

**MONETARY POLICY TRANSMISSION MECHANISM: EVIDENCE FROM
THE SOUTHERN AFRICAN DEVELOPMENT COMMUNITY (SADC)**

MASTER OF ARTS (ECONOMICS) THESIS

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**UNIVERSITY OF MALAWI
CHANCELLOR COLLEGE**

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MASTER OF ARTS (ECONOMICS) THESIS

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**University of Malawi
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SEPTEMBER, 2017

DECLARATION

I, the undersigned hereby declare that this thesis is my own original work which has not been submitted to any other institution for similar purposes. Where other people's work has been used acknowledgements have been made.

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Signature

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CERTIFICATE OF APPROVAL

The undersigned certify that this thesis represents the student's own work and effort and has been submitted with our approval.

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DEDICATION

To my dear Parents, Thomas and Dorothy Mkombe.

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ABSTRACT

This study conducts a comparative analysis of the monetary policy transmission mechanism in the SADC region by assessing the importance and similarity of the interest rate channel for the SADC countries. Using the vector auto-regression (VAR) approach, the study focuses on the reduced-form relationships between short term interest rates, inflation and real output by utilizing quarterly data for the period from 2007Q1 to 2015Q4. The 3 variable VAR model analysis was carried out by examining the dynamic nature of multivariate Granger causality tests, impulse response functions and variance decomposition estimates generated from the model. The main findings from the study suggests that the effect of a monetary contraction on output seems relatively similar for some SADC countries but different for others in terms of the speed, direction, pattern and timing with magnitudes being small and not significant for most countries in the region, while large and significant for other countries in the region. The effect of monetary policy contraction on the inflation rate in terms of the timing, speed and direction of response is also relatively similar for some SADC countries but different when compared to others and just as with output, the magnitude seems to be small and not significant for most countries in the region. It can be concluded that the importance of the interest rate channel differs across countries in the SADC region with the main conclusion been that the interest rate channel is not effective for all SADC countries except for Botswana and South Africa.

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LIST OF ABBREVIATIONS AND ACRONYMS

ADF	Augmented Dickey Fuller
AIC	Akaike Information Criterion
ARDL	Autoregressive Distributed Lag Model
BCC	Central Bank of Congo
BCM	Central Bank of Madagascar
BoM	Bank of Mauritius
BOT	Bank of Tanzania
BoZ	Bank of Zambia
CBL	Central Bank of Lesotho
CEE	Central and Eastern Europe
CEMAC	Central African Economic and Monetary Union
CPI	Consumer Price Index
DFGLS	Dickey Fuller test with GLS trending
DRC	Democratic Republic of Congo
EAC	East African Community
EMU	European Monetary Union
EU	European Union
GCC	Gulf Cooperation Council
GDP	Gross Domestic Product
HQIC	Hannan-Quinn Information Criterion
IFS	International Financial Statistics
IMF	International Monetary Fund
IRFs	Impulse Response Functions
LR	Log Likelihood Ration

M2/M3	Broad Money
MENA	Middle East and North Africa
MTM	Monetary policy Transmission Mechanism
OMO	Open Market Operations
PNG	Papua New Guinea
RBM	Reserve Bank of Malawi
RBZ	Reserve Bank of Zimbabwe
SADC	Southern African Development Community
SARB	South African Reserve Bank
SBIC (SC)	Schwartz Bayesian Information Criterion
SVAR	Structural VAR
UK	United Kingdom
USA	United States of America
VAR	Vector Autoregressive model

CHAPTER 1

INTRODUCTION

1.1 Background to the Study

The monetary transmission mechanism has been one of the most researched areas in the history of macroeconomic theory especially in the aftermath of the global financial crisis which has disrupted some channels of monetary transmission. This has been the case because effective monetary policy is considered as a strong tool for the stabilization of an economy and such evaluations provide central banks with pertinent insight for better decision-making (Cevik&Teksoz, 2012; Hussain, 2014).

The Southern African Development Community (SADC), established in 1992, is a regional economic community comprising of 15 Member States namely Angola, Botswana, Democratic Republic of Congo, Lesotho, Madagascar, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia and Zimbabwe, with the goals of poverty eradication and regional integration. Regional studies in the SADC region have paid less attention to the Monetary Transmission Mechanism (MTM) even when empirical literature has proved that it is necessary to know the extent to which the strength of the monetary transmission mechanism differs across countries in the same region.

Monetary policy is seen as a powerful tool for impacting the economy since an increase in money supply is expected to lead to an increase in real output and price level (Mishkin, 2006). Monetary policy affects these economic variables through the MTM, which is understood as the pass through of the monetary shocks. Literature has identified the channels of monetary policy action as the interest rate channel, the credit channel, the exchange rate channel and the asset price channel (Mishkin, 1996).

Empirical literature has shown that monetary policy tends to change the real economic activities and the prices through transmission mechanisms (Hussain, 2014). This is in relation to what Taylor (1995) acknowledged, that monetary transmission mechanism closely relates to how actual adjustments in monetary policy variables impinge on real income (output) and prices, since the monetary transmission mechanism is also concerned with how long it takes for monetary policy decisions to have an effect on the real economy, how strong the impacts are, and whether the results achieved are the intended results (Thlaku, 2005).

According to Cevik and Teksoz (2012), Buigut (2009) and Creel and Levasseur (2005), the efficacy of the MTM is influenced by among other things; the economic, legal and financial structure prevailing in the specific country, and these channels vary across countries due to differences in the extent of financial intermediation, the level of development of domestic capital markets, the degree of central bank autonomy, and each country's specific structural economic conditions.

It has been argued therefore that unless policymakers know more about how monetary policy decisions influence macroeconomic variables such as aggregate output,

employment, and consumer prices through the different channels of monetary transmission, they will always be facing greater uncertainty about the timing and effectiveness of policy actions and consequently in maintaining macro-financial stability (Cevik&Teksoz, 2012). An examination of the transmission mechanisms therefore gives room for the evaluation of the responsiveness of economic variables that is price level and real output to monetary policy shocks with regard to the speed of adjustment, magnitude of the effect as well as the important channels of the transmission mechanism (Buiguit, 2009).

1.2 Problem Statement

Although the monetary policy transmission mechanism has been a subject of much research over a number of years in both developed and developing countries, there is no consensus on how it works. Alexander *et al.* (1995), acknowledged that significant gaps remain with regard to the precise nature of the channels through which monetary impulses are transmitted through economies, just as Bernanke and Gertler(1995) asserted that‘the monetary transmission mechanism remains a blackbox that need to be explored’.As such studies have been carried out worldwide,both at a national and a regional level.

Empirical literature has revealed that monetary transmission channels vary systematically across countries in the same region, with some channels being insignificant and not important and other channels being significant and important and for other regions the transmission mechanism was found to be similar. Such studies include those done in both developed and developing countries. Some of these studies include those by Angeloni *et al.* (2001), Reyes (2002), Creel and

Levasseur (2005), Buigut (2009), Oros and Romocea-Turcu (2009), Cevik and Teksoz (2012), Davoodiet *al.* (2013) and Odabaşioğlu and Aydın (2015). Most of these studies have researched the interest rate channel of the monetary transmission because economic literature stipulates that ‘the interest rate channel is the most important transmission mechanism of monetary policy’.

While most of theoretical and empirical literature on monetary transmission mechanisms has been for developed and emerging economies with well-functioning financial markets, little is known about the monetary policy transmission mechanism in the SADC countries where most of the financial markets in this region are least developed.

In the SADC region, a study by Lungu (2008) which investigated the Bank lending channel in this region produced mixed results. But the relative importance and similarity of the other monetary policy transmission channels, their magnitude and timing of monetary policy effects still remains an open question in the region.

It is therefore against this background that this study seeks to assess the importance and similarity of the interest rate channel of monetary policy transmission in the SADC region which economic literature presents as the most important channel of monetary policy transmission.

1.3 Objectives of the Study

The overall objective of this research work is to assess the importance and similarity of the interest rate channel for the SADC countries.

The specific objectives of the study are:

- i. To examine the relative importance of the interest rate channel in the SADC countries.
- ii. To compare the strength of the interest rate channel across the SADC countries.

1.4 Research Hypotheses

- i. Monetary policy shocks through short term interest rates do not affect inflation and output.
- ii. The strength of the interest rate channel is not similar across the SADC countries.

1.5 Significance of the Thesis

This research work is set up to investigate the importance and similarity of the interest rate channel in the SADC region. Hence, this research work is significant in many ways: Firstly, it will appraise the monetary transmission mechanism of the region, if what economic literature stipulates hold for SADC countries, as well as highlight the differences in transmission mechanisms among the SADC countries. The study will also offer relevant policy recommendations that will inform the conduct of monetary policy for a better control of the economy by the relevant central Banks.

1.6 Scope and Limitation of the study

The scope of the study is confined to the investigation of the effectiveness of the monetary transmission mechanism in the SADC region, specifically assessing the importance and similarity of the interest rate channel of the monetary policy

transmission channels in the region for the period starting 2007Q1 to 2015Q4 by using vector autoregressive regression technique. The study period is chosen in order to assess the role of this channel in the recent years.

The study will use only fourteen countries of the SADC region, all SADC countries except Zimbabwe, based on data availability from the World Bank data base and IMF International Financial statistics for the study period. However, this limitation will not invalidate the result of the study.

1.7 Plan of the Thesis

The rest of this study is structured as follows. Chapter 2 will give an outline of the conduct of monetary policy in the SADC region and Chapter 3 will present a review on monetary transmission literature that is relevant to the study. Chapter 4 will explain the data and methodology followed in this study. In Chapter 5, results and discussions of the research will be presented and in Chapter 6, the conclusion, policy implications and recommendations based on the results of the study will be presented.

CHAPTER 2

CONDUCT OF MONETARY POLICY IN THE SADC

2.1 Introduction

This Chapter will give a summary of how monetary policy is conducted in each of the fifteen countries in the SADC region.

A. Angola

The main objective of Angola's monetary policy is to preserve the value of their national currency. The operational target to this objective has ever since been base money, through the Bank's reserve money program until September 2011 when the bank relied heavily on interest rates after the introduction of the National Bank of Angola (BNA) reference rate (IMF, 2015). The Bank now has overnight standing facilities for injection and absorption of liquidity with 28- and 63-day T-bills; 7- and 28-day repurchase agreements; spot sales of foreign currency; and mandatory reserve requirements as other instruments to manage liquidity (IMF, 2015).

B. Botswana

The objective of monetary policy in Botswana before the year 2002 was diversification and sustainable growth. Monetary authorities used interest rates indirectly to influence inflationary pressures in the economy. The commercial bank credit growth rate was the most important intermediate target and it was

directly influenced by monetary policy through changes in interest rates (Munyengwa, 2012). From 2002, the objective of monetary policy became price stability where an inflation objective that has to be achieved in that year was announced. In 2006, the monetary authorities abandoned the annual inflation objective and introduced a three-year medium-term inflation objective of 3–6 percent, which considered a more reasonable horizon (Munyengwa, 2012).

Thereafter, price stability objective continued to be pursued with the aim to achieve low and sustainable levels of inflation that is consistent with the bank's three year medium-term inflation objective (Bank of Botswana, 2016). To achieve this price stability goal, the Bank uses interest rates and Open Market Operations (OMO) to influence the demand conditions which affect inflation in the economy. The formulation of monetary policy also takes into account the safeguarding of a stable financial system in ensuring that the broader national objective of monetary policy which is sustainable economic development is achieved (Bank of Botswana, 2016).

C. Democratic Republic of Congo (DRC)

The Central Bank of Congo (BCC) has price stability as its primary objective of monetary policy. Despite the high degree of dollarization, the BCC's intermediate monetary target is base money. In implementing monetary policy, the BCC sets out a path for the growth of the money supply consistent with its inflation objective and the projection for economic growth. Money growth is broken down into weekly targets revised weekly by the BCC according to updated money demand projections (IMF, 2013).

If projected short-term money growth deviates from the programmed path, the BCC intervenes by injecting or absorbing liquidity through the purchase/sale of central bank bills. The BCC's monetary policy instrument is the policy rate. The BCC changes its policy rate to respond to perceived permanent monetary shocks (IMF, 2013). By increasing the interest rate, the BCC intends to increase the attractiveness of assets in local currency hence reducing liquidity in the system. During times of double-digit inflation, the BCC typically targets a real policy rate of about 10 percent and achieves the monetary policy objective by estimating a time lag of two to three months for a change in the policy rate to affect money demand (IMF, 2013).

D. Lesotho

Monetary policy in Lesotho aims to achieve price stability, promote sustainable economic growth, full employment and a sustainable pattern of international payments. It mirrors that of South Africa (CBL, 2004). The bank achieves these monetary policy goals through the use of indirect monetary policy instruments that enhance price signal role in the economy (CBL, 2004).

E. Madagascar

The Central Bank of Madagascar (BCM) has price stability as its monetary policy primary objective. This objective is achieved through the bank's conduct of monetary policy that centres on a monetary programming framework as it aims to achieve an annual growth rate target of broad money with M3 serving as the intermediate guide basing on assumptions of CPI inflation and real GDP growth rate. Using money multiplier which is set on a three-month moving average basis, this intermediate guide translates into an operating guide (IMF, 2005).

The conduct of monetary policy in Madagascar make use of direct policy instruments even though the bank adopted indirect market instruments from the mid-1990s. This is mainly because indirect instruments are hampered by chronic excess liquidity conditions which make them ineffective. As such, the Bank alters the statutory reserve requirement ratio in order to regulate base money and overall liquidity (IMF, 2005).

