails are fat because the kurtosis value exceeds three.

4.2 Unit Root Test Results

In testing for the presence of a unit root among the time series variables, the ADF test based on generalised trending was used because it is efficient. The decision criteria is that whenever the DF statistic exceeds any one of the critical values corresponding to the conventional levels of 1%, 5% and 10% levels the null hypothesis is rejected. The implication of the rejection of the null hypothesis is that the series are stationary and therefore do not co-move or trend with time. Time series variables can be stationary at levels meaning they are integrated of order zero I(0) or become stationary after differencing d times meaning they are integrated of order d. The results are presented in Table 2 below

Table 2: Results of Stationarity Test based on Generalised Trending

Variable	t-DF Statistic	Critical 1%	Critical 5%	Critical 10%	Conclusion
logM1	**-10.545***	-4.038	-3.449	-3.149	Stationary I(0)
logDEBT	**-4.112***	-4.038	-3.449	-3.149	Stationary I(0)
logGDP	**-4.427***	-4.038	-3.449	-3.149	Stationary I(0)
LogGPD1	**-8.542***	-4.038	-3.449	-3.149	Stationary I(1)
LogOPD1	**-7.694***	-4.038	-3.449	-3.149	Stationary I(1)
logPP	**-3.722****	-4.038	-3.449	-3.149	Stationary I(0)
logTP	**-3.444*****	-4.038	-3.449	-3.149	Stationary I(0)

The asterisks * implies stationarity at 1%, ** implies stationarity at 5% and *** implies stationarity at 10%. D1 means that the variable has been differenced once.

Source: Author's own Computation using stata software

From Table 2 above, what is obtaining is that variables are not integrated to the same order. All other variables are stationary at levels except for logarithm of Gold Price (logGP) and logarithms of Oil Price (logOP) which are integrated of order one. The implication of the unit root test results is that there is no reasonable suspicion of cointegration among variables since all of the variables in the system are not integrated to the same order. The ensuing step then is to carry out the optimal lag selection for a VAR model while skipping the cointegration test and the VECM. The reason is that the pre-condition for cointegration (Integrated to the same order) has not been met and therefore the VAR model is the appropriate model.

4.3 Selection of the Optimal Lag Length

The optimal lag length was determined using the Akaike information Criterion. The optimal lag was found to be one and it is the one that reduces serial correlation among the residuals. The optimal lag of one was also confirmed by other information criteria such as the Final Prediction Error (FPE), Hannan-Quinn Information Criteria (HQIC), Schwartz Bayesian Information criteria (SBIC). The lag-order one is the one which minimizes the values of these other information criterion. Lag order one has corresponding values denoted by asterisk

indicating that indeed it is the optimal lag as confirmed by other several information criterion. The results are presented in Table 3 below

Table 3: Optimal Lag Length Results

Lag	AIC	FPE	HQIC	SBIC
0	3.52142	0.006792	3.67683	3.90512
1	**2.36121***	**0.00213***	**2.60987***	**2.97513***
2	2.39756	0.002213	2.73946	3.2417
3	2.48155	0.002413	2.9167	3.5559
4	2.53604	0.002558	3.06443	3.84061

Source: Author's own Computations using Stata Software

From Table 3 above, the information criterion confirmed that the lag order one is the optimal lag. The AIC had a value of 2.36121 which is the minimum given all the values corresponding to other lags. As shown by the asterisks in table 3 above, all other information criteria confirmed the lag order one. Therefore, the empirical VAR model used in this study is of the first order and innovation accounting is also based on the lag order one throughout the whole process.

4.4 Impulse Response Functions Results

Because the estimated coefficients of an unrestricted VAR model are less informative due to weak theoretical basis, the impulse response function is the powerful tool that the study employed. Of particular interest was the response of the liquidity variable (M1) to a one standard deviation shock in commodity prices and other control variables in line with objectives and questions raised in Chapter Two. The impulse response graphs are shown in Appendix F but their interpretations are given below.

The continuous line on the graph traces out the time path of a shock while the shaded area is the 95% confidence interval. The forecast horizon used in this analysis is ten periods and is drawn on the horizontal axis. A shorter forecast horizon resonates well with the efficient market hypothesis that financial variables responds quickly to new information and as such efficient forecasting should be in the short term. The vertical axis shows the magnitude of the response variable to a shock. When the continuous line reverts to zero, the shock is said to

have died out or normalizes. The time it takes for the shock to normalise determines the persistence of that particular shock. The analysis of the response of the liquidity variable to its own shocks was deliberately omitted since they do not give any meaningful result to the problem that the research intends to solve. The responses of the liquidity variable (M1) to shocks in all other variables in the system are interpreted below in line with the objectives of the study.

The response of Liquidity (M1) to a shock in Gold Price (GP) is negative with a -1.5% impact after adjusting for non-stationarity of the GP variable. This means that a one standard deviation shock in GP results in a decline in M1 by 1.5% hence exacerbating the cash crisis. The shock is persistent for a period of a quarter and normalises abruptly thereafter. The lower limit of the confidence interval deviates more than its upper limit counterparty suggesting that shocks in GP of greater severity than observed are more likely to occur within the first quarter of the forecast horizon based on the lower limit of the confidence interval.

The response of Liquidity (M1) to a shock in Oil Price (OP) is also negative with a magnitude of the impact of approximately -0.05% after adjusting for non-stationarity of the OP variable. This means that a one standard deviation shock in oil price results in a decline in M1 by approximately 0.05%. The shock persists for less than a quarter before it normalises. This suggests that shocks in oil prices are likely to be transitory rather than permanent as they quickly die out. What is worth noting is that shocks in oil price do not have any positive influence on liquidity since Zimbabwe is an importer of fuel which is a liquidity leakage via the nostro account. Thus, shocks in oil price worsen the liquidity situation in Zimbabwe.

Surprisingly, a shock in Platinum Price (PP) was found to have a positive impact on the liquidity variable (M1) over the forecast horizon considered. A one standard deviation shock in PP increases liquidity by approximately 0.01%. The shock sheds off slowly and reverts to zero in the fifth period. The response of the liquidity variable to such a shock is quite minimal based on the magnitude even though it yields positive influence on liquidity. The results might be as a result of the nature of platinum as a mineral. Platinum contains several mineral components in it for example rare metals like iridium, osmium, rhodium, and palladium that are of value. This makes platinum a diversified commodity by nature hence price shocks may not have a negative impact on its price hence contributing positively to liquidity.

The response of the liquidity variable (M1) to a shock in Tobacco Price (TP) is positive. The impact is approximately 2%, thus a one standard deviation shock in TP results in a

corresponding 2% increase in liquidity. The justification for this result is linked to the transfer of risk from farmers to buyers in that farmers sell their tobacco through an auction system locally and may not be affected by global shocks. The payment of farmers via banks increases liquidity in the financial system with minimum exposure to global shocks. The shock in TP is highly persistent and does not shed off within the forecast horizon of ten periods. This is beneficial to Zimbabwe in solving the cash crisis. Encouraging in this result is that the liquidity variable is highly responsive up to the magnitude of 2% while the shock does not shed off quickly.

The response of M1 to a shock in the budget deficit a fiscal variable (debt) is negative and the magnitude is approximately -0.05%. This implies that a one standard deviation shock in budget deficit proxed by debt will reduce the available liquidity (M1) by approximately 0.05%. The shock is persistent for two successive quarters and normalises in the seventh period. The implication is that though the severity of the impact on M1 may appear trivial (-0.05%), the persistence of the shock is on its own problematic because it worsens the cash crisis due to the lasting impact. The persistence of the shock can be as a result of the fact that governments find it difficult to adjust their expenditures suddenly and further the carry-over effect of debt. The results are in line with the predictions of the fiscal performance transmission mechanism, that budget deficit worsens cash crisis because government will have to borrow from the domestic financial market by issuing treasury bills thereby creating excess electronic balances that are not matched by corresponding counterparty physical cash balances.

Within the forecast horizon, M1 responds negatively to a shock in GDP with a magnitude of approximately -0.1%. This implies that a one standard deviation shock in GDP translates to an approximately -0.1% decrease in liquidity (M1). The shock does not revert to zero and so persists in the negative territory within the forecast horizon, this suggests that such a shock is likely to have a long lasting impact to liquidity for a long period of time. The economic logic for such a phenomenon is that output shocks are difficult to manage as production capacity cannot be adjusted overnight and so may have far reaching consequences in the financial market. This is likely to be the case assuming that as GDP declines, commodity funds held as savings prior to a shock will be massively withdrawn from the financial institutions which may trigger financial panic and cash crisis.

