FOREWORD

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It has to be amplified that whilst care has been given to ensure accuracy in terms of methodological application and use of analytical tools available, errors and omissions are those of authors. As such should a reader identify such an error and/or an omission, please forward these to the General Manager, Economic Policy Research and Statistics Department who is reachable at sikhumbuzod@centralbank.org.sz. Further, each of the published material contains contact details of the authors. Readers are encouraged to interact with authors to enable the Bank to improve the quality of its research work.

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Relationship and Causality between Interest Rates and Macroeconomic Variables in Swaziland

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Abstract

The main goal of this research was to provide empirical evidence on the linkage between monetary policy rates and financial and macroeconomic variables using monthly data from 1990 to 2015. The policy rates which the CBS uses are the discount rate, liquidity rate, and the reserve requirement, hence this paper estimated three models using the SVAR modelling approach. Utilising the Johansen Cointegration test, the existence of a long run relationship among the variables was found. Granger causality tests were also undertaken, results of which shows that discount rate has unidirectional causality relationship with real GDP, savings, household credit, consumer price index, and asset prices. Unidirectional causality from liquidity requirement to GDP and CPI was found, and from reserve requirement to real GDP and consumer price index. SVAR results show the existence of monetary policy transmissions in three channels, which are interest rate channel, credit channel, and asset price channel, but are not very strong. The paper recommends that the Bank continue with utilising the discount rate as its main monetary policy tool. Furthermore, the liquidity requirement and reserve requirement need to be reviewed at least once in two years as they were found to contribute more to variations in the CPI than the discount rate.

Key Words: Monetary policy rates, Cointegration, Causality, SVAR, Swaziland

1.0 INTRODUCTION

The financial crisis of 2007-2009 raised many questions about the role and efficacy of monetary policy in addressing economic cycles and shocks. Some of this debate has focused on how monetary policy tools influence consumption, investment, inflation, growth and other macroeconomic variables. Understanding how economic players adjust their activities to the economic environment around them is important in informing which policy options are likely to be most effective, and help shape policy makers’ expectations.

Due to multiple roles played by interest rates in the economy and complex relations with other economic indicators, interest rates behave differently in different countries under various circumstances. Thus, theoretical methods and models developed and tested in, say, a developed country with an established financial and credit market with low level of inflation, may not always be appropriate when same is applied to transitional, inflationary or other economy. Moreover, using different methods and models, economists may reach different conclusions even in the same country (Kosse, 2002).

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According to Chileshe et al (2014), the effect of interest rate setting on the broader economy works through what is termed the monetary transmission mechanism (MTM): the process through which monetary policy decisions are transmitted into and affect (positively or negatively) economic activity and prices. This process is one that links central banks’ operational targets (typically short term interest rates or reserve money) to its intermediate targets (medium and long-term interest rates, broad money, credit, and exchange rate) and eventually to its targets (inflation and output).

1.1 Monetary Policy in Swaziland

The ultimate goal of monetary policy is the attainment of price stability. Likewise, Swaziland’s monetary policy objective as stated in the Central Bank Order is to promote price and financial stability, which ensures a stable and sound financial system, so as to foster financial conditions conducive to economic development in Swaziland. Monetary policy formulation is to a large extent influenced by the country’s membership to the Common Monetary Area (CMA). The CMA agreement dictates both the monetary and exchange rate policies of the country. According to the agreement, Swaziland’s currency (the Lilangeni) is pegged on a one-to-one basis to the South African Rand (which freely floats with other major currencies). Keeping the exchange rate peg serves as an intermediate goal for monetary policy in Swaziland. To support this exchange rate policy of the currency board, Swaziland has to keep the levels of reserves equivalent to/or above the conventional international standard of 3 months of import cover. Furthermore, there is free flow of capital within the CMA countries. Given the above conditions, the rule of impossible trinity’ creeps in and dictates important monetary policy implications.