F. Malawi

The Reserve Bank of Malawi (RBM) has price stability as its objective of money supply (Chiumia, 2015). The monetary policy framework in Malawi has since 1994, following the floating of the exchange rate, been officially designated as reserve money targeting with OMO playing an important role. The system operates as if the central bank also targets short term interest rates through adjustments in the bank rate (Ngalawa, 2009).

The choice of instruments has moved from direct instruments after independence in 1964, to indirect instruments since 1989 when financial reforms through Structural Adjustment Programmes commenced. As an instrument target of monetary policy, reserve money is used to reflect OMO and foreign exchange transactions (Chiumia, 2015).

G. Mauritius

Economic and financial conditions have affected the conduct of monetary policy in Mauritius over the years. The Bank of Mauritius (BoM) has price stability and an orderly balanced economic development as its monetary policy primary objective

(IMF, 2010). During the financial liberalisation era, the BoM moved from direct monetary control, to indirect monetary control and it started influencing money growth and market interest rates (IMF, 2010).

Whereas money supply remained the intermediate policy target of monetary policy, in 1999 the operating target which used to be the reserve money, was replaced by the Lombard rate which is the key interest rate, which was also later on replaced by the repo rate in 2006, and it became the signalling device of monetary policy to market participants (IMF, 2010). In its conduct of monetary policy, the Bank also regulates the supply of reserve money and uses OMO to sterilise excess liquidity in order to ensure that the overnight interbank market rate mirrors the repo rate (IMF, 2010).

H. Mozambique

The Banco de Mozambique (BM) has price stability (annual inflation between 3% and 5%) as its main goal of monetary policy. In its conduct of monetary policy, the Bank adopts an operational framework based on the monetary aggregates with money base as the instrument of the monetary policy (BM, 2007). Adjustments in the monetary base involves interventions in the money market through OMO (Machava&Brännä, 2015). Considering this, the Bank uses indirect instruments to reach the operational targets. Apart from OMO, reserve requirements, repo and reverse operations and the discount window are also used as instruments (BM, 2012).

I. Namibia

The conduct of monetary policy in Namibia has a goal of ensuring price stability in the interest of sustainable growth and development. The Bank of Namibia's monetary

policy framework is underpinned by the fixed currency peg to the South African Rand. In ensuring that the goal of price stability is achieved, the Bank uses the maintenance of the fixed peg as an intermediate target while importing inflation from South Africa (Bank of Namibia, 2008).

In addition, the bank monitors the level of official reserves as an operating target and in order to reach this operational target, the bank uses; call account, repurchase operations, Bank of Namibia Bills and other monetary policy tools to manage liquidity in the banking system with the Repo rate, that is kept close to that of South Africa, been the main policy tool (Alweendo, 2008).

J. Seychelles

The current monetary policy framework for Seychelles has price stability as its final target. The Central Bank of Seychelles (CBS) achieves this objective by managing money supply indirectly with the operating target been reserve money. In controlling money supply, the bank links money supply to reserve money through the money multiplier (CBS, 2004) and relies on OMO to achieve reserve money targets (CBS, 2016).

K. South Africa

The objective of monetary policy in South Africa has shifted from the control of money supply to stabilizing of interest rates and the exchange rate. Prior to 2000, monetary policy targeted the growth of broad money. The policy tool that was employed in this regime was the repo rate, which the South Africa Reserve Bank (SARB) used to control overnight lending to commercial banks and short-

term market interest rates. The objective of the SARB by then, was to protect the internal and external value of the Rand (Thlaku, 2011).

In 2000, the South African government decided to implement Inflation Targeting as the new monetary policy framework. The decision was to set a target range of between three and six percent in the year 2002. The policy main objective of the SARB did not change. The SARB aimed to protect the value of the currency so that it could continue to pursue economic growth that is balanced and sustainable. The primary objective of the SARB is to influence interest rates so that they can combat inflation (Thlaku, 2011).

L. Swaziland

Swaziland's MTM targets inflation rate following the direct transmission of inflation from South Africa. The monetary authorities started inflation targeting in 2000 following South Africa (Ndzinisa, 2008). Prior to 1990's, formal inflation targeting was not part of the framework because money supply growth which was an intermediate target, anchored the decisions of monetary policy. From late 1990s, the Reserve Bank of Swaziland moved to "eclectic" or "pragmatic" inflation targeting with monetary aggregates still playing a greater role in the inflation process, but the Bank now begun to closely monitor the financial and real indicators in determining the appropriate level of short-term interest rates (Ndzinisa, 2008).

M. Tanzania

The financial liberalisation era saw the epoch of monetary policy reform, moving to indirect monetary policy with the adoption of a monetary-targeting framework in

1993. The reserve money and the broad money (M2) policies became operational and intermediate targets, respectively. The Bank of Tanzania (BoT) act was further amended in 1995, providing a narrowed mandate of price stability (Nyorekwa&Odhiambo, 2014).

The bank has since then used a number of indirect monetary policy instruments. The open market operations have been in operation since the first auction of government securities in 1993/94. The standby credit discount window and Lombard facility were initiated in 2003. The minimum statutory requirements were introduced later in the 1990s; and these remained in place until 2009, when reserve requirements on central government deposits of 20% were introduced (BoT, 2011). Repurchase agreements (Repos) with maturity of 1-21 days were introduced in 2007. Moral suasion is also used as a monetary instrument. Monetary targets were set using end-period money stocks until 2006; and thereafter, an average reserve money policy was adopted (Nyorekwa&Odhiambo, 2014).

N. Zambia

The principal purpose of the Bank of Zambia (BoZ) is to achieve and maintain price and financial system stability for balanced macro-economic development. Monetary policy focus on achieving the end-year annual inflation rate target of 7.0%. To achieve this objective, the BoZ rely mainly on open market operations that are directed at maintaining the interbank rate within a given corridor around the BoZ Policy Rate (BoZ, 2015).

In its conduct of monetary policy, the Bank of Zambia used direct instruments from 1964 up until 1991. The objective of monetary policy during this period was output growth and direct controls were used. In response to the changing financial environment and global consensus, the BoZ placed greater emphasis on market-based (indirect) monetary instruments such as OMO rather than direct instruments, such as credit and interest controls, in its conduct of monetary policy from 1992 (BoZ, 2014).

In 1993, the BoZ employed both direct and indirect instruments, with a greater reliance on the latter. The indirect instruments include government securities which comprise Treasury bills and bonds auctions, daily OMO, Repurchase Agreements (Repos), the discount window and foreign exchange dealings while the direct instruments include the core liquid asset ratio and the statutory reserve ratio. The Bank of Zambia also adopted the money supply aggregate as the primary monetary policy instrument to play the main role in monetary policy. Reserve money is the operating target of monetary policy while broad money, defined as including foreign exchange deposits of commercial banks, is the intermediate target of monetary policy (BoZ, 2014).

O. Zimbabwe

In the 1980s, the conduct of monetary policy in Zimbabwe was administratively controlled and made use of direct instruments. With the objective of price stability and promoting economic activity through agriculture, the Reserve Bank of Zimbabwe (RBZ) monetary policy focused on restraining credit creation. From the 1990s, price stability has been the ultimate objective of Zimbabwe's monetary policy with monetary aggregates as the intermediate policy target (RBZ, 2001).

The bank monitors the level of liquidity on a daily basis in the money market ensuring that it is consistent with the monetary growth target. In the financial liberalisation era, the conduct of monetary policy was affected and the bank began to use indirect instruments which replaced the direct instruments that were used earlier on (RBZ, 2001).

2.2 Review of the financial systems structure in SADC economies

Ramlogan (2004) as cited in Buigut (2008) acknowledged that the interest rate channel likely plays a smaller role for countries with less than fully developed capital markets, since in most cases, the main source of investment finance is bank credit. That is to say that for the interest rate channel to be effective, the structure of the financial markets is an important factor.

Since the study is also after comparing the transmission mechanism in the region, an establishment of whether there exists different types of financial markets and institutions and whether the degree of their development differs across these countries is necessary since differences in the stages of development of the financial systems will likely entail differences in the strength of the interest rate channel across the SADC region. Therefore, a review of the financial systems structure in SADC is necessary as Buigut (2008) acknowledged, that differences in financial markets structures across countries implies differences in the transmission mechanism.

In a study on a review of the financial systems structures in SADC member states by Phakedi (2014), it was found that SADC countries are at different development stages

with regards to their money and capital markets. Hence entailing that most countries in SADC have underdeveloped financial systems that are currently in the stages of development as can be seen in Appendix A. From this finding, it can be expected that firstly the interest rate channel will not be effective for most countries in this region and secondly that the transmission mechanism will differ across the SADC countries.

CHAPTER 3

REVIEW OF LITERATURE

3.1 Introduction

This chapter gives a review of theoretical and empirical literature on the monetary policy transmission mechanism.

3.2 Theoretical literature

Understanding of monetary policy and how it affect aggregate economic activities (output and employment) as well as its extended effect on other macroeconomic variables in the economy (the MTM) is a necessary ingredient in conducting this research work.

Monetary policy refers to the decisions made by monetary authorities to ensure price stability by use of various instruments. It is a vital tool under the command of the monetary authorities used in the management of the economy in order to achieve certain macroeconomic objectives (Output and Inflation). Monetary transmission mechanism refers to the effect of these decisions on economic activity and inflation through the interest rate channel, exchange rate channel, asset prices channel, and the expectations channel (Odabaşioğlu & Aydın, 2015).

The transmission mechanism between money market and real market is the most important factor influential on the efficiency of monetary policy in economies since

changes in the money market of a country as a result of the conditions undergone by its economy affect its real sector through various channels (Kuttner and Mosser, 2002).

Below is the summary about such generally accepted channels of monetary transmission mechanism with much focus on the interest rate channel.

3.2.1 The Interest rate Channel

The interest rate channel of transmission of monetary policy was clearly defined in Keynes's General Theory (Mohammed, 2013). According to the Keynesian view, a fall in real interest rate due to monetary expansion decreases cost of capital, thereby leading to an increase in investments and thus in total product (Dornbusch & Fischer, 1994). The traditional Keynesian approach to the monetary transmission mechanism works directly through interest rates. The proposition is based on the belief that monetary policy (e.g. a change in the short-term official interest rate) has an impact on (short and long term) nominal as well as real interest rates that in turn affect consumer and investment spending, aggregate demand and output (Mishkin, 1996).

Mishkin (2004) analysed this traditional mechanism based on the Keynesians view by assuming expansionary monetary policy where an increase in money supply leads to a fall in real interest rate. This in turn lowers the cost of capital which is a source of expansion in investment spending thereby causing a rise in aggregate demand and a rise in output.

The focus of the traditional transmission mechanism mainly lies on the real interest rate since it is the rate affecting mostly consumer and business decisions. This happens because of the slow adjustment of goods prices over time, and the expectation is that expansionary monetary policy will lower short term real interest rates following the lowering of the short term nominal interest rates (Mohammed, 2013). Hence, a change in the nominal interest rate results in a change in real interest rate along the period where prices and expectation are adjusting.

Mohammed (2013) noted that it is rather the real long term interest rate that has major impacts on spending and not the short term interest rate. This therefore provides an important mechanism for how monetary policy can stimulate the economy, even in times when the monetary authorities drives down the nominal interest rates to zero.

With nominal interest rates hitting a floor of zero, an expansion in the money supply can raise the expected price level and hence expected inflation, which in turn decrease the real interest rate. This means that spending will be stimulated through the interest rate channel even when the nominal interest rate is fixed at zero (Mishkin, 2004). As a result, spending may be encouraged with the real interest rate going down since it is not the short-term real interest rate but the long-term real interest rate which is influential on expenditures (Mishkin, 2007).

By the functioning of the interest rate channel, a change starting in the short-term interest rate manifests itself in medium-term and long-term interest rates through supply and demand mechanism in financial markets. That is to say, the change made by the monetary authority in the short-term nominal interest rate influences the short-

term and the long-term real interest rates under the assumption of price rigidity (sticky prices). Price rigidity is one of the factors making monetary policy influential on real economy in the short term. The degree of rigidity determines how long it takes for monetary transmission to take place (Taylor, 1995).

Although, the conventional approach to the interest channel does not explicitly take the role of expectations into account, a change in interest rates as a result of a policy change may quite well have an impact on the economy through expectations and confidence about the future outlook of the economy (Bank of England, 2001). However, it is not an easy task to predict the monetary policy effects direction since variations are expected with time (Mohammed, 2013).

3.2.2 Other channels of monetary policy transmission mechanism

Other channels through which monetary shocks influence the level of economic aggregates other than the interest rate channel include the bank lending (credit) channel, exchange rate channel, balance sheet channel, asset price channel and expectations channel.

3.2.2.1 The bank lending (or credit) channel

This channel works through the response of credit aggregates to changes in interest rates and other policy instruments. It is an extension i.e. an enhancement mechanism to the interest rate channel and amplifies the real effects of monetary policy through changes in the supply of bank credit (Bernanke & Blinder, 1992; Bernanke & Gertler, 1995). The necessary condition for the credit channel to operate is the significant role

of banks as a source of capital for the private sector, especially in bank-based emerging market economies (Cevik&Teksoz, 2012).

3.2.2.2 The exchange rate channel

This channel works through the impact of monetary developments on exchange rates and aggregate demand and supply where an increase in interest rates is expected to lead to exchange rate appreciation, which lowers the price of imported goods and services and thereby pushes down domestic inflation. The effectiveness of this channel depends on among others, the exchange rate regime, the degree of openness to capital flows as well as the extent of exchange rate pass through (Taylor, 1995). Whereas this channel is effective for small open economies with a fixed exchange rate regime only when domestic interest rates track foreign interest rates as it leaves little or no room for domestic monetary policy, this channel is more effective when such countries pursue a flexible exchange rate regime (Cevik&Teksoz, 2012).