Table 4: Summary of the Impact of Shocks on Liquidity based on IRFs

Shock in:	Negative Impact	Positive Impact	Persistence
logGP	-1.5%		Not persistent
logOP	-0.05%		Not persistent
logPP		0.01%	Persistent
logTP		2%	Highly persistent
logdebt	-0.05%		Persistent
logGDP	-0.1%		Highly persistent

Source: Author's Own Computations using stata software

Shocks on gold price and oil price have negative impact on liquidity while shocks on platinum and tobacco prices tend to have positive impact on liquidity. The impact of shocks on debt and GDP on liquidity were found to be negative. Generally shocks to the variables ranges from persistent to highly persistent and this prolongs the cash crisis in the economy whenever these shocks occur. Shocks in Gold Price present a negative impact of a greater magnitude among all the commodities while GDP shock presence the second largest impact on liquidity.

4.5 Forecast Error Variance Decomposition (FEVD) Results

The variance decomposition considered in this study is that of liquidity (M1) which is the variable of interest. FEVD shows the movement in the variable of interest attributed to shocks in other variables and its own shocks. The values are multiplied by 100% to get a percentage value. What is shown in Table 5 below is that though all the variations in the liquidity variable are attributed to its own variations in period 1, the percentage declines at each successive period as the liquidity variable becomes responsive to other variables. The percentage attributed to changes to each variable is somehow consistent with the IRF simulation results, for example shocks in tobacco price yielded the highest impact on M1 and also in this case its changes explains the greatest variations in the error variance of M1 within the forecast horizon.

In period 10, the Liquidity variable (logM1) explains approximately 91.6% of its forecast error variance while Tobacco Price (logTP) explains approximately 5.99% of the forecast error variance of the liquidity variable (logM1).

Gold Price (logGPD1) contributed approximately 1% to the forecast error variance of M1 for seven successive periods before its contribution retarded. The forecast horizon is quite short considering that the frequency of the data is monthly, hence the contribution of other variables to the forecast error variance of the liquidity may become significant over a much longer forecast horizon.

Table 5: Variance Decomposition of Liquidity (logM1)

Period	logM1	logdebt	logGDP	logTP	logGPD1	logOPD1	logPP
1	1.00000	0.00000	0.00000	0.0000	0.00000	0.00000	0.00000
2	.975432	.002875	.001071	.006515	.009976	.00412	.000012
3	.966439	.004474	.001309	.013505	.010116	.004104	.000053
4	.958788	.004929	.001456	.020389	.010076	.004279	.000083
5	.951513	.004953	.001637	.027203	.010074	.004523	.000098
6	.944407	.004918	.001867	.033947	.010049	.004709	.000104
7	.937361	.004954	.002134	.040604	.010002	.004838	.000107
8	.930349	.005088	.002421	.04716	.009944	.004928	.000109
9	.92338	.005309	.00272	.053606	.00988	.004995	.00011
10	.916472	.005596	.003021	.059939	.009814	.005047	.000111

Source: Author's Own Computations using stata software

4.6 Transmission Mechanism Results

The two models below in table 6 are based on two transmission variables, these variables are the fiscal performance variable-debt and the Savings-Withdrawals transmission variable-Savings. These transmission variables make up model 1 and model 2 respectively.

The results from the regression procedure (Shown in Table 6 below) shows that commodity price shocks are propagated into the liquidity crisis via the fiscal performance transmission mechanism. The fiscal variable change in the stock of domestic debt (a proxy for budget deficit) is influenced by the negative shocks generated. The coefficient was found to be statistically significant at 10% and bears a negative sign that conforms to the theoretical predictions. However, the savings-withdrawals transmission mechanism was found to be weak and the coefficient is statistically significant.

Table 6: Transmission Mechanism Determination Results

	Model 1	**Model 2**
	lnGdebt	**lnSav**
c	2.653587***	14.29444***
	(.5174719)	(.7029832)
Shocks	-.4591735*	-.0184012
	(.2587263)	(.1261637)
lnGGDP	-.1726098	.0893051
	(.2194134)	(.1044448)
lnIR		-.2621757
		(.4773135)

*** and * Represents significant at 1% and 10% level respectively. Numbers in parenthesis represent standard errors.

Source: Author's Own Computation using stata software

4.6 Conclusion

The overall conclusion from the results is that commodity price shocks impact on the liquidity variable. Shocks in gold price and oil price were found to influence liquidity negatively. While contrary to the stated hypotheses, shocks in tobacco price and platinum price were found to have a positive influence on liquidity. Further, shocks in GDP and debt

were also found to have a negative influence on the liquidity variable and this was in line with theoretical predictions.

CHAPTER FIVE

Conclusion and Economic Policy Recommendation

5.0 Introduction

The chapter summarises the key findings of the study within the period considered and concludes the study. Economic policy recommendations shall be drawn entirely from the findings laid out in the previous chapter. In addition, areas of further research within the discipline are highlighted to stimulate interest to would be researchers who may want to add value to the existing body of knowledge on commodity price shocks and liquidity.

5.1 Summary of Key Findings and Conclusions of the Study

The interest to pursue this study was derived from the on-going cash crisis that the Zimbabwean economy is facing, this coincided with the turbulence in the global commodity market which results in shocks that hit commodities that Zimbabwe relies on for liquidity in the economy. The lack of explanations about the phenomenon in the literature particularly in the Zimbabwean context left the researcher with no option but to go down the trenches in search for a lasting solution to the problem of cash in the face of persistent commodity price shocks under a scenario of dollarization.

The study employed the VAR model of order one (a single lag VAR) based on impulse response functions and forecast error variance decomposition on monthly time series data spanning from 2009m01 to 2017m12. Having subjected the model to all necessary diagnostic tests to ensure reliability and credibility of the results, the study managed to meet the objectives set in chapter one and to answer the basic questions. The key finding is that commodity price shocks impact on the liquidity variable through the fiscal performance transmission mechanism.

Results suggest that shocks in gold price (GP) and oil price (OP) tend to have negative impact on liquidity (cash crisis). Among the two commodities, shocks in GP were found to have a much bigger impact on the liquidity variable (M1). This is because gold has been contributing significantly to liquidity in Zimbabwe and as such any disturbance to its price is

likely to have a direct influence on liquidity. Further explanation is derived from the fact that gold is a precious metal which is used both as a store of value or as an investment alternative, such that its price is determined by the performance of other investment alternatives and thus its greater impact on liquidity. The negative impact of shocks on oil price is in line with the earlier explanation of worsening of the current account and the destabilisation of the nostro account. When oil price goes up as projected for 2018 and beyond, Zimbabwe will have to use more foreign exchange which is claimed on its nostro balances. In so doing the import bill rises and the current account worsens resulting in haemorrhaging of the liquid cash available in the economy that ultimately result in cash crisis.

What was puzzling from the results was that shocks in tobacco price (TP) and platinum price (PP) were found to have positive impact on liquidity within the period considered. What the results suggests for these commodities might be a case where positive shocks were outweighing the negative shocks such that net gains tend to accrue with positive shocks. What is encouraging is the magnitude of the impact of a shock in tobacco price and the persistence of thereof. The result might have been influenced by the existence of a functional local market for tobacco that is based on an auction system such that negative shocks in the global market may have minute impact on liquidity since the risk would have been shifted to private buyers who then export. A shock in Platinum Price (PP) contributes positively but by a very small magnitude, positive shocks might have arisen from the inherent mineral content of the commodity. Platinum have several by products that are extracted from it and so its price tend to be resilient to shocks because of the value derived from its by-products

In addition, shocks on the fiscal performance variable (domestic debt) were found to have a negative impact on liquidity. The explanation is premised on the fiscal performance transmission mechanism whereby in the face of budget deficits the government will over borrow in the domestic market thereby creating liquidity crisis in the economy. The finding resonates with what is obtaining in Zimbabwe, where the government has been running budget deficits since 2013 to the time of the study.

Shocks in output were also found to have a negative impact on liquidity, this is so because the stability of the financial sector is also linked to the productive capacity of the economy. Output shocks are often accompanied by massive withdrawals of savings which destabilizes the financial sector.