Figure 1: The “Impossible Trinity” in Monetary Policy

According to the theory of the ‘impossible trinity’ (also known as triangle of impossibilities or the trilemma), a country cannot have a pegged exchange rate regime, free capital mobility and autonomy in its monetary policy all at the same time. A country can only do two of these three things. Thus given the Swaziland case under the CMA, free movement of capital and the exchange rate peg imply loss of monetary policy independence for the country. Swaziland has little scope to undertake discretionary monetary policy in response to domestic developments. The movement of the central bank’s major policy tool (the
discount rate) has to mirror those of South Africa by implication of the dictatorship of the ‘impossible trinity’ even if Swaziland can wish otherwise, to avoid capital flight (Nxumalo, 2012).

Thus, it can be safely said that Swaziland fall under a permanently fixed exchange rate system because she belongs to the CMA. The fixed exchange rate has the disadvantage of precluding the use of monetary policy by the Central Bank of Swaziland. However, based on the trilemma, the country uses the interest rate as a monetary policy instrument, to fight inflationary pressures and curb capital flight. Hence the major objective of this paper is to assess the effectiveness of such policy rate to the economy of Swaziland. There are three policy rates which the Bank uses, the major one being the discount rate (DR). The others are the liquidity (LRQMNT) and reserve requirements (RSVREQ), whose movements against the discount rate are shown in Figure 2.

Figure 2: Movements in the Monetary Policy Rates; 1990M01 to 2015M12

Source: Central Bank of Swaziland

1.2 Channels of Monetary Policy Transmission

The channel of monetary policy is concerned with the changes associated with the adjustment of the policy rate and the effects on prices of goods and services, output of sectors, and employment. Positive variations in aggregate demand in the country do shift the production level, employment and wages which in turn reflect on changes in prices. Monitoring the extent of policy transmission is important so as to take the necessary measures to avoid adverse effects which are unfavourable to the growth and development of the economy. Monetary transmission mechanism identifies five main channels of monetary policy transmission:

- **Interest Rate Channel** - The interest rate channel is considered the primary monetary transmission mechanism in traditional models that operate by altering the marginal cost of lending and borrowing and thereby produce changes in investment, saving, aggregate demand and prices.

- **Credit Channel** - The credit channel is associated with the bank lending and the bank balance sheet transmission mechanisms. It consists of factors that assist and support the effect of interest rate and is linked with the commercial banks’ lending activities, with balance sheets effects. However, the lending rate is taken to be less important in this respect if the demand for bank deposits is highly elastic. Generally, the bank lending sub-channel works by influencing banks’ ability to make loans
following changes in the monetary base, while the balance sheet sub-channel is premised on the prediction that the external finance premium that a borrower faces depends on the borrower’s net worth.

- **Asset Price Channel** - The asset price channel is based on the idea that monetary policy can have important effects on prices of assets such as bonds, equity, and real estate channels. In this channel, a contractionary interest rate (raising interest rate) makes bonds relatively less profitable to equities forcing equity prices to fall. It can be concluded that reducing equity prices leads to a decline in the ratio of market value of firms to the replacement cost.

- **Expectations Channel** - this channel is based on the private sector’s expectations about the future stance of monetary policy and related variables. This reflects the notion that monetary policy changes can influence expectations about the future course of real activity and the confidence with which those expectations are held. Changes in perceptions will then affect the behaviour of participants in financial markets and other sectors of the economy through, for instance, changes in expected future labour income, inflation expectations, unemployment, sales, and profits.

- **Exchange Rate Channel** - The exchange rate channel impacts on spending pattern of individuals, firms and ultimately on goods and services. In a flexible exchange rate regime which is determined by the market forces and an expansionary monetary policy will lower the domestic currencies and raise the prices of imported goods and services.

Figure 3 shows the channels of monetary policy in picture form. Three of the channels are linked to domestic demand, while the other two are linked to external demand. Due to the size of the Swaziland economy and its monetary policy (currency peg), the most likely channels are those linked to domestic demand than external demand.