3.2.2.3 The balance sheet channel

This channel operates through the impact of monetary innovations on the net wealth and credit worthiness of households and companies. According to Mishkin (1996), wealth effects influences consumption demand through changes in real money balances of households and firms that rely on borrowed funds just like in the bank lending channel (Cevik&Teksoz, 2012).

3.2.2.4 The asset price channel

This channel operates through the impact of monetary shocks on yields, equity shares, real estate, and other domestic assets, operating through changes in the market value

of corporate and household wealth. According to Mishkin (1995), changes in short-term interest rates and/or other policy instruments can alter firms' capacity for fixed investment spending through balance sheet effects, and household consumption through wealth effects (Cevik&Teksoz, 2012).

3.2.2.5 The expectations channel

This channel works through the impact of monetary shocks on the perception of households and firms about intertemporal rates of substitution. According to Taylor (1995), Inflation expectations, for example, influences interest rates, exchange rate movements, wages, aggregate demand, and domestic prices (Cevik&Teksoz, 2012).

3.3 Empirical literature

The functioning of monetary transmission channels is expected to vary across countries if among other things there exists differences in: the extent of financial intermediation, the degree of domestic capital markets development, the degree of central bank autonomy, as well as each country's specific structural economic conditions (Cevik&Teksoz, 2012). While there is ample theoretical and empirical literature on how monetary shocks affect macroeconomic aggregates in developed and emerging economies with well-functioning financial markets, little is done on developing countries.

Empirical studies in this area have mainly used the Vector Auto Regressive (VAR) approach and focused primarily on the reduced-form relationships between monetary policy and output using a small number of variables such as, real output, inflation(consumer price index), interest rate, credit, and the exchange rate. Literature

contains a lot of studies dealing with the transmission mechanisms in various countries or groups of countries in which the influences of monetary policy decisions on real sector variables are investigated in terms of just one channel or several channels.

This section will examine some of the studies in greater detail to obtain a better idea about their methods and findings.

3.3.1 World Economies (Apart from Africa)

Ganevet *al.* (2002) investigated the efficiency of the interest rate and exchange rate channels in all EU member and CEE transition economies from the year 1995 to 2000 using the Granger causality test and impulse response analyses and tried to reveal the existence of long-term relationships between basic macro variables. They concluded that there is a systematic interaction between the variables in the long term for all countries except for Estonia and Slovenia, and inflation responses are mostly consistent with the theory for transition economies.

Creel and Levasseur (2005) used a structural VAR model with short-term restrictions to investigate the relative importance of interest rate, credit and exchange rate channels for the Czech Republic, Hungary and Poland from the period 1993:1 to 2004:3. Using a Structural VAR model with short term restriction, they observed that the interest rate, exchange rate, and credit channels were less efficient and when compared with other channels, the interest rate and the exchange rate channels played an increasing role in Poland in comparison to other countries in the study.

Elbourne and Haan (2006) evaluated the functioning of monetary transmission mechanisms in all EU member CEE countries for the period 1993 to 2004. They took different sample periods for each country basing on monetary policy regimes. Using the structural vector autoregressive methodology, they found little evidence on the link between financial structure indicators and monetary policy for these ten countries and concluded that the monetary transmission mechanism would function efficiently if weak banks were strengthened.

Oros and Romocea-Turcu (2009) assessed the monetary policy transmission channels of six CEECs namely Hungary, Poland, Czech Republic, Romania, Slovakia and Slovenia over recent periods corresponding to stable monetary regimes. The interest rate channel, the domestic credit channel and the exchange rate channel were the interest of the study. The relative importance of these channels was determined using a structural VAR model. The empirical results showed that all the countries in the study shared a weak domestic credit channel and depicted some heterogeneity with regards to the relative effectiveness of the exchange rate and interest rate channels.

Matousek and Sarantis (2009) investigated the efficiency of the bank credit channel for eight EU member CEE economies for the years 1994 to 2003 and employed panel and dynamic panel data estimation techniques. They found evidence of a bank lending channel in all countries in the study, however the strength of the channel varied across countries.

Jimborean (2009) investigated the efficiency of the bank credit channel in ten CEE countries in the period between 1999 and 2005 within the framework of a comparison

model involving bank characteristics such as size and found the existence of a functioning bank-lending channel through small banks which would be strengthened more in the future.

Eichenbaum (1992) described and assessed the nature of the empirical support for the effects of monetary policy using bivariate VAR in five advanced regions of the world, namely the USA, UK, Japan, France, and Germany. His VAR model includes the industrial production, consumer price index, and official interest rate as the key variables in the baseline VAR model. The results of the VAR model showed that monetary shocks lead to output following a hump-shaped pattern in all the five countries investigated.

Kashyap and Stein (2000) studied the Monetary Transmission Mechanism in USA with quarterly data from 1976 to 1993 and used a two-step flexible specification procedures and run a cross sectional regression at the first stage and bivariateregression in the second stage. They found evidence of the bank lending channel in USA.

Elbourne (2008) estimated an eight variables SVAR model when investigating the role of housing price in the MTM in UK. The results of his paper revealed that housing price do not play a significant role in the transmissions of the bank of England monetary policy. The implication of this finding is that credit and wealth channels do not account for a significant variation of output in response to monetary policy innovations in UK.

Ahmed (2008) analysed various channels of monetary policy transmission in the two small pacific economies, i.e., Fiji and Papua New Guinea (PNG) using a VAR model. He used quarterly data from 1974Q1 to 2003Q4 for PNG and from 1971Q1 to 2003Q4 for Fiji. In his VAR analysis, he found that the monetary channel is more important in explaining the output variation in Fiji than the credit channel especially in the long run. While in PNG the credit channel plays significant role compared to money channel supporting the fact that in less developed financial sector economies, the bank lending channel is more important.

Reyes (2002) analysed the monetary transmission mechanism in USA by employing VAR approach. He found empirical evidence that support the four channels of transmission mechanism surveyed by Mishkin (1996). The result of his study showed that real interest rate, asset price, real expenditure and money are the major variables affecting the dynamics of output. However, real exchange rate, real net export, real bank loans and real deposit have a weak influence on output.

Loayza (2002) studied the monetary transmission channels in Australia, Canada and the United Kingdom. Using the VAR approach, he found that the interest rate and exchange rate channels are important in all of the mentioned countries. Asset price and credit channels on the other hand were not important in any of the countries in the study.

Angeloni *et al.* (2002) made an attempt to examine the monetary transmission mechanisms in euro area countries using Vector Autoregressive (VAR) models and structural euro area models. By employing country specific data of countries like

Austria, Germany, France, Italy, Belgium, Spain and Portugal, they found that the interest rate and credit channels are the most significant transmission channels in the area.

Odabaşioğlu & Aydın (2015) investigated the effectiveness of the monetary transmission channels in Central and Eastern European (CEE) transition economies from 1995:01 to 2012:12. In determining the short-term dynamics, they used VAR analysis and for the long-term dynamics of the effects of transmission channels, the autoregressive distributed lag (ARDL) analysis was used. They found that the exchange rate and financial development channels were the most efficient channels in most of the economies in the study.

Cevik & Teksoz (2012) empirically investigated the effectiveness of monetary policy transmission in the Gulf Cooperation Council (GCC) countries. Using the structural vector autoregressive model (SVAR) analysis, they found that the bank lending and interest rate channels were relatively effective in influencing non-hydrocarbon output and consumer prices, and the exchange rate channel did not prove to be an important channel mainly because of the pegged exchange rate regimes.

Isakova (2008) examined monetary policy efficiency in Central Asia by investigating the monetary transmission mechanism in the region's economies in Kazakhstan, the Kyrgyz Republic, and Tajikistan using a five variable vector auto regression (VAR) with Cholesky ordering of the form (Y, P, M, R, S) and a recursive identification following this ordering where Y is real income, P is price indices (CPI), M is the monetary aggregates, R is the policy rate and S is the nominal exchange rate

to the U.S dollar. Using monthly data from 1995 to 2006 and with all variables transformed into natural logarithms except interest rates, the results of the study suggested that the bank lending channel has been weak and unimportant while the interest rate channel is relatively important and an effective channel of monetary policy transmission in these countries.

Acosta-Ormaechea and Coble (2011) empirically studied the MTM in Chile, New Zealand, Peru and Uruguay. The study used a three variable VAR model to analyse the interest rate channel. The benchmark model that was used was of the form (R_t, I_{Pt}, CPI_t) , where R_t is the money market rate also known as the policy variable, I_{Pt} is the year on year change of an index of economic activity and CPI_t represented the annual inflation rate. With all the variables transformed into natural logarithms except for the money market rate, the results led them to the conclusion that the exchange rate channel played a more substantial role in controlling inflationary pressures in Peru and Uruguay and that the interest rate channel was more important in Chile and New Zealand.

3.3.2 African Economies

Saxegaard (2006) examines the pattern of excess liquidity in Sub-Saharan Africa and its consequences for the effectiveness of monetary policy using non-linear structural or threshold vector autoregressive (SVAR) model for Central African Economic and Monetary Community (CEMAC) region, Nigeria, and Uganda. Using quarterly data from the IMF's International Financial Statistics (IFS) over the period 1990 to 2004, he estimated a four variable threshold VARs (SVARs) ordered (Y, P, S, M_0) , where Y is real output, P is inflation, S is the nominal exchange rate and M_0 is base

money used as the instrument of monetary policy. He found that a money supply shock has weaker effects on real output and inflation when bank liquidity is high in Nigeria and Uganda with no effect in CEMAC thereby suggesting that excess liquidity weakens the monetary policy transmission mechanism.

Lungu (2008) uses vector auto-regressions (VAR) with Cholesky ordering to investigate the existence of a bank lending channel in the Southern African Development Community (SADC). His study employed monthly data from 1990 to 2006 in an eight variable VAR, with recursive identification ordered (Y, M2, M0, P, RS, L, RL, RD), where Y is real output, M2 is broad money, M0 is base money, P is the domestic price level, RS is the bank rate (RS) controlled by the central bank as the policy variable, L is the bank lending rate to the private sector, RL is the bank lending rate and RD is the deposit rate. Using data from the IMF's IFS database and various central banks' monthly and quarterly report with variables expressed in natural logarithms except for interest rates which are expressed in decimals, he found mixed results but reported the existence of a bank lending channel in all SADC countries in the sample.

Buigut (2009) employed the vector auto-regression (VAR) model with Cholesky ordering to investigate the monetary transmission mechanism for the East African Community (EAC) countries using annual time series data from the IFS for Kenya, Tanzania and Uganda. Using a three variable recursive VAR of the form (Y, CPI, R), where Y is real output, CPI is inflation and R is a short term interest rate, he found that the effect of a monetary policy shock on output and inflation are not significant

and concluded that the interest rate channel may not be so important for this region with regards to the proposed monetary union.

Davoodiet *al.* (2013) explored the relative importance of interest rate channel in East African Countries, using VAR model, with output, price level, reserve money, policy interest rate or other short-term interest rate, credit to private sector and the exchange rate as the variables. He found absence of the long run relationship among all the endogenous variables in the model and concluded that the traditional interest rate channel is not strong as it was very insignificant for the region as a whole.

Boughrara (2008) assessed the bank lending channel in Morocco and Tunisia using Tunisia (1989:1 to 2005:4), Morocco (1990:1 to 2005:4) quarterly data applied structural VAR analysis and Ramey (1993) approach and found that the bank lending channel is operative in Morocco and Tunisia (Davoodiet. *al.*, 2013).

Neaime (2008) assessed the monetary transmission mechanism across the region and how successful the MENA countries have been in making a smooth transition to inflation targeting using Recursive VAR and found that the exchange rate channel played an important role for Egypt and Turkey, while the interest rate channel was effective for Jordan, Lebanon, Morocco, and Tunisia.

Ziaei (2009) assessed the long run effects of monetary policy on bank lending, foreign asset and liability in ten (10) Middle East and North Africa (MENA) countries: Algeria, Bahrain, Egypt, Kuwait, Lebanon, Morocco, Oman, Qatar, Tunis and Turkey using quarterly, 1991:4 to 2006:4 data and applied the Johansen cointegration and

dynamic ordinary least square (DOLS) and concluded that the Bank lending channel was likely to be an effective monetary transmission channel.

Mishra *et al.* (2011) surveyed the evidence on the effectiveness of monetary transmission in developing countries using the VAR approach. In their study, not more than one study confirmed results on monetary policy shock effects on aggregate output to the consensus effects in the United States or other advanced countries and suspected that the “facts on the ground” were an important part of the story. Thus, there is no evidence of effective monetary transmission in developing countries, compared to developed countries like some Central and Eastern European transition economies.

Mishra & Montiel (2012) surveyed the evidence on the effectiveness of monetary transmission in low income countries and found that it is hard to place confidence in the strength of monetary transmission in such countries. They distinguished between the “facts on the ground” and “methodological deficiencies” interpretations of the absence of evidence for strong monetary transmission and suspected that “facts on the ground” are an important part of the story.

Kireyev (2015) investigated on how to improve the effectiveness of monetary policy in the West African Economic and Monetary Union using a distributed lag model. He concluded that, the transmission mechanism of monetary policy remained constrained and improving monetary policy effectiveness requires the proactiveness in determining the stance of fiscal policies, developing financial markets, and liberalizing controlled interest rates.

3.3.3 Empirical literature conclusion

As can be seen from the above African studies, most of these studies were undertaken in the developed regions of the world where financial systems are well developed with a few in developing regions like Africa where most of the financial systems are undergoing various stages of development. Hence for the SADC region, where the financial system is still developing, this paper will be a good motivation in investigating empirically the monetary transmission mechanism in the region.