5.2 Economic Policy Recommendations

Guided by empirical results obtained in Chapter Four, it has been confirmed that shocks in gold price and oil price present negative impact on liquidity. The government should expedite on the value addition of gold in line with the ZIMASSET. This has the effect of insulating the commodity price against adverse global shocks hence fetching higher price in the global market compared to the value obtained when selling primary commodities. This results in increased supply of export revenue a key source of liquidity. The process of value addition counteracts the effects of the circular decline of the terms of trade of primary commodities that hurts exporters of primary commodities as postulated by Prebisch and Singer (1950).

To curb against a high import bill as a result of increased oil prices, the government should engage in forward contracts with major producers. This allows the government to sign contracts to buy fuel in the future at a price agreed today hence taking a covered position by hedging against future price uncertainties. This conserves the available cash in the economy and limits the effects of cash crisis.

Further, shocks in tobacco price and platinum price were found to impact positively on liquidity. Therefore, it is prudent that the Central Bank manages the booms in these commodities wisely. It will be crucial to accumulate reserves or contingent liquidity buffers during times of booms, these will be useful during times of cash crisis. The recommendation is in line with common practises in developed countries like Canada, Australia and the majority of Arab countries where strategic liquidity buffers are built up during when a commodity boom occur. These buffers are essential insulations against commodity price shocks and are run down to stabilize the financial market when a crisis occurs.

From the transmission mechanism results, change in government debt has been found to be a conduit between commodity price shocks and cash crisis. Given also the deleterious impact of government borrowing on cash crisis, it is advisable for the government to re align its expenditures in a manner that minimizes budget deficits to avoid over-borrowing. This is commendable given the empirical finding that commodity price shocks are propagated through the fiscal performance transmission mechanism. Hence, adopting a pro-cyclical government budget is also an imperative given that government revenues tend to perform better in times of commodity booms and poorly when negative shocks occur. Further, the government should see to it that it minimizes over borrowing in the domestic financial market through the issuance of treasury bills. Rather it is imperative to consider borrowing offshore

since it has negligible impact on the domestic financial market than the impact of excessive domestic borrowing.

Further, the government should create an environment that supports high production across all the sectors of the economy rather than to rely on commodities for liquidity. In ideal economies, stability of the financial sector is tied to the productive capacity. Thus, it is crucial for the government to create a well-diversified economy with high output in minimising the probability of a cash crisis.

5.3 Suggestions for Further Research

Given the uncertainty that exists in the commodity market, it is important that further research be directed towards the financialization of commodities just like how currencies are treated in the foreign exchange market using swaps, futures and forward contracts to hedge against risk. Forth coming studies should also try and incorporate the impact of illicit financial flows on liquidity. The current study left out the variable because of data issues especially on monthly basis and the definition of the concept is still shrugged in ambiguity.

Further, the determination of the commodity price shocks transmission mechanism should be re-considered by would be interested researchers in the discipline. The major flaw of this study on transmission mechanism was the use of proxy variables instead of actual variables. This was necessitated by the absence of the actual data on the transmission variables which in the end resulted in a weak transmission mechanism as evidenced by the fiscal variable being significant at a low level of significance (10%). In addition, would be researcher within the discipline can also consider several other mechanisms through which commodity price shocks are propagated into a liquidity or cash crisis.

REFERENCES

Ajmera, R., Kook, N. and Crilley, J. (2017) 'Impact of Commodity Price Movements on CPI Inflation', (April 2012), pp. 29–43.

Berument, H., Basak, N. C. and Dogan, N. (2017) 'The Impact of Oil Price Shocks on the Economic Growth of Selected MENA Countries', *International Association for Energy Economics*, 31(1), pp. 149–176.

Bower, U., Geis, A. and Winkler, A. (2007) *Commodity Price Fluctuations and their Impact on Monetary and Fiscal Policies in Western and Central Africa*. Frankfurt.

Chen, A. . (2018) 'Portfolio Selection with Stochastic Cash Demand', *The Journal of Financial and Quantitative Analysis*, 12(5), pp. 701–723.

Chizema, R. (Poverty R. F. T. (2016) *PRFT Socio-economic Policy Dialogue Series Thematic Paper on the Socio-Economic Implications of the Cash Shortages on the Poor in Zimbabwe*. Harare.

Christensen, B. V. (2016) 'BIS Papers Challenges of low commodity prices for Africa', (87).

Ciang, P. K. and Chang, P. H. K. (1989) *by*. Messachusetts Institute of Technology.

Cody, B. . and Mills, L. . (2017) 'The Role of Commodity Prices in Formulating Monetary Policy Author (s): Brian J . Cody and Leonard O . Mills Source : The Review of Economics and Statistics , Vol . 73 , No . 2 (May , 1991), pp . 358-365 Published by : The MIT Press Stable URL : http':, *The Review of Economics and Statistics*, 73(2), pp. 358–365.

Deaton, A. (1999) 'Commodity Prices and Growth in Africa', *Journal of Economic Perspectives*, 13(3), pp. 23–40.

Enders, W. (2015) *Applied Econometric Time Series*. fourth. Washington, D.C: John Wiley & Sons. doi: HB 139.E55 2015.

Frankel, J. (2006) *The Effect of Monetary Policy on Real Commodity Prices Jeffrey Frankel Harpel Professor , KSG , Harvard University For Asset Prices and Monetary Policy The*

Effect of Monetary Policy on Real Commodity Prices. Chicago.

G.S, M. (1992) *Introduction to Econometrics*. Second Edi. New York: Macmillan Publishing Company.

IMF (2017) 'IMF Commodity Market Monthly; June 9, 2017'. Washington, D.C: International Monetary Fund, pp. 1–24.

Inoue, T. and Okimoto, T. (2017) *Measuring the Effects of Commodity Price Shocks on Asian Economies*. wp/639. Tokyo, Japan.

Jones, D. W., Leiby, P. N. and Paik, I. K. (2017) 'Oil Price Shocks and the Macroeconomy : What Has Been Learned Since 1996', *International Association for Energy Economics*, 25(2), pp. 1–32.

Kahn, R., Tananbaum, S. A. and Fellow, S. (2016) 'Venezuela ' s Descent Into Crisis', (May).

Kinda, T., Mlachila, M. and Rasmane`, O. (2016) *Commodity Price Shocks and Financial Sector Fragility*. WP/16.

Knop, S. J. (2014) 'The Sectorial Impact of Commodity Price Shocks in Australia'.

Kumah, F. Y. and Matovu, J. M. (2017) 'Commodity Price Shocks and the Odds on Fiscal Performance : A Structural Vector Autoregression Approach Commodity Price Shocks and the Odds on Fiscal Performance : A Structural Vector Autoregression hanges in commodity prices translate into shifts in fisc', 54(1), pp. 91–112. doi: 10.1057/palgrave.imfsp.9450001.

Mupunga, N. and Ngundu, T. (2016) *Commodity Price Shocks and Financial Sector Stability in Commodity Dependent Countries in Southern Africa*. 12. Harare.

Pedersen, M. (2015) *The Impact of Commodity Price Shocks in a Major Producing Economy: The Case of Copper and Chile*. Santiago.

Qiu, Y. U. E. (2017) *Essays on Commodity Price Shocks, Bank, Risk, and Market Volatility Forecasting*. Queen's University.

Ratti, R., Kang, W. and Vespignani, J. (2017) *Global Commodity Prices and Global Stock Volatility Shocks : Global Commodity Prices and Global Stock Volatility Shocks : Effects across Countries*. Texas.

RBZ (2016) ‘2016 Mid-Term Monetary Policy Statement’. Harare: Reserve Bank of Zimbabwe, pp. 1–85. Available at: www.rbz.co.zw/monetary-policy.html.

RBZ (2017) ‘Monetary Policy Statement “ Stimulating Economic Growth and Bolstering Confidence ”’. Harare: Reserve Bank of Zimbabwe.

RBZ (2018) ‘Monetary Policy Statement: Enhancing Financial Stability To Promote Business Confidence Reserve Bank of Zimbabwe Governor’. Harare: Reserve Bank of Zimbabwe. Available at: http://www.rbz.co.zw/assets/tourism-and-hospitality-talking-notes-12-jan-2018.pdf.

Roache, S. K. (2012) *China â€™ s Impact on World Commodity Markets*. 12. Washington, D.C.

Sims, C. A. (1980) ‘Macroeconomics and Reality’, *The Econometric Society*, 48(1), pp. 1–48.

Tiawara, N. H. O. (2015) *The Effect of Commodity Prices on African Economic Growth*. St Cloud State University.

Tober, S. and Zimmermann, T. (2009) ‘Monetary Policy and Commodity Price’, 48(August), pp. 231–237. doi: 10.1007/s10272-009-0300-4.