From the studies reviewed in this chapter, the study can confirm that indeed the monetary transmission channels vary systematically across countries in the same region, and that the transmission channels that are effective and important for developed countries cannot be taken lightly as relevant monetary transmission channels for developing countries as well.

CHAPTER 4

RESEARCH METHODOLOGY

4.1 Introduction

According to Cheng (2006), it has become customary to investigate the effects of monetary policy using a VAR methodology. This is a way of uncovering linear dependence among multiple time series variables. In this approach, the variables have an equation each which explain its evolution based on its own lagged values, of other variables, and an error term.

Lungu(2008) explains that the choice of the VAR approach is inspired by the existence of empirical literature using VARs to examine the monetary transmission in Africa, Europe and Asia focusing on reduced-form relationships between monetary policy and macroeconomic variables. The inspiration to employ a VAR model has also come from the existence of a large empirical literature i.e. Bernanke and Blinder (1992), Jiang et al. (2005), Agha *et al.* (2005), Lungu (2008), Buigut (2009), Hussain (2009), Baig (2011) and Hussain (2014), to mention a few, who applied the VAR model to examine the impact of monetary policy on real income and prices.

Morsink and Bayoumi (1999) observed that the VAR approach allows us to place minimal restrictions on how monetary shocks affect the economy, which given the lack of consensus about the workings of the monetary transmission mechanism is a distinct advantage. This study therefore utilizes VAR approach based on variance

decomposition analysis and impulse response function to examine the effect of interest rate channel on key economic variables i.e. output and inflation, following Buigut (2009) who investigated the interest rate channel of monetary policy transmission in the East African Community (EAC).

4.2 Data and Variables

The study make use of Quarterly time series data (2007Q1 to 2015Q4) sourced from the International Financial Statistics (IFS CD Rom). Quarterly real GDP is obtained after interpolating the annual real GDP data from the World Bank Data base. The study uses the Lisman and Sandee Interpolation Method, which is a method of interpolation through which quarterly data is obtained from yearly aggregates while at the same time, ensuring that variability is present, in STATA. Following Buigut (2009), the variables included in the analysis are determined based on monetary transmission mechanism literature. In this regard, short term interest rate (R) represent the interest rate channel. Moreover, gross domestic product (GDP) and consumer price index (CPI) representing inflation are used as macroeconomic variables in the models.

4.3 VAR Diagnostic statistics:

Before estimation, VAR appropriateness is checked so that we do not end up with spurious VAR. The study conducts the following important diagnostic tests namely: Stationarity tests, Stability test, Lag selection criterion test, Residual serial correlation, LM test, Residual multivariate normality: Jacque Bera test and Residual Heteroskedasticity test.

4.3.1 Stationarity test

To test the time series properties of the data, the study conducts stationarity tests using the Augmented Dickey-Fuller (ADF) test and the Dickey-Fuller test with GLS detrending (DFGLS) is also conducted to further the unit root test. A time series variable is stationary when it has a finite mean, variance and auto-covariance function that are all independent of time. Stationarity is essential for standard econometric theory because without it we cannot obtain consistent estimators which in turn give doubtful or spurious regression results.

4.3.2 Lag Selection Criteria

The lag length of the VAR estimation can be selected using the Akaike Information Criterion (AIC), Schwartz Bayesian criterion (SBIC), Hannan-Quinn Information Criteria (HQIC) and the Log Likelihood Ratio (LR). This study's decision is based on the Schwartz Bayesian criterion (SBIC), since it is believed to select a more parsimonious model (Enders, 2015). In the literature, the importance of lag length determination is demonstrated by Braun and Mittnik (1993) who show that estimates of a VAR whose lag length differs from the true lag length are inconsistent as are the impulse response functions and variance decompositions derived from the estimated VAR.

4.3.3 Stability Test

The stability test requires that the roots of the polynomial lie within the unit circle. According to Phaff (2008), one important characteristic of a VAR model is its stability. He explains that if the VAR model is stable, it generates stationary time series with time invariant means, variances and covariance structure, given sufficient

starting values. The stability test of the VAR model is done using the inverse root of the characteristic autoregressive (AR) polynomial. The estimated model is considered stable if all the roots have modules less than one and lie within the unit circle. If the model is not stable, some roots will lie outside the circle, in which case certain results such as impulse response standard errors are invalid.

4.3.4 Cointegration Test

Buigut (2009) observes that when testing for cointegration among the variables, the Johansen (1988) procedure is usually used to test the presence and the number of cointegration relations in the system. It considers a model where we have a vector of variables $[Z_t]$ which are endogenous. The generalized specification of an unrestricted VAR is given as follows:

$$Z_t = A_k Z_t + \dots + A_m Z_{t-k} + \partial + v_t \dots \dots \dots 1$$

Where Z_t is a (nx1) matrix which means the VAR model has n variables, $A_k \dots \dots \dots A_m$ are (nxn) matrices of autoregressive coefficients to be estimated, k is the lag length, ∂ is the deterministic term, and v_t is the error term. This unrestricted VAR can be used to estimate dynamic relationships among jointly endogenous variables.

In making inferences about the number of cointegrating relations, two statistics known as the trace statistic and the maximum eigen value statistic are used. The trace statistic, (λ_{trace}) , a likelihood ratio test statistic, tests the null hypothesis that the number of distinct cointegrating vectors is less than or equal to r against a general alternative. This value is equal to zero when all $\lambda_i = 0$. The further away the estimated

roots (eigenvalues) are from zero the more negative is the $\ln(1 - \lambda_i)$ and the larger the trace statistic. The trace statistic is determined using the following formula:

$$\lambda_{trace} = -T \sum_{i=r+1}^n \ln(1 - \lambda_i) \dots \dots \dots 2$$

Where T is the number of observations and λ_i is the i th eigenvalue. The null and alternative hypotheses are given as $H_0: r = 0, H_1: r > 0; H_0: r \leq 1, H_1: r > 1; H_0: r \leq 2, H_1: r > 2$; etc. An alternative is the maximum eigenvalue test statistic (λ_{max}), which tests the null that the number of cointegrating vectors is r against the alternative of $r + 1$ cointegrating vectors. The maximum eigenvalue statistic is determined using the following formula:

$$\lambda_{max}(r, r + 1) = -T \ln(1 - \lambda_i) \dots \dots \dots 3$$

The null and alternative hypotheses are given as $H_0: r = 0, H_1: r = 1; H_0: r = 1, H_1: r = 2, H_0: r = 2, H_1: r = 3$; etc. To make inferences regarding the number of cointegrating relationships, the trace and maximum eigenvalue statistics are compared with the critical values. If the calculated value is greater than the critical value, the null hypothesis of no cointegration is rejected and equation (1) is reformulated into a Vector Error Correction Mechanism (VECM) as specified in equation (4).

According to Buigut (2009), the VECM considers information about the cointegration by combining both the short run and long run effects as the error correction term. Following Buigut (2009), we define a VECM for each SADC country i , and let Z be a vector of endogenous variables for each country in time period t , such that

$$Z_t^i = (RGDP_t^i, CPI_t^i, R_t^i)$$

Where RGDP is real output, CPI represents inflation, R is short term interest rate. Assuming Z_t is a vector of I(1) variables then ΔZ are stationery. The vector error correction is specified as:

$$\Delta Z_t = \sum \Gamma_i \Delta Z_{t-1} + \Pi Z_{t-k-1} + \delta + \varepsilon_t \dots \dots \dots 4$$

Where $\Pi = \alpha\beta$, α ; is a matrix and containing short run dynamics and β is the matrix containing the long run equilibrium relationships and $\sum \Gamma$ is a (kxk) dimensional coefficient matrices. δ is the deterministic term and ε_t is the error term.

4.4 VAR Analysis

In the approach used in this study, we first estimate the general VAR model. In the event that there is no cointegration, the unrestricted VAR is estimated. On the other hand, the Vector Error Correction Model (VECM) which is a restricted VAR will be estimated if there is cointegration. Secondly, we generate impulse responses. Thirdly, we estimate variance decomposition estimates. This is so because in empirical applications, the main uses of the VAR are Granger Causality test, impulse response analysis and variance decomposition analysis; what last two are together called Innovation Accounting (Enders, 2015).

The basic VAR model in a matrix form or trivariate system can be written as following.

$$\begin{bmatrix} Y_t \\ P_t \\ M_t \end{bmatrix} = A(l) \begin{bmatrix} Y_{t-1} \\ P_{t-1} \\ M_{t-1} \end{bmatrix} + \begin{bmatrix} \varepsilon_{yt} \\ \varepsilon_{pt} \\ \varepsilon_{mt} \end{bmatrix} \dots \dots \dots 5$$

In the above equation, according to Hussain (2014), Y_t represents the output, P_t is used for the price level and M_t is used for policy instruments. $A(l)$ is a 3*3 matrix polynomial in the lag operator L where ε_{it} is a white noise disturbance term. The

model assumes that ε_{it} is a time t serially uncorrelated shocks to the i th variables. These shocks can either be independently distributed innovations to Y_t , P_t and M_t .

In estimating VAR models, the choice of identification is important and most studies reviewed used standard Cholesky decomposition. Samkharadze (2008) states that for Cholesky identification scheme the order of the variables becomes important, as different ordering may give different results. Christiano, Eichenbaum and Evans (1999) state that under a Cholesky decomposition, the relationship among the reduced-form innovations is assumed to be recursive, so that if variables are ordered according to their place in the recursive chain, the reduced-form innovation in the first variable is assumed to be structural, while that in the second is a structural innovation in the second variable combined with a contemporaneous response to the structural innovation in the first variable, that of the third is a structural innovation in the third variable combined with a contemporaneous response to the structural innovations in the first two variables, and so on. They refer to this as the recursiveness assumption.

In choosing the order of the endogenous variables for the basic VAR model, we follow Buigut (2009) who proposes the following order:

$$Z_t^i = (Y_t^i, \pi_t^i, R_t^i) \dots\dots\dots 6$$

Where Y stands for real output, π represents inflation and R is the measure of short term interest rates. Therefore the ordering of this study will be

$$Y_t^i = (RGDP_t^i, CPI_t^i, R_t^i) \dots\dots\dots 7$$

Where $RGDP$ stands for real output, CPI represents inflation and R is the measure of short term interest rates. The ordering of the variables is based on the assumption that

a shock to the monetary policy through short term interest rates would be transmitted to price level and output. According to Samkharadze (2008), this is done to reflect the likely degree of endogeneity of the policy variable to current economic conditions.

4.4.1 Granger Causality Test

To test whether there is any association between, output, inflation and short term interest rates, the study conducts multivariate Granger causality tests. Granger causality analysis (GCA) is a method for investigating whether one time series can correctly forecast another (Granger, 1969). The concept of Granger causality relates to whether one variable can help improve the forecast of another. The regression formulation of Granger causality states that a variable X is the cause of another variable Y if the past values of X are helpful in predicting the future values of Y (Liu & Bahadori, 2012).

4.4.2 Impulse Response Functions

The dynamic relationship among the variables in the vector autoregressive model is investigated through impulse response function. Impulse response function (IRFs) indicates the dynamic responses of the dependent variables in the VAR system to one unit shock in each of the variables. In other words, they trace the effects of a shock to an endogenous variable on the variables in the VAR. IRFs are used to uncover responses of the main macroeconomic variables to a monetary policy shock. The impulse response can be explained in the following way.

The VAR model in the standard form is:

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_n Y_{t-k} + \varepsilon_t \dots \dots \dots 8$$

where Y_t is an $(n \times 1)$ vector having n variables and $A_1 \dots \dots \dots A_n$ are $(n \times n)$ matrices of autoregressive coefficients to be estimated. If Y_t is covariance stationary the above model can be written in a vector moving average representation, characterized as,

$$Y_t = \mu + \sum_{i=0}^{\infty} \varphi_i \varepsilon_{t-i} \dots \dots \dots 9$$

Where μ is the unconditional mean of Y_t . The moving average representation is a particularly useful way to observe the interaction between the variables included in the vector autoregressive model. Provided that the system is stable, the shock should gradually die away. Now consider there are two variables Y_t and P_t . The coefficients of φ_i can be used to produce the effects of ε_{yt} and ε_{pt} unit shock on the total time paths of Y_t and P_t sequence. The accumulated effects of unit shock of ε_{yt} and ε_{pt} can be obtained by the suitable summary of the coefficients of the impulse response function.

4.4.3 Variance Decompositions

The proportion of the fluctuations of a given variable that are caused by different shocks in the VAR system are investigated through Variance decomposition. Variance Decomposition shows the fraction of forecast variance error of the variables that are due to its “own” shocks, versus shocks to the other variables. variance decomposition provide an insight to policymakers on how long and by what magnitude monetary policy takes to affect each variable. In addition, the variance decomposition gives information about the relative importance of each random innovation to the variables in the VAR and will help to make inferences about monetary policy transmission.

To illustrate how variance decomposition operates, we take a vector autoregressive model in the standard form i.e.

$$Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \dots + A_n Y_{t-k} + \varepsilon_t \dots \dots \dots 10$$

And identify the coefficients of $A_1, A_2, \dots, A_k$ and then bring up to date equation 10 for one era and taking the provisional anticipation of Y_{t+1} .

The above-mentioned model transforms in the following:

$$E_t Y_{t+1} = A_1 Y_t + A_2 Y_{t-2} + \dots + A_k Y_{t-k+1} \dots \dots \dots 11$$

One step-ahead forecast error is:

$$Y_{t+1} - E_t Y_{t+1} = \varepsilon_{t+1} \dots \dots \dots 12$$

Moreover, the n-step-ahead forecast error is:

$$\varepsilon_{t+n} = A_1 \varepsilon_{t+n-1} + A_1^2 \varepsilon_{t+n-2} + \dots + A_1^n \varepsilon_{t+1} \dots \dots \dots 13$$

Equation 13 determines the n-step-ahead forecast error variance of a given variable which is explained by shocks to each independent variable.