Xinshen, D. *et al.* (2002) *Assessing Impacts of Declines in the World Price of Tobacco on China, Malawi, Turkey and Zimbabwe*. 1. Washington, D.C.

Data Attachment

	logM1	logGP	logTP	logPP	logOP	logdebt	logGDP
2009m01	6.591065	2.933836	3.583084	2.976538	1.642021	5.470037	1.485721
2009m02	6.598051	2.974512	3.612519	3.014205	1.62163	5.444334	1.522444
2009m03	6.618106	2.9658	3.623621	3.034135	1.668808	5.388139	1.480007
2009m04	6.622979	2.949488	3.622336	3.066494	1.701379	5.473978	1.498311
2009m05	6.624174	2.96785	3.626004	3.052567	1.764579	5.432866	1.494155
2009m06	6.626947	2.97574	3.627887	3.085597	1.83979	5.46354	1.498311
2009m07	6.627568	2.970453	3.627249	3.065303	1.810681	5.439498	1.4843
2009m08	6.628972	2.977438	3.630688	3.095019	1.855093	5.529994	1.487138
2009m09	6.632098	2.998517	3.633504	3.110152	1.834714	5.481065	1.489958
2009m10	6.634971	3.018351	3.636433	3.124755	1.869705	5.415125	1.471292
2009m11	6.641318	3.051938	3.646149	3.14632	1.889595	5.326856	1.4843
2009m12	6.647778	3.05489	3.649401	3.157602	1.874376	5.33069	1.471292
2010m01	6.649637	3.048427	3.649873	3.19254	1.887173	5.396831	1.575188
2010m02	6.64615	3.039578	3.642394	3.181944	1.873687	4.464929	1.591065
2010m03	6.633278	3.046627	3.623966	3.203965	1.89926	4.485312	1.558709
2010m04	6.622562	3.060202	3.621155	3.233123	1.925224	4.44542	1.596597
2010m05	6.624507	3.081143	3.627834	3.210816	1.878627	4.41847	1.600973
2010m06	6.632578	3.090935	3.63727	3.191236	1.873466	4.510108	1.578639
2010m07	6.639469	3.076628	3.641658	3.183438	1.872619	4.447806	1.568202
2010m08	6.640081	3.084866	3.638498	3.187687	1.87982	4.487886	1.585461
2010m09	6.63891	3.104138	3.639322	3.201875	1.881477	4.473582	1.584331
2010m10	6.639279	3.12776	3.639237	3.22755	1.912325	4.379436	1.572872
2010m11	6.639968	3.136684	3.640698	3.228598	1.927032	4.33659	1.563481

2010m12	6.639834	3.143188	3.638969	3.233349	1.954271	4.359978	1.623249
2011m01	6.639764	3.133686	3.640558	3.251743	1.967036	4.385972	1.575188
2011m02	6.637882	3.138202	3.635189	3.261477	1.990846	4.373173	1.582063
2011m03	6.646146	3.153284	3.656833	3.248015	2.036011	4.411197	1.655138
2011m04	6.660138	3.170523	3.663417	3.254766	2.065367	4.421938	1.705008
2011m05	6.655049	3.179718	3.646516	3.252015	2.033699	4.469361	1.658965
2011m06	6.644481	3.18451	3.642436	3.247605	2.024672	4.599784	1.528917
2011m07	6.645829	3.19666	3.649195	3.245453	2.033088	4.646555	1.660865
2011m08	6.654558	3.245268	3.659855	3.256405	2.002107	4.623353	1.64836
2011m09	6.661086	3.248498	3.662314	3.242569	2.003544	4.69232	1.718502
2011m10	6.661721	3.221787	3.661127	3.186162	1.999338	4.695408	1.710963
2011m11	6.658266	3.2403	3.655386	3.203299	2.022861	4.623636	1.715167
2011m12	6.651339	3.214836	3.647254	3.162741	2.017995	4.652483	1.725912
2012m01	6.646074	3.218549	3.64489	3.175894	2.029686	4.650339	1.652246
2012m02	6.645034	3.241751	3.645179	3.219522	2.051876	4.643882	1.652246
2012m03	6.643282	3.224261	3.641376	3.218906	2.07109	4.476678	1.660865
2012m04	6.640138	3.217273	3.638896	3.200251	2.055629	4.497552	1.620136
2012m05	6.638954	3.201135	3.639011	3.167524	2.017392	4.502325	1.649335
2012m06	6.635393	3.203783	3.631745	3.159525	1.957743	4.692946	1.758155
2012m07	6.627078	3.202567	3.622361	3.154065	1.985669	4.695619	1.656098
2012m08	6.623216	3.21227	3.624069	3.162343	2.02232	4.692757	1.696356
2012m09	6.623218	3.241748	3.622366	3.210492	2.026472	4.663331	1.676694
2012m10	6.624046	3.242188	3.625719	3.213738	2.014554	4.695844	1.69897
2012m11	6.628017	3.235942	3.630303	3.197655	2.005071	4.711508	1.696356
2012m12	6.633977	3.226539	3.637621	3.199275	2.005153	4.753794	1.683047
2013m01	6.641387	3.223197	3.645121	3.21455	2.021604	5.227169	1.670246
2013m02	6.643824	3.21154	3.642523	3.223898	2.031963	#VALUE!	1.687529

2013m03	6.641868	3.202239	3.641212	3.199468	2.010819	#VALUE!	1.722634
2013m04	6.640693	3.172561	3.640173	3.17408	1.994985	5.255292	1.659916
2013m05	6.638969	3.150458	3.637761	3.168843	1.997241	5.32679	1.700704
2013m06	7.975055	3.128189	3.652573	3.155406	1.998881	5.314267	1.686636
2013m07	6.659381	3.109077	3.666083	3.146586	2.022255	5.365998	1.70927
2013m08	6.667962	3.130894	3.669833	3.174958	2.034057	5.369435	1.704151
2013m09	6.671428	3.129883	3.673018	3.163418	2.03646	5.359104	1.61066
2013m10	6.675779	3.119447	3.678522	3.15029	2.022952	5.476666	1.694605
2013m11	6.691167	3.105803	3.703454	3.152319	2.011259	5.520874	1.705864
2013m12	6.694036	3.086898	3.68441	3.132153	2.023177	5.55388	1.695482
2014m01	6.688397	3.094915	3.692347	3.152579	2.009012	5.515617	1.895423
2014m02	6.697936	3.113803	3.703454	3.149074	2.020472	5.618099	1.952308
2014m03	6.704814	3.125832	3.706171	3.161853	2.0172	5.690403	1.923244
2014m04	6.706406	3.113425	3.706641	3.155436	2.020637	5.678443	1.937518
2014m05	6.707854	3.110165	3.709063	3.163242	2.02413	5.670674	1.921686
2014m06	6.703877	3.10632	3.698629	3.162194	2.034922	5.697767	1.963788
2014m07	6.69842	3.117467	3.69821	3.173821	2.022126	5.627354	1.97174
2014m08	6.695097	3.112313	3.691962	3.160267	2.000217	5.640952	1.957607
2014m09	6.69213	3.092212	3.692297	3.133373	1.981592	5.64585	2.002166
2014m10	6.693155	3.087245	3.69401	3.100288	1.934902	5.672564	1.984077
2014m11	6.693089	3.07016	3.692166	3.082182	1.886453	5.665042	1.993877
2014m12	6.69234	3.079406	3.692514	3.084691	1.783213	5.712344	1.962843
2015m01	6.692366	3.097171	3.692217	3.094279	1.673082	5.73562	1.952308
2015m02	6.691692	3.088873	3.691167	3.078152	1.738701	5.770285	2.024075
2015m03	6.693399	3.071377	3.695619	3.056386	1.722853	5.792637	1.97359
2015m04	6.696718	3.078794	3.697814	3.061185	1.759995	5.822991	1.975432
2015m05	6.699175	3.078685	3.700531	3.057057	1.795926	5.977995	1.970347

2015m06	6.697458	3.072434	3.694362	3.036956	1.787508	6.0311	1.978181
2015m07	6.691317	3.052428	3.688249	3.004007	1.73512	6.064475	1.975432
2015m08	6.690359	3.048415	3.692458	2.993039	1.659821	6.076279	1.98945
2015m09	6.690769	3.051064	3.689074	2.984248	1.665393	6.072748	1.989895
2015m10	6.687787	3.064177	3.686496	2.989855	1.671697	6.098027	2.004321
2015m11	6.684465	3.036006	3.682424	2.947041	1.634612	6.133484	2.003029
2015m12	6.681365	3.031707	3.680304	2.934408	1.563165	6.194335	1.97359
2016m01	7.976622	3.040567	3.67479	2.932093	1.473925	6.060397	1.995635
2016m02	6.671911	3.079	3.669014	2.963481	1.491782	6.187885	1.983626
2016m03	6.664432	3.095218	3.659802	2.985754	1.572174	6.090132	1.892095
2016m04	6.662114	3.094213	3.664414	2.997469	1.610128	6.25625	1.977724
2016m05	6.667855	3.100698	3.671269	3.015301	1.662159	6.263583	1.983175
2016m06	6.677479	3.105987	3.683602	2.993057	1.678397	6.150861	1.956168
2016m07	6.685921	3.126018	3.688228	3.036429	1.644701	6.154041	1.941511
2016m08	6.688708	3.12716	3.689187	3.049857	1.651988	6.144941	2.155336
2016m09	6.693054	3.122743	3.696885	3.019826	1.653631	6.160452	1.822822
2016m10	6.695512	3.102622	3.694135	2.981882	1.692788	6.177023	1.819544
2016m11	6.693167	3.092843	3.692197	2.980067	1.655715	6.167951	1.824126
2016m12	6.694054	3.063468	3.695903	2.963022	1.721151	6.18437	1.955495
2017m01	6.695805	3.076313	3.695706	2.987286	1.729084	6.208806	2
2017m02	6.694282	3.091386	3.692852	3.003301	1.735226	6.367411	1.986772
2017m03	6.693122	3.090406	3.693392	2.983568	1.706746	6.363993	1.959041
2017m04	6.686761	3.102735	3.680028	2.982651	1.717365	6.384271	1.892095
2017m05	6.673415	3.095532	3.6667	2.968609	1.698043	6.407612	1.977724
2017m06	6.68393	3.10046	3.700503	2.968824	1.664329	6.437907	1.986772
2017m07	6.700783	3.092317	3.701064	2.963268	1.678124	6.290011	1.959041
2017m08	6.693122	3.093982	3.703338	2.972666	1.698478	6.506943	1.929419

2017m09	6.686761	3.095427	3.699096	2.951338	1.723866	6.524529	2.158061
2017m10	6.673415	3.096674	3.698167	2.966142	1.739731	6.546253	1.819544
2017m11	6.68393	3.095901	3.731742	2.977724	1.744293	6.578165	1.819544
2017m12	6.700783	3.098169	3.70759	2.984032	1.727296	6.367722	1.824126

APPENDICES

Appendix A: Descriptive Statistics

	LOGDEBT	LOGGDP	LOGGP	LOGM1	LOGOP	LOGPP	LOGTP
Mean	12.46937	4.074802	7.157671	15.39969	4.278318	7.161303	8.438151
Median	12.60740	3.937689	7.132649	15.34275	4.330353	7.248147	8.436478
Maximum	15.14678	4.969119	7.479943	18.36685	4.768861	7.509828	8.592654
Minimum	9.985367	3.387774	6.755408	15.17649	3.393837	6.751394	8.250357
Std. Dev.	1.604135	0.430446	0.165495	0.418364	0.365214	0.226596	0.068748
Skewness	-0.116765	0.055439	0.059990	6.801578	-0.386622	-0.248238	-0.110234
Kurtosis	1.674305	1.675801	2.875290	48.53881	1.850731	1.671595	1.977422
Jarque-Bera	8.003019	7.798935	0.132268	9976.495	8.474360	8.882570	4.833040
Probability	0.018288	0.020253	0.936005	0.000000	0.014448	0.011781	0.089232
Sum	1321.754	431.9290	758.7131	1632.367	453.5018	759.0981	894.4440
Sum Sq. ...	270.1912	19.45480	2.875797	18.37800	14.00504	5.391288	0.496262
Observati...	106	106	106	106	106	106	106

APPENDIX B : Stationarity Tests

```
. dfuller lnM1, regress

Dickey-Fuller test for unit root                    Number of obs   =       107

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -10.215            -3.508            -2.890           -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
      D.lnM1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnM1 |
        L1. |   -.995531   .0974605   -10.21   0.000    -1.188777   -.8022848
            |
       _cons |   15.33102    1.50119    10.21   0.000     12.35444    18.3076
------------------------------------------------------------------------------

. dfuller lnM1, regress

Dickey-Fuller test for unit root                    Number of obs   =       107

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -10.107            -3.508            -2.890           -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
      D.lnM1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnM1 |
        L1. |   -.984859   .0974477   -10.11   0.000    -1.17808   -.7916383
            |
       _cons |   15.1667   1.501021    10.10   0.000     12.19045    18.14294
------------------------------------------------------------------------------
```

```
. gen lnGDP=ln(GDP)

. dfuller lnGDP, regress

Dickey-Fuller test for unit root                    Number of obs   =       107

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -1.978            -3.508            -2.890           -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.2965

------------------------------------------------------------------------------
      D.lnGDP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
        lnGDP |
          L1. |  -.0809454   .0409306    -1.98   0.051    -.1621034    .0002125
              |
        _cons |   .3434036   .1672057     2.05   0.042     .0118655    .6749417
------------------------------------------------------------------------------

. dfuller lnGDPD1, regress

Dickey-Fuller test for unit root                    Number of obs   =       106

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -15.484            -3.508            -2.890           -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
     D.lnGDPD1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
---------------+---------------------------------------------------------------
      lnGDPD1  |
          L1.  |  -1.435458   .0927037   -15.48   0.000    -1.619293   -1.251623
               |
         _cons |   .0191154   .0159942     1.20   0.235    -.0126017    .0508325
------------------------------------------------------------------------------

. dfuller lnTP, regress

Dickey-Fuller test for unit root                    Number of obs   =       107

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)            -2.496            -3.508            -2.890           -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.1164

------------------------------------------------------------------------------
       D.lnTP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
         lnTP |
          L1. |  -.0724538   .0290272    -2.50   0.014    -.1300094   -.0148981
              |
        _cons |   .6139171   .2448888     2.51   0.014     .1283479    1.099486
------------------------------------------------------------------------------

.

. dfuller lnTPD1, regress

Dickey-Fuller test for unit root                    Number of obs   =       106

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical       5% Critical      10% Critical
               Statistic           Value             Value            Value
------------------------------------------------------------------------------
 Z(t)           -10.633            -3.508            -2.890           -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
     D.lnTPD1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
      lnTPD1  |
          L1. |  -1.031662   .0970289   -10.63   0.000    -1.224074   -.8392504
              |
        _cons |   .0021674   .0019712     1.10   0.274    -.0017415    .0060764
------------------------------------------------------------------------------

.
```

```
. dfuller lnOP, regress

Dickey-Fuller test for unit root                    Number of obs   =       107

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)            -1.387             -3.508              -2.890             -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.5886

------------------------------------------------------------------------------
      D.lnOP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnOP |
         L1. |  -.0289087   .0208471    -1.39   0.168    -.0702447    .0124273
             |
       _cons |   .1258003   .0897177     1.40   0.164    -.0520932    .3036939
------------------------------------------------------------------------------

.

. dfuller lnOPD1, regress

Dickey-Fuller test for unit root                    Number of obs   =       106

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)            -7.498             -3.508              -2.890             -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
     D.lnOPD1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lnOPD1 |
         L1. |  -.7018381   .0936074    -7.50   0.000     -.887465   -.5162112
             |
       _cons |    .075982   .4827984     0.16   0.875    -.8814253    1.033389
------------------------------------------------------------------------------

. dfuller lnGP, regress

Dickey-Fuller test for unit root                    Number of obs   =       107

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)            -2.504             -3.508              -2.890             -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.1145

------------------------------------------------------------------------------
      D.lnGP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       lnGP |
         L1. |  -.0506027    .020208    -2.50   0.014    -.0906715   -.0105339
             |
       _cons |   .3659596   .1447717     2.53   0.013      .078904    .6530152
------------------------------------------------------------------------------

. dfuller lnGPD1 , regress

Dickey-Fuller test for unit root                    Number of obs   =       106

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)            -8.430             -3.508              -2.890             -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
     D.lnGPD1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
      lnGPD1 |
         L1. |  -.7803947   .0925682    -8.43   0.000    -.9639609   -.5968284
             |
       _cons |    .001913   .0033222     0.58   0.566     -.004675    .0085011
------------------------------------------------------------------------------
```

```
. dfuller lnPP, regress

Dickey-Fuller test for unit root                   Number of obs   =       107

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)            -1.119            -3.508              -2.890             -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.7076

------------------------------------------------------------------------------
       D.lnPP |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
        lnPP |
         L1. |  -.0225295   .0201423    -1.12   0.266    -.0624679    .0174089
             |
       _cons |   .1616612   .1444586     1.12   0.266    -.1247735    .4480959
------------------------------------------------------------------------------

.

. dfuller lnPPD1 , regress

Dickey-Fuller test for unit root                   Number of obs   =       106

                                 ------------ Interpolated Dickey-Fuller ------------
                 Test         1% Critical         5% Critical        10% Critical
               Statistic           Value               Value              Value
------------------------------------------------------------------------------
 Z(t)            -9.250            -3.508              -2.890             -2.580
------------------------------------------------------------------------------
MacKinnon approximate p-value for Z(t) = 0.0000

------------------------------------------------------------------------------
      D.lnPPD1 |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
--------------+---------------------------------------------------------------
       lnPPD1 |
         L1. |  -.8940277   .0966522    -9.25   0.000    -1.085693   -.7023629
             |
       _cons |  -.6568343   6.075571    -0.11   0.914    -12.70492    11.39125
------------------------------------------------------------------------------
```