CHAPTER 5

RESULTS AND DISCUSSIONS

5.1 Introduction

The data used is Quarterly time series data sourced from the International Financial Statistics (IFS CD Rom). Quarterly real GDP was obtained after interpolating the annual time series data from the World Bank Data base. The study made use of the Lisman and Sandee Interpolation Method in STATA. All the SADC countries are included in the study except for Zimbabwe due to data availability. An attempt was made to use comparable time series data from each country in terms of what the series measures and the time series properties to allow for comparability of models for the SADC countries. For each country three variables, Real GDP, Inflation and short term interest rate are included. The series covers the period from 2007 Quarter 1 to 2015 Quarter 4 for all the fourteen SADC countries in the study.

The Treasury bill rate represents the short term interest rate, and the consumer price index (CPI) is used to estimate the inflation rate (change in prices). In the case of Angola, Botswana and DRC, the Treasury bill rate is incomplete for the study period, as such, the quarterly time series discount rate is used to represent the short term interest rate. A missing value for example, 2009Q3 is filled by a simple average of 2009Q2 and 2009Q4 values. The discount rate for some of the fourteen countries was incomplete as well. Hence it was not possible to switch to use the discount rate for all the countries. Thus the real side of the economy is mirrored by the Real GDP in

natural logs. The interest rate, expressed in percentage form, by the Treasury bill rate (the discount rate for Angola, Botswana and Democratic Republic of Congo). While the price changes (inflation) is mirrored by the CPI in natural logs.

5.2 Stationarity tests

To test for the presence of unit roots, the data was examined using Augmented Dickey Fuller test (ADF). However the Dickey-Fuller test with GLS detrending (DFGLS) was also conducted to further test for the presence of unit roots. The ADF and the DFGLS failed to reject the null of a unit root at 5% level of significance in natural logs of some variables in levels and after first differencing as can be seen in tables 1 to 14. However the test statistics reject the null of a unit root in the differences. Thus based on the ADF tests and the DF-GLS tests all variables for ten countries (Botswana, Lesotho, Malawi, Mauritius, Mozambique, Namibia, South Africa, Swaziland, Tanzania and Zambia) in the study are integrated of order 1, $I(1)$ and for the remaining four countries (Angola, Congo, Madagascar, Seychelles), the results are mixed whereby some variables are integrated of order 0, $I(0)$, some are integrated of order 1, $I(1)$ and others are integrated of order 2, $I(2)$.

The results mean that the study will continue with ten countries that have $I(1)$ variables because literature has not identified a method of working with a combination of either $I(0)$ and $I(2)$ variables or $I(1)$ and $I(2)$ variables. For example, methods such as

Autoregressive Distributed Lag (ARDL) models work only for I (0) and I (1) variables

and not for a mix with I (2) variables. The Stationarity tests results can be seen in Tables1 to 14 below.

Table 1: Stationarity Tests and Integration Results for Angola

Variable	ADF (levels)	ADF (first difference)	ADF (second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-0.696802	-2.516095	-5.565757*	0.410351	-0.509274	-4.397115*	I(2)
LNCPI	-0.541258	-1.661334	-5.710245*	0.519892	-1.700104*	-5.776968*	I(1)
R	-1.170901	-4.018996*	-7.314120*	-1.257932	-3.121025*	-7.314120*	I(1)

Table 2: Stationarity Tests and Integration Results for Botswana

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-0.513833	-4.652186*	-4.899211*	0.126191	-4.558036*		I(1)
LNCPI	-2.649163	-1.401306	-5.575108*	-0.105391	-1.677492*		I(1)
R	-0.802836	-2.766293*	-8.774964*	-0.105391	-3.870136*		I(1)

Table 3: Stationarity Tests and Integration Results for DRC

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	2.492302	-2.004107	-6.958481*	-0.609939	-1.429216	-2.110742*	I(2)
LNCPI	-2.080759	-4.544085*	-9.233653*	-0.647768	-4.542885*	-8.779348*	I(1)
R	-1.367823	-3.646861*	-6.414804*	-1.196751	-2.643578*	-5.102379*	I(1)

Table 4: Stationarity Tests and Integration Results for Lesotho

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-2.223445	-2.652247*	-4.719858*	-0.732322	-2.644151*		I(1)
LNCPI	-1.289395	-3.605107*	-5.332705*	0.922429	-2.084245*		I(1)
R	-1.929995	-2.755225	-5.613167*	-1.912088	-2.682506*		I(1)

Table 5: Stationarity Tests and Integration Results for Madagascar

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	0.857374	-2.947132*	-4.091533*	-0.453895	-3.471189*	-4.194758*	I(1)
LNCPI	-1.828856	-1.745194	-11.83511*	0.243766	-2.164724*	-9.784739*	I(1)
R	-2.572994	-7.202597*	-8.473780*	-0.600428	-0.823335	-6.174785*	I(2)

Table 6: Stationarity Tests and Integration Results for Malawi

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-3.883677*	-1.529231	-6.422585*	-0.500487	-1.935153*		I (1)
LNCPI	3.885558	-3.196415*	-4.094527*	2.216209	-2.089851*		I(1)
R	-1.295678	-4.949707*	-7.428851*	-1.333776	-4.244161*		I(1)

Table 7: Stationarity Tests and Integration Results for Mauritius

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-1.414379	-3.727114*	-7.118505*	-0.772254	-2.620054*		I(1)
LNCPI	-2.924747	-2.613332	-7.405639*	-0.224643	-4.750745*		I(1)
R	-3.329876*	-4.774712*	-5.831618*	-0.840727	-4.347105*		I(1)

Table 8: Stationarity Tests and Integration Results for Mozambique

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	3.049864	-12.14093*					I(1)
LNCPI	-1.311386	-3.045816*					I(1)
R	-2.575571	-3.751470*					I(1)

Table 9: Stationarity Tests and Integration Results for Namibia

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-2.420562	-3.051308*					I(1)
LNCPI	-2.873856	-4.321501*					I(1)
R	-1.584537	-4.369853*					I(1)

Table 10: Stationarity Tests and Integration Results for Seychelles

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-1.276572	-2.566283	-5.828308*	-0.240769	-1.752327	-2.576950*	I(2)
LNCPI	-3.470724*	-2.997300*	-7.128021*	-0.490868	-3.229238*	-6.348454*	I(1)
R	-3.363420*	-4.460985*	-7.311191*	-3.31791*	-4.514493*	-7.408048*	I(0)

Table 11: Stationarity Tests and Integration Results for South Africa

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-0.914447	-3.583931*	-4.606908*	-0.413123	-2.874751*		I(1)
LNCPI	-2.160632	-3.076036*	-7.550008*	1.045156	-3.344837*		I (1)
R	-1.756059	-2.682080	-4.726415*	-1.619450	-2.706365*		I(1)

Table 12: Stationarity Tests and Integration Results for Swaziland

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-0.815915	-1.491011	-6.084763	-0.412523	-1.670437*		I(1)
LNCPI	-3.091677	-3.8821251	-6.021542	0.155572	-3.555218*		I(1)
R	-1.101135	-3.4245556	-6.479610	-1.684000	-3.462404*		I(1)

Table 13: Stationarity Tests and Integration Results for Tanzania

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	1.911572	-3.736997*					I(1)
LNCPI	-0.584188	-5.351415*					I(1)
R	-2.64470	-5.291271*					I(1)

Table 14: Stationarity Tests and Integration Results for Zambia

Variable	ADF (levels)	ADF (first difference)	ADF (Second difference)	DFGLS (levels)	DFGLS (first difference)	DFGLS (Second difference)	COMMENT
LNRGDP	-3.022274*	-1.778557	-5.242327*	-0.932436	-1.935153*		I (1)
LNCPI	0.313879	-1.829871	-4.094527*	1.357907	-2.089851*		I(1)
R	-1.875598	-4.302317*	-6.443782*	-1.923952	-4.244161*		I(1)

Note: Critical value is -2.95 at 5% significance level for ADF and Critical values are -1.95 and -1.61 at 5% and 10% significance level respectively for DF-GLS

5.3 Lag Length criterion

Appendix B gives the lag length selection results based on the Likelihood-Ratio test statistics (LR), Final prediction error (FPE), Akaike's information criterion (AIC), Schwarz information criterion (SC) and the Hannan and Quinn information criterion (HQIC). However, Table 15 gives lag selection results for the VAR models based on the Schwarz information criterion (SC) which, according to Enders (2015), selects a more parsimonious model.

The optimal lag length was found to be one for all countries except for Botswana, Mozambique, South Africa and Swaziland whose lag length was two, which was also sufficient to render serially uncorrelated VAR errors. Davoodiet *al.* (2013) noted that such findings are in contrast with most empirical work on MTM in advanced countries which make use of six to twelve lags for monthly data, or two to four quarters for quarterly data due to Friedman's early work that lags in monetary policy are long and variable. As such, some may expect that monetary policy takes time to have its effects in the SADC region as has been the case for advanced countries as well as basing on the conventional wisdom, but Davoodiet *al.* (2013) noted that adding more lags results in increasing problems of over parameterization, which reflects the increase in noise and imprecision.

Table 15: Summary of the Lag selection criterion results

COUNTRY	CHOSEN LAG LENGTH BY SC
BOTSWANA	2
LESOTHO	1
MALAWI	1
MAURITIUS	1
MOZAMBIQUE	2
NAMIBIA	1
SOUTH AFRICA	2
SWAZILAND	2
TANZANIA	1
ZAMBIA	1

5.4 Stability Tests

In order to test the stability of the VAR models, the inverse root of the characteristic autoregressive (AR) polynomial was used. The results of the stability test in Appendix C show that no root lies outside the unit circle. Therefore, this indicates that the VAR models satisfy the stability condition for the interest rate channel model.

5.5 Cointegration Tests

The cointegration rank test was carried out using the Johansen method. The results of the rank tests are summarized in Table 16 showing the trace (λ trace) and maximum eigenvalue (λ max) statistics.

Table 16: Results of Cointegration Test

RANK	TRACE STATISTIC					CRITICAL VALUES
	BOTSWAN A	LESOTH O	MALAWI	MAURITIUS	MOZAMBI QUE	95%
0	50.21469	41.30356	32.12159	34.32604	42.75683	29.79707
≤ 1	14.99602	20.65876	14.63680	4.529316	15.72748	15.49471
≤ 2	3.360986	5.781376	0.318627	0.043785	0.122399	3.841466
	1	3	1	1	2	
	MAX STATISTIC					CRITICAL VALUES
	BOTSWA NA	LESOTH O	MALAW I	MAURITI S	MOZAMB IQUE	95%
0	35.21867	20.64480	17.48479	29.79673	27.02935	21.13162
≤ 1	11.63504	14.87738	14.31817	4.485531	15.60508	14.26460
≤ 2	3.360986	5.781376	0.318627	0.043785	0.122399	3.841466
	1 (VEC)	0 (VEC)	2 (VEC)	1 (VEC)	2 (VEC)	

RANK	TRACE STATISTIC					CRITICAL VALUES
	NAMIBIA	SOUTH AFRICA	SWAZIL AND	TANZANIA	ZAMBIA	95%
0	39.05506	61.31446	37.61184	19.51252	32.12159	29.79707
≤ 1	16.32455	28.32576	10.58493	5.365349	14.63680	15.49471
≤ 2	3.149185	8.374592	3.263466	0.120691	0.318627	3.841466

	2	3	1	NO	1	
	MAX STATISTIC					CRITICAL VALUES
	NAMIBIA	SOUTH AFRICA	SWAZIL AND	TANZANIA	ZAMBIA	95%
0	22.73051	32.98870	27.02691	14.14717	17.48479	21.13162
≤ 1	13.17537	19.95117	7.321466	5.244658	14.31817	14.26460
≤ 2	3.149185	8.374592	3.263466	0.120691	0.318627	3.841466
	1 (VEC)	3 (VEC)	1 (VEC)	0 (VAR)	0 (VEC)	

Note: The results shown here are based on two lags and unrestricted constant in the model.

Lesotho and Zambia results are mixed. The null hypothesis of no cointegration ($r = 0$) was rejected at the 5% critical values using the trace (λ trace) and cannot be rejected using the maximum eigenvalue (λ max) statistics for the interest rate channel model. This suggests that the variables are cointegrated. For this reason, the cointegration tests indicate that there is one cointegration vector ($r = 1$). Given these results, the vector error correction (VEC) model is estimated for the two countries.

Clearly the null of no cointegration ($r = 0$) for Tanzania cannot be rejected at the 5% critical values using both the trace (λ trace) and Max eigenvalue (λ max) statistics. This suggests that Tanzania variables are not cointegrated. As such a VAR model is estimated for this country.

For Botswana, Malawi, Mauritius, Mozambique, Namibia, South Africa and Swaziland, the null of no cointegration ($r = 0$) was rejected at the 5% critical values using the trace (λ trace) and maximum eigenvalue (λ max) statistics. This suggests that the variables are cointegrated. For this reason, the cointegrating tests indicate that there is one cointegration vector ($r = 1$) for Botswana, Mauritius and Swaziland; two cointegrating vectors ($r = 2$) for Mozambique and three cointegrating vectors ($r = 3$) for South Africa. Mixed results in terms of cointegrating vectors were found for Malawi and Namibia whereby for Malawi, the trace (λ trace) static indicated one cointegrating vector ($r = 1$) and the Maximum eigenvalue (λ max) statistic indicated two cointegrating vectors ($r = 2$) and for Namibia, the trace static (λ trace) indicated two cointegrating vectors ($r = 2$) and the Maximum eigenvalue (λ max) statistic indicated one cointegrating vector ($r = 1$). Given these results, the vector error correction (VEC) model, which is a restricted VAR, is estimated for these seven countries.