Appendix C: Selection of the Optimal lag

```
. varsoc lnM1 lndebt lnGDP lnGPD1 lnTPD1 lnOP lnPP

Selection-order criteria
Sample:  1960m7 - 1969m1                        Number of obs      =       103
+---------------------------------------------------------------------------+
| lag |    LL      LR      df    p      FPE       AIC      HQIC      SBIC    |
|-----+---------------------------------------------------------------------|
|  0  |  322.638                      5.1e-12   -6.1289  -6.05637  -5.94984 |
|  1  |  712.802  780.33   49  0.000  6.8e-15* -12.7534* -12.1732*  -11.321* |
|  2  |  748.439  71.275*  49  0.021  9.0e-15   -12.494  -11.4061  -9.80807 |
|  3  |   769.17  41.462   49  0.769  1.6e-14  -11.9451  -10.3495  -8.00575 |
|  4  |  796.668  54.996   49  0.258  2.6e-14  -11.5275  -9.42431  -6.33482 |
+---------------------------------------------------------------------------+
Endogenous:  lnM1 lndebt lnGDP lnGPD1 lnTPD1 lnOP lnPP
 Exogenous:  _cons
```

Appendix D: Residual Autocorrelation results

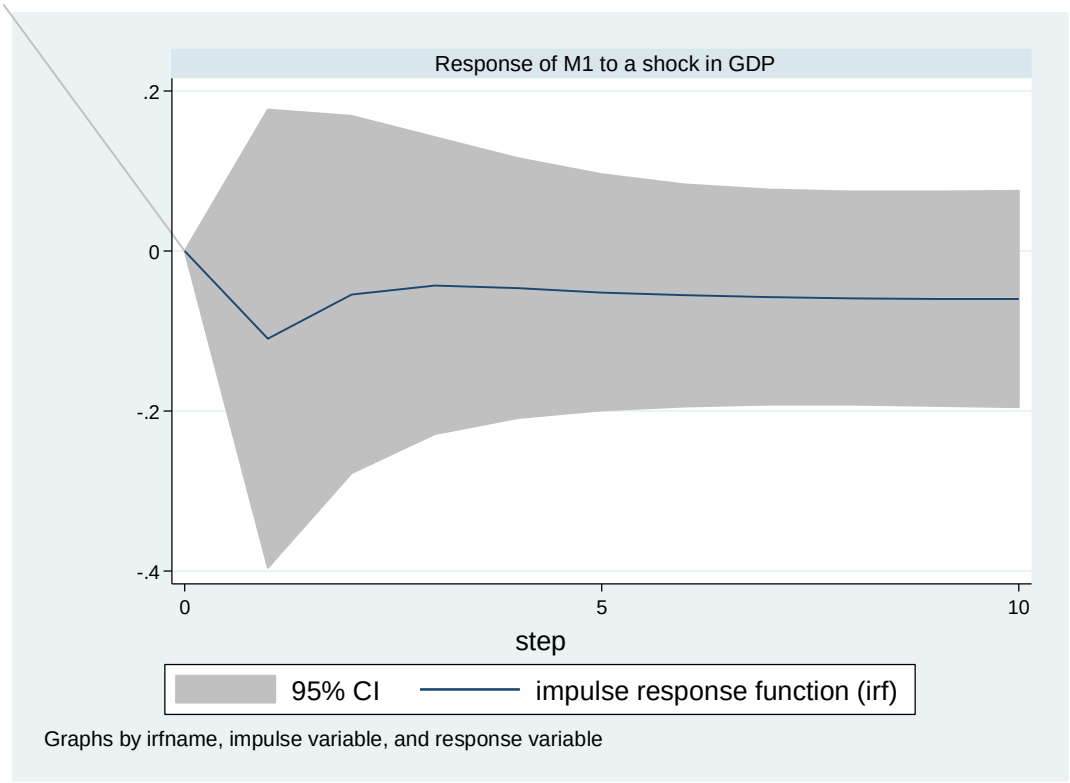
```
. varlmar

Lagrange-multiplier test
+-------------------------------------+
| lag |     chi2     df   Prob > chi2 |
|-----+-------------------------------|
|  1  |   52.2078    49     0.35039   |
|  2  |   37.9183    49     0.87458   |
+-------------------------------------+
H0: no autocorrelation at lag order
```

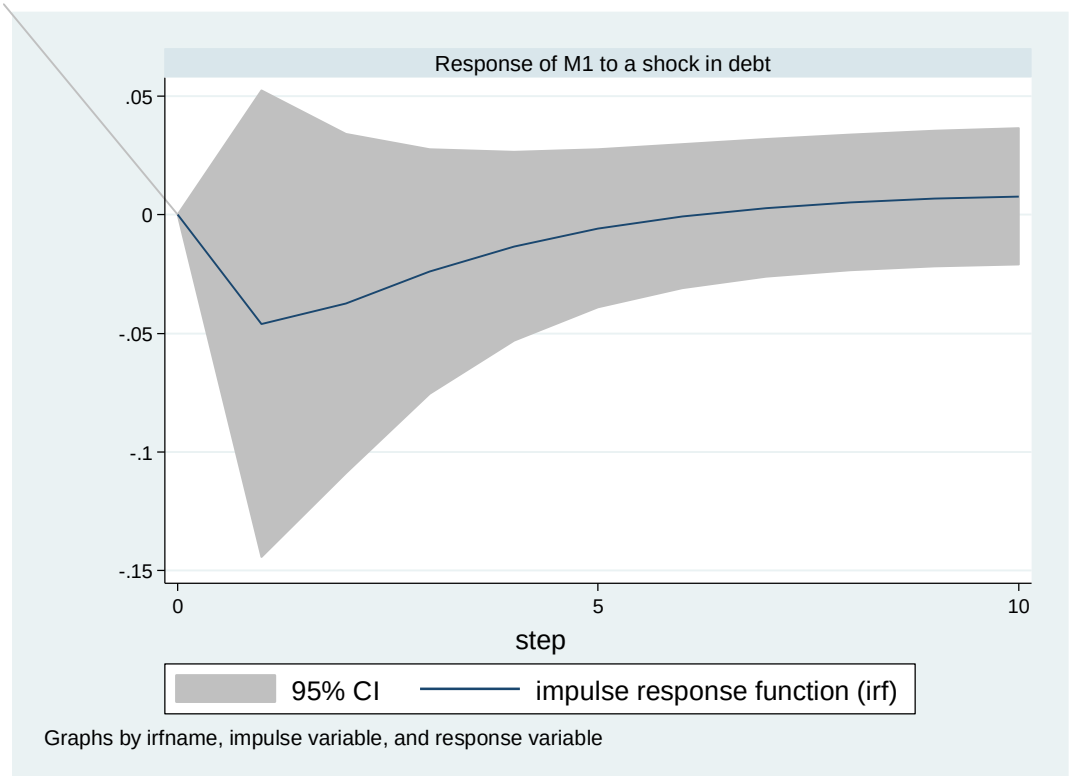
Appendix E: VAR regression Results

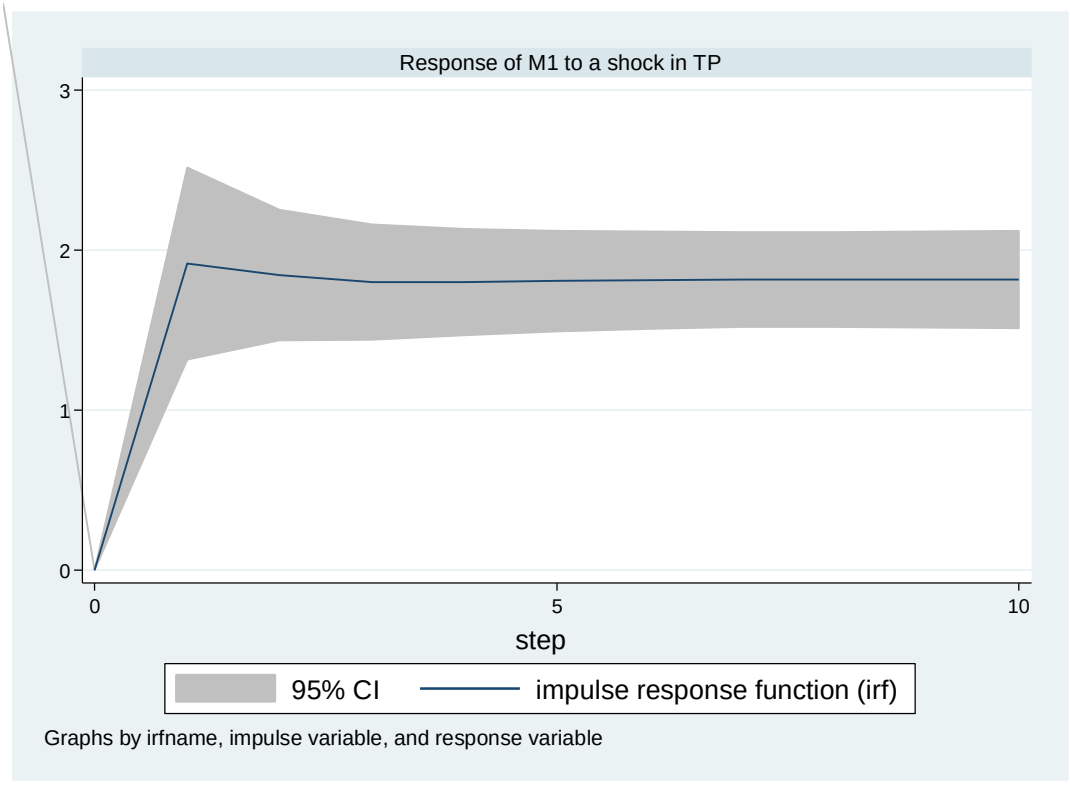
```
. var lnM1 lndebtD1 lnGDPD1, lags(1/1) exog(lnGPD1 lnTPD1 lnOPD1 lnPPD1)

Vector autoregression

Sample:  1960m4 - 1969m1                        No. of obs      =       106
Log likelihood = -575.1555                      AIC             =  11.30482
FPE            =  16.31447                      HQIC            =  11.54924
Det(Sigma_ml)  =  10.36422                      SBIC            =  11.90786

Equation             Parms      RMSE     R-sq      chi2     P>chi2
------------------------------------------------------------------
lnM1                     8      .423069   0.0418    4.62687   0.7054
lndebtD1                 8      .631577   0.1483   18.45918   0.0101
lnGDPD1                  8      13.9479   0.1870   24.38596   0.0010
------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
lnM1						
lnM1						
L1.	.0411996	.0982074	0.42	0.675	-.1512834	.2336827
lndebtD1						
L1.	.0791902	.0624657	1.27	0.205	-.0432404	.2016208
lnGDPD1						
L1.	-.0001529	.002689	-0.06	0.955	-.0054232	.0051173
lnGPD1	-1.250225	1.464013	-0.85	0.393	-4.119638	1.619189
lnTPD1	1.442252	2.007672	0.72	0.473	-2.492713	5.377218
lnOPD1	-.0108512	.0083411	-1.30	0.193	-.0271994	.0054969
lnPPD1	.0001495	.0008547	0.17	0.861	-.0015256	.0018247
_cons	14.76884	1.512429	9.76	0.000	11.80454	17.73315
lndebtD1						
lnM1						
L1.	.2911169	.1466085	1.99	0.047	.0037696	.5784642
lndebtD1						
L1.	-.2904657	.0932517	-3.11	0.002	-.4732355	-.1076958
lnGDPD1						
L1.	.0009737	.0040142	0.24	0.808	-.006894	.0088413
lnGPD1	-.5590214	2.185545	-0.26	0.798	-4.84261	3.724567
lnTPD1	2.258461	2.997143	0.75	0.451	-3.615831	8.132753
lnOPD1	-.0051546	.0124519	-0.41	0.679	-.0295599	.0192507
lnPPD1	.0004268	.0012759	0.33	0.738	-.0020739	.0029276
_cons	-4.488448	2.257821	-1.99	0.047	-8.913696	-.0632003
lnGDPD1						
lnM1						
L1.	.471145	3.237736	0.15	0.884	-5.8747	6.81699
lndebtD1						
L1.	.7666053	2.059391	0.37	0.710	-3.269728	4.802938
lnGDPD1						
L1.	-.4326501	.0886503	-4.88	0.000	-.6064015	-.2588987
lnGPD1	4.739134	48.26608	0.10	0.922	-89.86065	99.33892
lnTPD1	-12.1312	66.18961	-0.18	0.855	-141.8604	117.598
lnOPD1	.0017492	.2749909	0.01	0.995	-.5372231	.5407216
lnPPD1	.0037271	.0281778	0.13	0.895	-.0515003	.0589545
_cons	-6.783226	49.86225	-0.14	0.892	-104.5114	90.94499

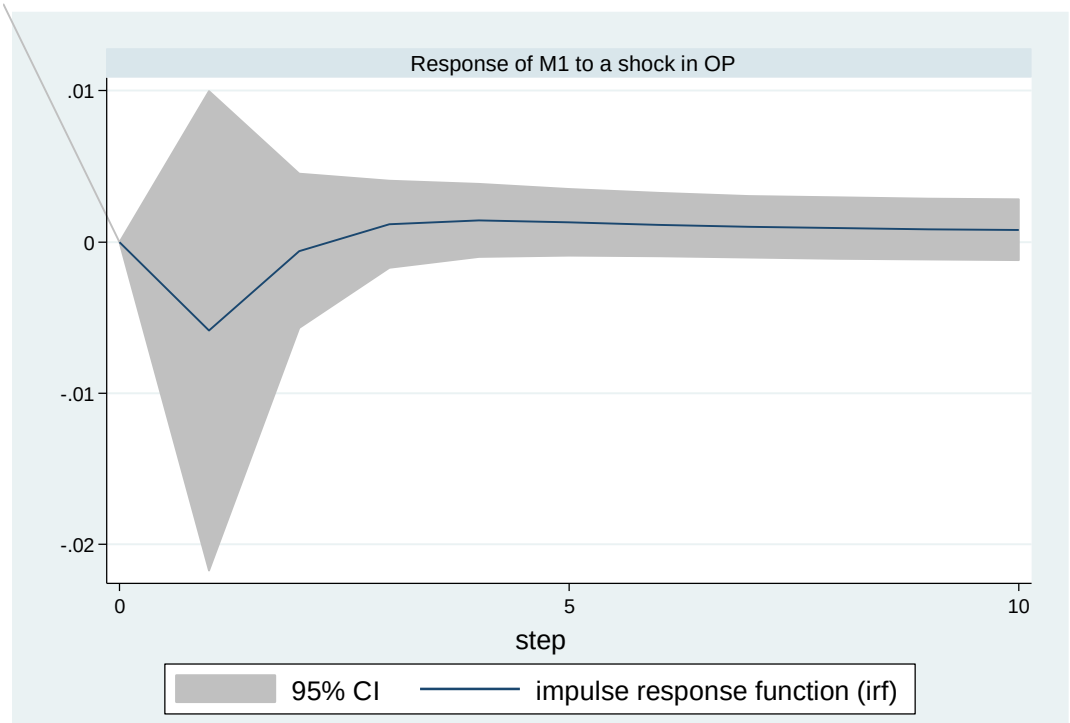
Appendix F: Impulse Response Functions Results



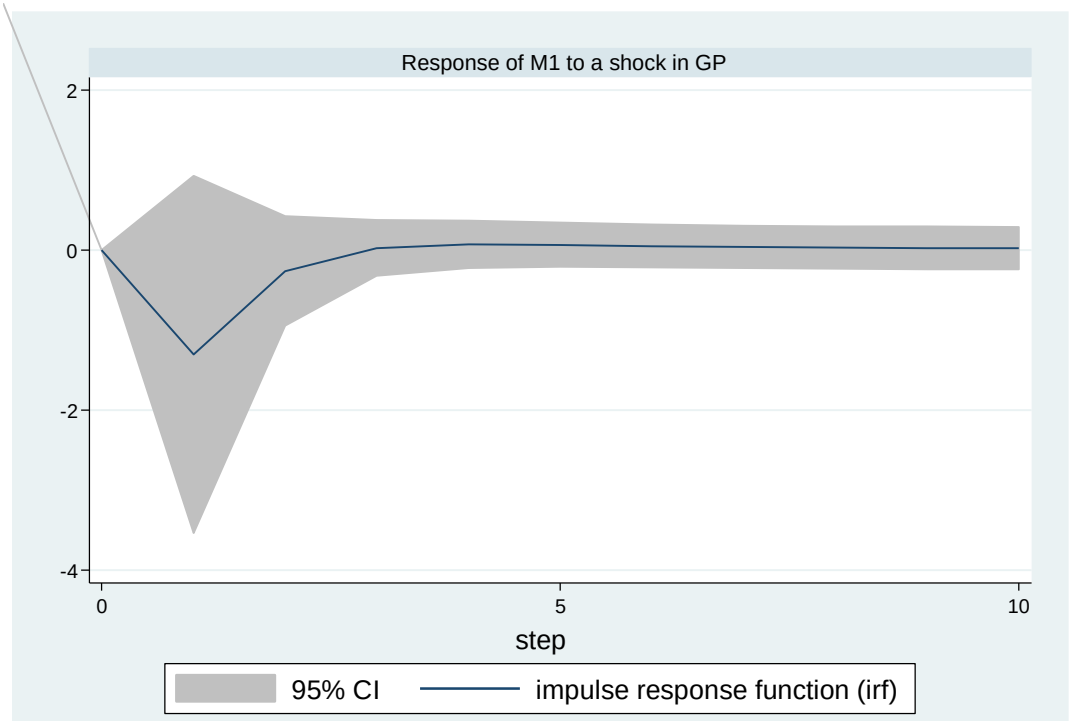


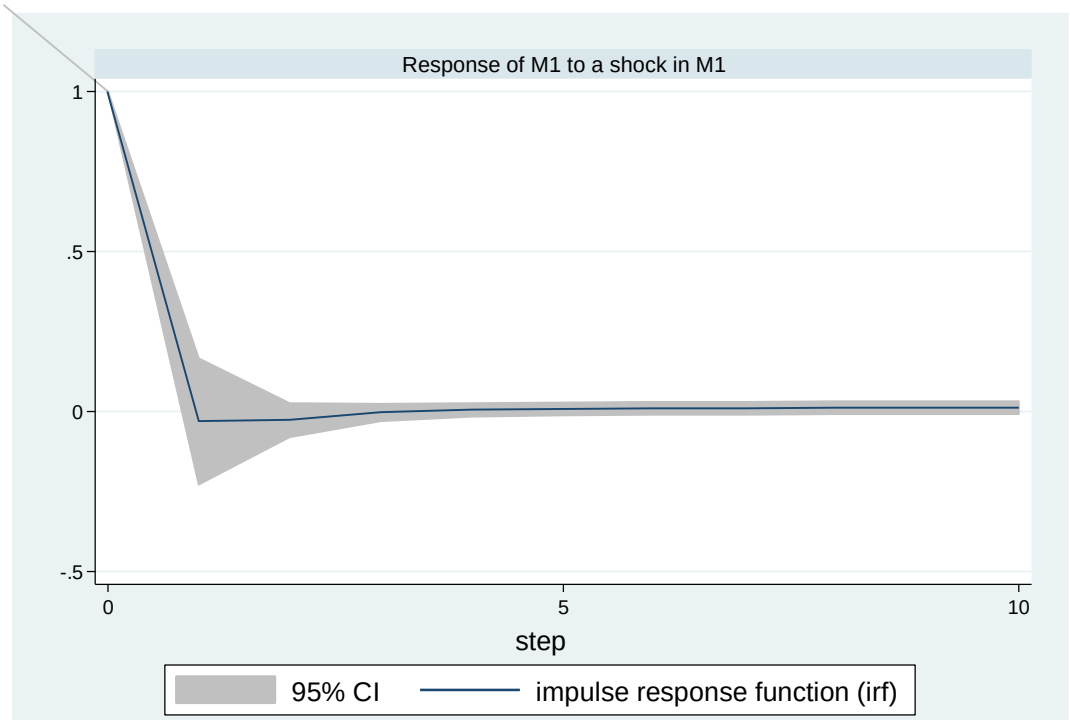


Graphs by irfname, impulse variable, and response variable



Graphs by irfname, impulse variable, and response variable


Response of M1 to a shock in GP
2
0
-2
-4
0
5
10
step
95% CI
impulse response function (irf)
Graphs by irfname, impulse variable, and response variable


Response of M1 to a shock in M1
1
.5
0
-.5
0
5
10
step
95% CI
impulse response function (irf)
Graphs by irfname, impulse variable, and response variable

Appendix G: Forecast Error Variance Decomposition Results

step	(1) fevd	(2) fevd	(3) fevd	(4) fevd	(5) fevd	(6) fevd	(7) fevd
0	0	0	0	0	0	0	0
1	1	0	0	0	0	0	0
2	.975432	.002875	.001071	.006515	.009976	.00412	.000012
3	.966439	.004474	.001309	.013505	.010116	.004104	.000053
4	.958788	.004929	.001456	.020389	.010076	.004279	.000083
5	.951513	.004953	.001637	.027203	.010074	.004523	.000098
6	.944407	.004918	.001867	.033947	.010049	.004709	.000104
7	.937361	.004954	.002134	.040604	.010002	.004838	.000107
8	.930349	.005088	.002421	.04716	.009944	.004928	.000109
9	.92338	.005309	.00272	.053606	.00988	.004995	.00011
10	.916472	.005596	.003021	.059939	.009814	.005047	.000111

(1) irfname = shocks, impulse = lnM1, and response = lnM1
(2) irfname = shocks, impulse = lndebt, and response = lnM1
(3) irfname = shocks, impulse = lnGDP, and response = lnM1
(4) irfname = shocks, impulse = lnTP, and response = lnM1
(5) irfname = shocks, impulse = lnGPD1, and response = lnM1
(6) irfname = shocks, impulse = lnOPD1, and response = lnM1
(7) irfname = shocks, impulse = lnPP, and response = lnM1

Determinantion of the Transmission Mechanism Results

Model 1: Fiscal Performance Transmission Mechanism