Therefore the results from the cointegration tests mean that the study will estimate nine VEC models for the nine countries where cointegration was found and a VAR model for Tanzania.

5.6 Results

Given the conclusion in the above section that suggest no cointegration and cointegration among the variables for the different countries among the variables, the results in this section are obtained based on both VAR and VECM models.

5.6.1 Granger Causality Test Results

The Granger Causality Test Results of the ten countries are shown in Table 17 to Table 26 below.

Table 17: Granger Causality Test Results for Botswana

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.3513	0.0547*
RLNCPI	0.5632		0.0381**
DR	0.7206	0.9413	

Table 18: Granger Causality Test Results for Lesotho

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.6391	0.0964*
RLNCPI	0.2796		0.0961*
DR	0.7797	0.3562	

Table 19: Granger Causality Test Results for Malawi

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.0035	0.7005
RLNCPI	0.5586		0.3492
DR	0.9371	0.6306	

Table 20: Granger Causality Test Results for Mauritius

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.5013	0.0011***
RLNCPI	0.7663		0.3188
DR	0.0276	0.3034	

Table 21: Granger Causality Test Results for Mozambique

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.0003***	0.2851
RLNCPI	0.3101		0.0549*
DR	0.9257	0.3415	

Table 22: Granger Causality Test Results for Namibia

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.9020	0.1166
RLNCPI	0.8070		0.1900
DR	0.0055	0.0570	

Table 23: Granger Causality Test Results for South Africa

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.4735	0.0000***
RLNCPI	0.6000	0.9876	0.0122**
DR	0.0590		

Table 24: Granger Causality Test Results for Swaziland

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.4561	0.7757
RLNCPI	0.1316		0.6290
DR	0.1948	0.5264	

Table 25: Granger Causality Test Results for Tanzania

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.9014	0.6046
RLNCPI	0.1946		0.2879
DR	0.7295	0.0694	

Table 26: Granger Causality Test Results for Zambia

	Dependent Variable		
Variable	DLNRGDP	DLNCPI	DR
DLNRGDP		0.0000	0.5590
RLNCPI	0.8547		0.9533
DR	0.4114	0.2491	

*Note: Entries show the probabilities of accepting the null hypothesis that the corresponding group of column variables did not Granger-cause the row variable, based on Wald tests' χ statistics. *,** and *** denote statistical significance at 10%, 5% and 1% significance level respectively. Diagonal entries have been omitted since they do not reflect causal implications.*

The results of the multivariate Granger causality tests in Table 17 to Table 26 above are presented as preliminary evidence of the causal links between monetary

policy and economic outcomes (inflation and output) through short term interest rates.

The evidence suggests that:

For Malawi, Namibia, Swaziland, Tanzania and Zambia, the interest rates channel is not statistically significant at both levels of significance.

For Botswana, Lesotho and South Africa, the interest rate channel is statistically significant at 10% for Lesotho, 5% for South Africa and 5% and 10% for Inflation and output respectively for Botswana.

For Mauritius and Mozambique, the interest rate channel is statistically significant in explaining Output and Inflation respectively at 10% level of significance.

5.6.2 Impulse Response Analysis

The results given by Figures 1 and 2 in Appendix D provide the impulse responses to an exogenous monetary policy shock based on the Cholesky decomposition following the variable ordering; output, inflation and short term interest rate. The ordering implies that the policy instrument does affect the other variables but with a lag. Such ordering allows the interest rate equation to be interpreted as a monetary policy reaction function (Haug et al., 2005). A nine year horizon with 36 Quarters is considered.

Thus Figures 1 and 2 presents the impulse responses of the two variables (RGDP and Inflation) for the ten SADC countries to a monetary policy tightening. Since the procedure uses residuals to obtain the impulses, this can be interpreted as response to

an unanticipated monetary policy tightening. It should be noted that in the Botswana case, the interest rate is based on the discount rate whereas for the other nine countries it is based on the short term Treasury Bill Rate. Thus the case of Botswana results may not be directly comparable to those of the nine countries. Data limitations did not allow the use of one common variable for the interest rate for a better comparability of the results.

THE RESPONSES OF GDP TO A MONETARY POLICY TIGHTENING (HIGHER INTEREST RATE).

FIGURE 1 (IN APPENDIX D) PLOTS THE DYNAMICS FOR 36 QUARTERS

For Lesotho, South Africa and Swaziland, output increases during the quarter following the shock until the third quarter but declined up to the fourth quarter first for Lesotho followed by South Africa and Swaziland in the fifth quarter and increased until the fifth quarter for Lesotho with Swaziland coming in the sixth quarter and South Africa in the eighth quarter. The oscillating pattern continued for Swaziland until the thirty-sixth quarter whereas for Lesotho and South Africa it stopped in the sixteenth quarter after which a constant trend was followed.

For Botswana, Malawi and Zambia, output declines during the quarter following the shock until the third quarter for Malawi and Zambia, and the fourth Quarter for Botswana, but increases up to the fourth and fifth quarter for Malawi and Zambia before decreasing in the sixth quarter. This oscillating pattern continues until the thirty-sixth quarter.

For Mauritius, Namibia, Tanzania and Mozambique output did not respond to the monetary shock in the first five quarters although for Mozambique this continued up to the twenty-fifth quarter until when it declined in the twenty-seventh quarter before increasing in the twenty-ninth quarter and this oscillating pattern continued for Mozambique. Whereas for Mauritius and Namibia, after the fifth quarter, output increased slowly until the twenty-fifth quarter where the oscillating pattern became rapid. While for Tanzania, after the fifth quarter, output declined slowly up to the twentieth quarter before increasing in the twenty-third quarter after which the oscillating pattern became rapid.

In Summary, all possible responses of output to a monetary shock have been found in the region. However the results are mixed although some countries exhibit some patterns of similarity in terms of direction, speed and timing.

THE RESPONSES OF INFLATION TO A MONETARY POLICY TIGHTENING (HIGHER INTEREST RATE).

FIGURE 2 (IN APPENDIX D) PLOTS THE DYNAMICS FOR 36 QUARTERS.

Inflation rises first in Botswana, Lesotho, South Africa, Swaziland and Zambia peaking in the second to third quarter, before declining. This is opposite to what is expected from a monetary contraction. This phenomenon has however been noted in many literature and has been denoted the ‘price puzzle’ (Haug et al., 2005; Hülsewig et al., 2004). It has been explained by some as a reflection of a cost mark-up pricing strategy. A rise in interest rate may then increase the price level in the short run by increasing variable costs. It could also be an indication that some important

variable(s) reflecting expectations about the future inflation have been omitted (Buigut, 2009). In this case it would imply that monetary policy in Botswana, Lesotho, South Africa, Swaziland and Zambia responds to expected inflation.

For Malawi and Namibia, inflation falls with a monetary contraction as expected although the response is faster in the case of Malawi, than for Namibia. The fall in inflation bottoms out in the third quarter for Malawi and between the third and fourth quarter for Namibia. This oscillating pattern continues until the thirty-sixth quarter.

For Mauritius and Tanzania, Inflation responded slightly in the first ten quarters, after which the response became abit clear although it increased with a very low magnitude for Mauritius and declined back to zero in the thirteenth quarter before increasing again up to the fourteenth quarter and the oscillating pattern continued up to the thirty-sixth-quarter with a rapid pattern from the thirty-seventh quarter. Whereas for Tanzania, the slight response continued up to the twentieth quarter after which output increased in that quarter and declined up to the twenty second quarter and this oscillating pattern continued up to the thirty sixth quarter.

For Mozambique, Inflation did not respond to the monetary policy shock in the first twenty five quarters after which inflation increased and then declined with minimal variation before the oscillating pattern became rapid.

In Summary, all possible responses of Inflation to a monetary shock have been found in the region. However the results are mixed although some countries exhibit some patterns of similarity in terms of direction, speed and timing.

5.6.2 Variance Decomposition Analysis

The results from variance decompositions are shown in Appendix E.

The results reveal that the proportion of variance of inflation due to innovations in interest rates are small for all countries in the study. Hence the interest rate did not appear to be a significant source of a decline in inflation for these countries.

Furthermore, the results reveal that the proportion of variance of output due to innovations in interest rates are small for Lesotho, Malawi, Mauritius, Mozambique, Namibia, Swaziland, Tanzania and Zambia. Hence the interest rate did not appear to be a significant source of an increase in output for these countries.

In addition to that, the proportion of variance of output due to innovations in interest rate are large enough for Botswana and South Africa. This implies that in the long run, interest rate appeared to be a significant source of an increase in output for Botswana and South Africa.

This is very much what would be expected for most of the SADC countries given the level of their financial systems development as reviewed in this study. Hence the findings from the study that the interest rate channel is not effective for most countries in the SADC region can be attributed to the fact that most of the countries in the region have underdeveloped money markets.

5.7 Empirical comparisons of the results with previous findings

This section provides some empirical comparisons of this study findings with previous findings: first in other regions, then in SADC countries. Finally the study provide some empirical justifications in support of this study findings.

5.7.1 Empirical comparisons with previous findings in other regions

These results concur with the existing empirical findings for other developing countries. Such studies include: a study by Isakova (2008) which examined monetary policy efficiency in Central Asia and found that the interest rate channel is relatively weak and does not prove to be an important monetary transmission channel in the region; a study by Buigut (2009) which assessed the importance of the interest rate channel in the East African Community and found that the interest rate channel is not significant and not important for this region; a study by Samba (2013) which evaluated monetary policy effectiveness under the Central African Economic and Monetary Union (CEMAC) area whose results showed that the traditional interest rate channel is not effective enough in the CEMAC area; and an IMF Staff report (2013) on the Western African Economic and Monetary Union (WAEMU) which revealed that the interest rate channel is largely ineffective in the WAEMU area.

5.7.2 Empirical comparisons with previous findings in SADC countries

Botswana: The finding that the interest rate channel is important and effective for Botswana, concurs with the findings of Munyengwa (2012) who also concluded that the interest rate channel is the most effective channel of monetary transmission in Botswana.

Lesotho: The finding that the interest rate channel is not effective in Lesotho are in line with the findings by Nindi (2012) who concluded that the interest rate channel is weak and not important for Lesotho.

Malawi: The finding that the interest rate channel is weak and unimportant for Malawi are in line with the findings by Mangani (2012) who concluded that the interest rate channel is weak and not important for Malawi.

Mauritius: The finding that the interest rate channel is not important and in effective for Mauritius are in contrast to the findings by Nunkooo-Gonpotet *al.* (2011) who concluded that the interest rate channel is a stronger channel of transmission mechanism in Mauritius

Mozambique: The finding that the interest rate channel is not important and in effective for Mozambique are in contrast to the findings of Nindi (2012) who concluded that the interest rate channel is a stronger channel of transmission mechanism in Mozambique.

Namibia: The finding that the interest rate channel is weak and ineffective for Namibia, are in contrast to the finding by Sheefani & Ocran (2012) who concluded that the interest rate channel is important and effective in Namibia.

South Africa: The finding that the interest rate channel is important and effective for South Africa corroborates the findings of Gumatae *al.* (2013) who concluded that the

interest rate channel is the most effective channel of monetary transmission in South Africa.

Swaziland: The finding that the interest rate channel is not effective in Swaziland are in line with the findings by Nindi (2012) who concluded that the interest rate channel is weak and not important for Swaziland.

Tanzania: The finding that the interest rate channel is weak and unimportant for Tanzania are in line with the findings by Buigut (2009) who concluded that the interest rate channel is weak and not important for all EAC countries of which Tanzania was part of the study.

Zambia: The finding that the interest rate channel is weak and unimportant for Zambia are in line with the findings by Funda (2014) who concluded that the interest rate channel is weak and not important for Zambia.

5.7.3 Empirical Justification in Support of the Findings

Empirical literature points to a number of factors that influence the monetary transmission mechanism which could therefore be some of the reasons for the difference in transmission as well as the ineffectiveness of the interest rate channel in the region. One of the most important factors is the degree of development of the money market and hence the composition of the finance affecting investment decisions. It has been concluded that for countries where the capital market is less than fully developed, the interest rate channel likely plays a smaller role since bank credit is likely to constitute the main source of investment finance (Ramlogan, 2004)

in Buigut (2009) and his conclusions concur with the findings of Bernanke and Gertler (1995), Isakova (2008) and Buigut (2009). This is very much what is expected for most of the SADC countries given the level of their financial systems development as reviewed in this study in chapter 2. Hence the findings from the study that the interest rate channel is not effective for most countries in the SADC region except for Botswana and South Africa can be attributed to the fact that most of the countries in the region have underdeveloped money markets with an exception of Botswana and South Africa.

CHAPTER 6

CONCLUSIONS, POLICY IMPLICATIONS AND RECOMMENDATIONS

6.1 Introduction

This chapter presents conclusions, policy implications and recommendations to the study.

6.2 Conclusions

The study conducted a comparative analysis of the monetary policy transmission mechanism in the SADC region by assessing the importance and similarity of the interest rate channel for the SADC countries. Using VAR and VEC models as tests suggested that the null of no cointegration was rejected for some countries and could not be rejected for other countries based on the variables that were used, the study focused on the reduced-form relationships between short term interest rates, inflation and real output by utilizing quarterly data for the period from 2007Q1 to 2015Q4. The 3 variable VAR model analysis was carried out by examining the dynamic nature of multivariate Granger Causality Tests, impulse response functions and variance decomposition estimates generated from the model.

A significant finding is that the effect of a monetary contraction on output seems relatively similar for some SADC countries but different for others in terms of the speed, direction, pattern and timing. This pattern and speed of adjustment corresponds

to what has been found in other studies for both developing and developed countries such as EAC, US and EMU. The same applies to the magnitudes which are small and not significant for some countries, while large and significant for other countries in the region.

The effect of monetary policy contraction on the inflation rate in terms of the timing, speed and direction of response is also relatively similar for some SADC countries but different when compared to others and just as with output, the magnitude seems to be small and not significant for most countries in the region.

Therefore, the study has produced mixed results since the interest rate channel of monetary transmission mechanism differs in these countries in terms of speed, direction, timing and magnitude of the response of output and inflation to monetary policy shocks and it can be concluded that it is not an important channel for most of the countries in the region.

The main findings from the study suggest that the interest rate channel is important in explaining output for Botswana and South Africa. While at the same time it is not important in explaining output and inflation for Lesotho, Malawi, Mauritius, Mozambique, Namibia, Swaziland, Tanzania and Zambia. The main conclusion is that the importance of the interest rate channel differs across countries in the SADC region.

The main implication to be drawn from these results seems to be that the interest rate channel is not effective for most of the countries in the SADC region except for

Botswana and South Africa as has been summarised in Appendix F. These results concur with the existing empirical findings for other developing countries. Such studies include: a study by Isakova (2008), and also a study by Buigut (2009) to mention a few.

Empirical literature points to a number of factors that influence the monetary transmission mechanism which could therefore be some of the reasons for the difference in transmission as well as the ineffectiveness of the interest rate channel in the region. One of the most important factors is the degree of development of the money market and hence the composition of the finance affecting investment decisions. It has been concluded that for countries where the capital market is less than fully developed, the interest rate channel likely plays a smaller role since bank credit is likely to constitute the main source of investment finance (Ramlogan, 2004) in Buigut (2009) and his conclusions concur with the findings of Bernanke and Gertler (1995), Isakova (2008) and Buigut (2009).

This is very much what would be expected for most of the SADC countries given the level of their financial systems development as reviewed in this study in chapter 2. Hence the findings from the study that the interest rate channel is not effective for most countries in the SADC region can be attributed to the fact that most of the countries in the region have underdeveloped money markets.

6.3 Policy Implications

The results of this study provide some policy implications as the model used in this study provides a very important tool that economists and researchers can use

inmaking economic judgements about how macroeconomic variables affect inflation and economic activity.

To enhance the effectiveness of the interest rate channel in the SADC region, the main policy implication is that monetary authorities should put much effort to move towards more market based monetary and financial sector policies by effectively employing continued efforts to develop domestic financial markets since the underdeveloped nature of the money markets, among others, restricts the importance of this channel in the SADC countries.

Monetary authorities in the SADC countries should also adopt a short-term money market rate as an operating target, since according to Sun (2010), financial institutions will price their loans with reference to these market rates and as the market rates move in response to central bank benchmark rate adjustments, this will allow the monetary authorities to effectively influence the short-term money market rate through open market operations therefore making the interest rate channel an effective channel of monetary policy transmission in the SADC region.

6.4 Recommendations for Further Research

Since the monetary policy transmission mechanism is a black box that needs to be explored, there is need for further research into the monetary policy transmission process in the SADC region, by assessing other channels of transmission; their importance and similarity in the region.

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APPENDICES

APPENDIX A: TYPES OF FINANCIAL INTERMEDIARIES IN SADC

ECONOMIES

Country	Money and capital markets	Instruments	Financial intermediaries	Stock market/ Exchange
Angola	Yes	Treasury bills, central bank TBC bills and Treasury bonds.	22 banks, including 4 state banks and micro-credit banks.	No
Botswana	Capital market not broad based. Bond market; money markets.	Bank of Botswana Certificates; bonds and shares.	7 Banking institutions	Small stock Market
DRC	Money market comprising banker's and interbank markets.	Short-terms loans; permanent facility; commercial paper.	18 Banks of deposits, 17 private and 1 mixed capital bank	Yes
Lesotho	Money market still developing; capital market not yet active.	Money market instruments include various deposits, Treasury bills and central bank paper; Treasury bonds still being developed.	8 financial intermediaries, including the Central Bank, 4 banks, money lenders, unit trusts (collective investment schemes) and insurance companies.	Preparations for stock market will follow the issuance of Tbonds
Malawi	Money and capital markets.	MM: Treasury bills, REPOS, BA, Commercial paper, savings bond, term deposits; Capital market:	MM: Commercial banks, finance houses, savings and credit institutions, institutional	Malawi Stock Exchange

		shares, government local registered stocks, promissory notes.	investors and discount house. Capital market: 4 stockbrokers on the Malawi Stock Exchange, with 14 listed companies.	
Mauritius	Money and capital markets exist.	MM: Treasury bills/Bank of Mauritius Bills/Notes and other Government Securities. CM: Shares, Treasury Notes, Inflation-linked bonds, benchmark bonds.	CB, banks, non-bank deposit taking institutions, money changers, foreign exchange dealers, etc.	Stock Exchange of Mauritius
Mozambique	Interbank money market; capital stock market.	TBs, Central bank bills, standing facilities, reserve requirements, repo and reverse repo, Treasury Bonds (Tbonds); corporate bonds and equities.	Central bank and Commercial bank.	
Namibia	Interbank money market; stock Exchange.	MM: demand and savings deposits, notice and fixed deposits, NCDs; Capital market: shares, government stock, bills, debentures and bonds of SOEs	Central banks, 4 commercial banks, other banking institutions, non-bank financial institutions, NSX.	Namibian Stock Exchange
Seychelles	Money market and capital Market.	Money market driven by TBs, Reverse	Banks, non-bank deposit taking	No stock Exchange currently. Govt.

		repurchase agreements, Deposit Auction Arrangements; Capital market: government Bonds.	institutions, foreign exchange dealers, Development Bank, insurance companies, pension funds, investment companies and trusts, housing finance company.	bonds are issued by the central bank as the agent of government
South Africa	Money and capital markets	MM: TBs and govt. bonds with less than 12 months, BA, promissory notes, commercial paper of banks, corporates, and public corporations, NCDs; Capital market – government bonds, bonds of public corporations and public entities, corporate bonds and shares.	Registered banks, mutual banks, local branches of foreign banks, bond exchange trading members, bond exchange broking members, primary dealers.	JSE Limited
Swaziland	Money and capital markets	Treasury bills, central bank bills, Bas, NCDs; debentures and bonds, equities, unit trusts.	Commercial banks and the central bank; Swaziland Stock Brokers, African Alliance of Swaziland Securities, Interneuron Swaziland.	Swaziland Stock Exchange
Tanzania	Money market since 1993	Treasury bills, Treasury bonds.	MM: Deposit money banks,	Dar es Salaam Stock Exchange

			insurance companies, pension funds, non-bank fin institutions, dealers and brokers, investment advisors, individuals.	in operation since 1998
Zambia	Money and capital markets	Treasury bills, commercial paper, term deposits and repos; government bonds.	Commercial banks, nonbank fin. Institutions and non-bank public, authorised dealers.	Lusaka Stock Exchange since 1994
Zimbabwe	Money and capital markets	TBs, central bank paper, parastatal paper guaranteed by government, NCDs, bills of exchange; shares, debentures, government bonds, public enterprises bonds, local government bonds.	Deposit money banks, other banking institutions, nonbank financial institutions, stock-broking firms, insurance companies, pension funds.	Zimbabwe Stock Exchange

Source: SADC Financial Systems: Structures, Policies and Markets. September 2012 in Phakedi (2014).

APPENDIX B: LAG LENGTH TESTS**BOTSWANA**

Lag	LogL	LR	FPE	AIC	SC	HQ
0	23.81257	NA	5.90e-05	-1.224269	-1.089590	-1.178339
1	192.6455	297.9404	4.89e-09	-10.62620	-10.08749	-10.44249
2	213.5546	33.20856*	2.46e-09*	-11.32674*	-10.38399*	-11.00523*

* indicates lag order selected by the criterion

LESOTHO

Lag	LogL	LR	FPE	AIC	SC	HQ
0	59.21369	NA	7.35e-06	-3.306688	-3.172009	-3.260759
1	243.5111	325.2307	2.45e-10	-13.61830	-13.07959*	-13.43458
2	259.1207	24.79164*	1.69e-10*	-14.00710*	-13.06435	-13.68559*

* indicates lag order selected by the criterion

MALAWI

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5.925285	NA	0.000339	0.525017	0.659696	0.570946
1	156.4704	286.5805	4.10e-08	-8.498256	-7.959541*	-8.314539
2	168.5991	19.26328*	3.46e-08*	-8.682299*	-7.739547	-8.360794*

* indicates lag order selected by the criterion

MAURITIUS

Lag	LogL	LR	FPE	AIC	SC	HQ
0	74.46183	NA	3.00e-06	-4.203637	-4.068958	-4.157708
1	201.1138	223.5034*	2.97e-09	-11.12434	-10.58562*	-10.94062*
2	211.0740	15.81916	2.85e-09*	-11.18082*	-10.23807	-10.85932

* indicates lag order selected by the criterion

MOZAMBIQUE

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-9.740580	NA	0.000425	0.749446	0.884125	0.795375
1	145.0484	273.1571	8.04e-08	-7.826378	-7.287662	-7.642660
2	168.6965	37.55876*	3.45e-08*	-8.688031*	-7.745279*	-8.366526*

* indicates lag order selected by the criterion

NAMIBIA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	39.31017	NA	2.37e-05	-2.135893	-2.001214	-2.089963
1	220.5063	319.7579	9.49e-10	-12.26508	-11.72636*	-12.08136
2	232.5281	19.09347*	8.06e-10*	-12.44283*	-11.50008	-12.12133*

* indicates lag order selected by criterion

SOUTH AFRICA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	61.73265	NA	6.34e-06	-3.454862	-3.320183	-3.408932
1	257.4951	345.4632	1.08e-10	-14.44089	-13.90217	-14.25717
2	277.4507	31.69421*	5.74e-11*	-15.08534*	-14.14259*	-14.76383*

* indicates lag order selected by criterion

SWAZILAND

Lag	LogL	LR	FPE	AIC	SC
0	75.38301	NA	2.84e-06	-4.257824	-4.123145
1	236.2474	283.8784	3.76e-10	-13.19103	-12.65231*
2	250.8304	23.16113*	2.75e-10*	-13.51943*	-12.57668

* indicates lag order selected by the criterion

TANZANIA

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-11.71109	NA	0.000477	0.865358	1.000037	0.911287
1	115.5847	224.6396	4.55e-07	-6.093215	-5.554500*	-5.909498
2	127.5775	19.04744*	3.87e-07*	-6.269264*	-5.326512	-5.947759*