```
. reg lnGdebtlgd lnshocks lnGGDP
```

Source	SS	df	MS		
Model	4.98140348	2	2.49070174	Number of obs	= 16
Residual	19.4898968	13	1.49922283	F(2, 13)	= 1.66
				Prob > F	= 0.2278
Total	24.4713002	15	1.63142002	R-squared	= 0.2036
				Adj R-squared	= 0.0810
				Root MSE	= 1.2244

lnGdebtlgd	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnshocks	-.4591735	.2587263	-1.77	0.099	-1.018118	.0997706
lnGGDP	-.1726098	.2194134	-0.79	0.446	-.6466236	.301404
_cons	2.653587	.5174719	5.13	0.000	1.535657	3.771517

Model 2: Savings Withdrawals Transmission Mechanism

```
. reg lnSAV lnshocks lnIR
```

Source	SS	df	MS	Number of obs =	55
Model	.203843251	2	.101921625	F(2, 52) =	0.24
Residual	21.7079338	52	.417460266	Prob > F =	0.7843
				R-squared =	0.0093
				Adj R-squared =	-0.0288
Total	21.9117771	54	.40577365	Root MSE =	.64611

lnSAV	Coef.	Std. Err.	t	P>|t|	[95% Conf.	Interval]
lnshocks	.0233299	.0899661	0.26	0.796	-.1572003	.20386
lnIR	-.1973915	.2831068	-0.70	0.489	-.7654869	.370704
_cons	14.29444	.7029832	20.33	0.000	12.8838	15.70508

.