* indicates lag order selected by the criterion

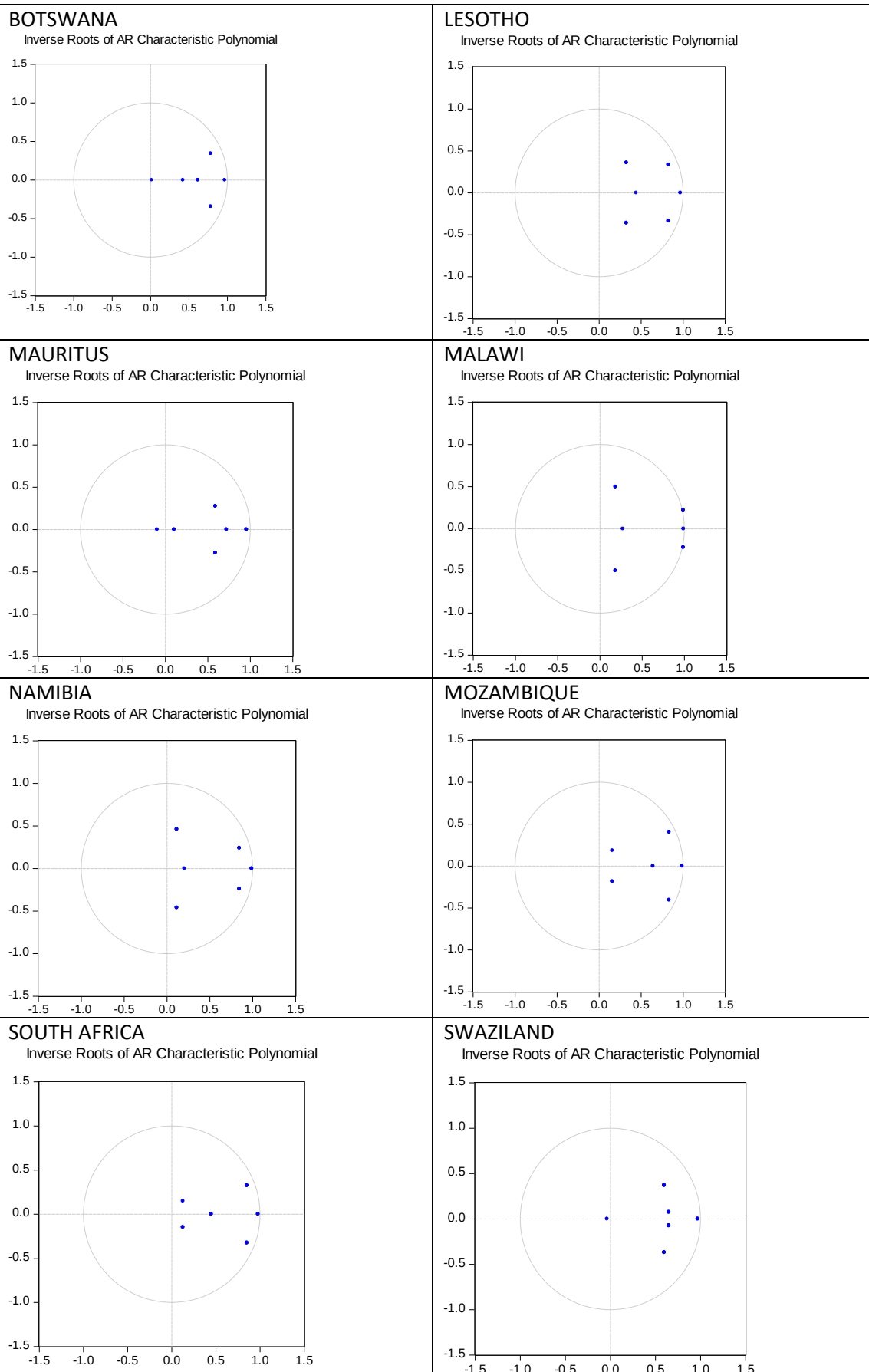
ZAMBIA

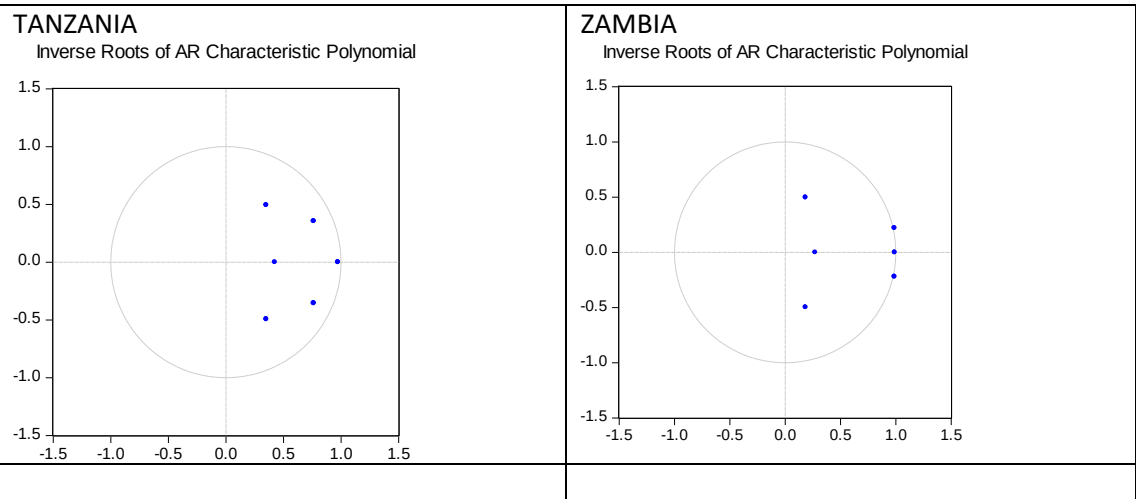
Lag	LogL	LR	FPE	AIC	SC	HQ
0	-5.925285	NA	0.000339	0.525017	0.659696	0.570946

1	156.4704	286.5805	4.10e-08	-8.498256	-7.959541*	-8.314539
2	168.5991	19.26328*	3.46e-08*	-8.682299*	-7.739547	-8.360794*

* indicates lag order selected by the criterion

APPENDIX C: STABILITY TEST GRAPHS





APPENDIX D: IMPULSE RESPONSE FUNCTION

Figure 1: Impulse Response Functions for LNRGDP for 36 Quarters

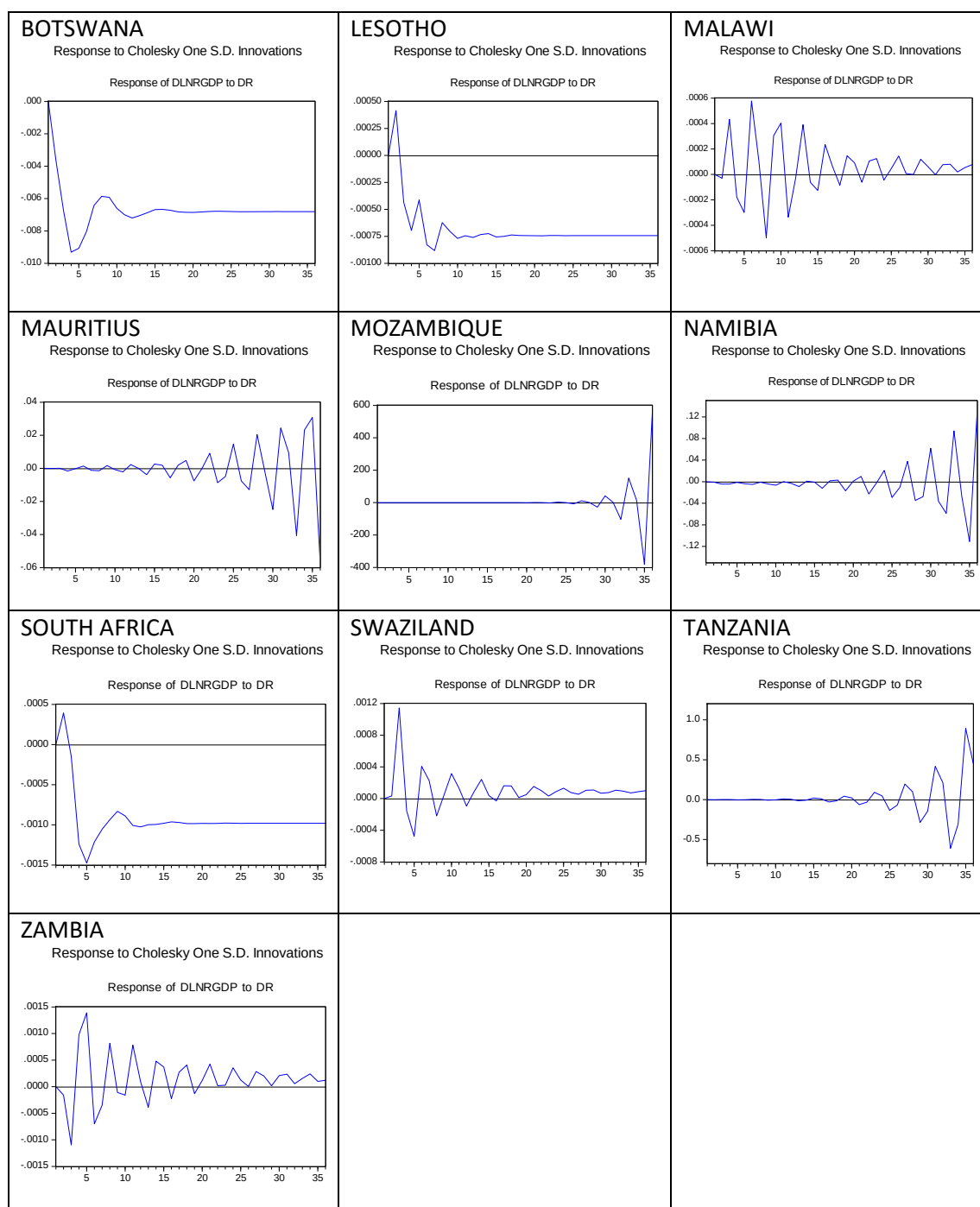
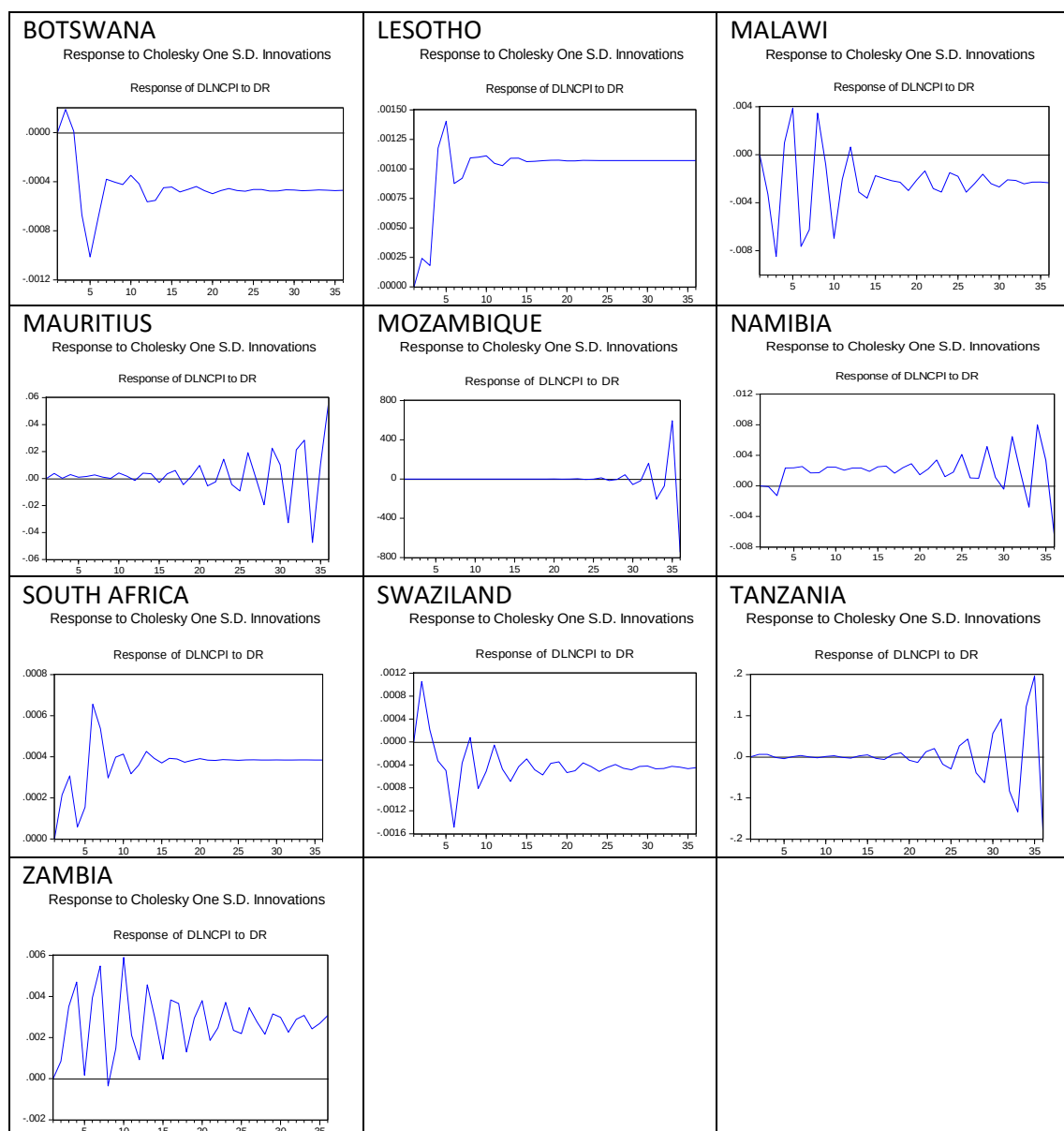


Figure 2: Impulse Response Functions for LNCPI for 36 Quarters



APPENDIX E: VARIANCE DECOMPOSITION RESULTS

COUNTRY	R EXPLAINING LNRGDP	R EXPLAINING LNCPI	COMMENT
BOTSWANA Quarter 12 Quarter 24 Quarter 36	42.25775 48.40121 50.80159	0.732860 0.795112 0.816234	IMPORTANT
LESOTHO Quarter 12 Quarter 24 Quarter 36	1.716440 2.306795 2.553509	7.383142 6.822958 6.429127	IMPORTANT
MALAWI Quarter 12 Quarter 24 Quarter 36	0.454729 0.327479 0.244003	3.355455 3.618386 3.861400	NOT IMPORTANT
MAURITUS Quarter 12 Quarter 24 Quarter 36	5.961195 5.976877 6.583935	4.991198 5.965464 6.544926	NOT IMPORTANT
MOZAMBIQUE Quarter 12 Quarter 24 Quarter 36	0.259778 0.243393 0.226103	0.233645 0.203612 0.186693	NOT IMPORTANT
NAMIBIA Quarter 12 Quarter 24 Quarter 36	8.382168 3.832629 4.299769	9.144323 8.849682 5.277221	NOT IMPORTANT
SOUTH AFRICA Quarter 12 Quarter 24 Quarter 36	19.77437 27.85177 32.07262	0.412057 0.471498 0.489186	IMPORTANT
SWAZILAND Quarter 12 Quarter 24 Quarter 36	2.996230 2.023624 1.547593	1.150854 1.019026 0.942485	NOT IMPORTANT
TANZANIA Quarter 12 Quarter 24 Quarter 36	2.123534 2.351408 2.348900	1.150854 2.068793 1.944398	NOT IMPORTANT
ZAMBIA Quarter 12 Quarter 24 Quarter 36	2.211004 1.487653 1.102774	10.32210 12.45041 13.24447	NOT IMPORTANT

APPENDIX F: EFFECTIVENESS OF THE INTEREST RATE CHANNEL IN THE SADC REGION

EFFECTIVENESS OF THE INTEREST RATE CHANNEL BASED ON VAR AND VECM			
COUNTRY	Evidence	Effectiveness	Conclusion
Botswana	Yes	Effective	Effective
Lesotho	Yes	Ineffective	Ineffective
Malawi	No	Ineffective	Ineffective
Mauritius	Yes	Ineffective	Ineffective
Mozambique	Yes	Ineffective	Ineffective
Namibia	No	Ineffective	Ineffective
South Africa	Yes	Effective	Effective
Swaziland	No	Ineffective	Ineffective
Tanzania	No	Ineffective	Ineffective
Zambia	No	Ineffective	Ineffective