Figure 3: Channels of Monetary Policy Transmission

1.3 Stylised Facts about the Swazi Economy

Major macroeconomic developments of the Swaziland economy during 1990 to 2015 can be summarized with the following stylised facts:

1.3.1 Inflation and Interest Rates Developments

The Central Bank of Swaziland has, as
its ultimate goal, inflation management to create an environment conducive to economic growth. The monetary authorities in the country basically use the discount rate to control inflation but cognisant of the movements in the discount rate in South Africa. As shown in Figure 4, a tight monetary policy stance appears to have been one of the dominant features for the Swaziland economy between 1990 and 1998. Nominal interest rates were mostly double-digit with a few exceptions of brief episodes of interest rates falling slightly to 9.5 per cent, especially in 2001. Monetary policy stance began to loosen since 1999 to 2006 before interest rates started picking up in 2007 and 2008 at the height of the financial crisis. Again in 2009 the Bank adopted an accommodative monetary policy stance as depicted by the downward trend in discount rates until a slight tightening in July 2015.

Figure 4 also shows the trend in Swaziland’s discount rate and inflation from 1990 to 2015. The graph shows that high inflation rates tend to be followed by an increase in the discount rate. As inflation increased the Bank reacted by increasing the discount rate in an attempt to contain inflation. This is evidenced by the movements in the two variables in 2002, 2007, and 2008 with an increase in inflation being followed by an increase in nominal interest rates and vice versa. From the graph, it is clear that as the Bank increases the bank rate as a way of curbing inflation, inflation would respond by falling albeit with a lag. Such an observation can be plausibly explained by the inflation-targeting framework as adopted by South Africa in February 2000.

However, post the fiscal crisis of 2011 the Bank decided to maintain low interest rates in an effort to stimulate growth in the economy, hence the coexistence of high inflation and an accommodative monetary policy stance as depicted in Figure 4. The pre-inflation targeting framework period prior to 2000 was characterized by targeting intermediate monetary aggregates like money supply growth to anchor inflation. Importance was given to price stability but the time in which price stability would be attained was not defined. As a result, the relationship between the discount rate and inflation shows that these two variables are not tracking each other as depicted in Figure 4.

Figure 4: Trends in Discount Rate and Inflation in Swaziland; 1990 to 2015

Source: Central Bank of Swaziland

1.3.2 Interest Rates and GDP Growth Rates Developments

Figure 5 indicates that low interest rates do not seem to bear a significant relationship with real output. While the Bank adopted an accommodative monetary policy stance since 1999 to 2006, real output did not grow as expected, posting an average growth of 3.5 per cent in that period against an average discount rate of 9.7 per cent. Again in 2009 there was a loosening of the monetary
policy stance until a slight tightening in July 2015. During this period, the country saw an environment of the coexistence of low interest rates and low GDP growth, averaging 5.5 per cent and 2.6 per cent respectively, an indication that low interest rates have not necessarily stimulated the economy save for the periods of 2005 to 2008 as well as 2013 where the economy grew by more than 4 per cent.

**Figure 5: Interest Rates and GDP Growth; 1990 to 2015**

Source: Central Bank of Swaziland

### 1.3.3 Interest Rates and Treasury Bills

Figure 6 indicates that changes in the discount rate have produced a significant, albeit varied, immediate impact on Treasury Bills rate for the period under review. The effect of a discount rate change on the Treasury Bills rate was significant since 1990 with Treasury Bills rate consistently being lower than the discount rate until 2004 and after 2006. However, after 2010 to 2015 the yield in Treasury Bills has been above the discount rate, with the spread gradually increasing. This could be attributed to the recent Government fiscal crisis which led to institutional investors bidding higher than the prevailing discount rate (interest rate) in order to cushion themselves.

**Figure 6: Discount Rates and Treasury Bills Rate: 1990 to 2016**

Source: Central Bank of Swaziland

### 1.3.4 Interest Rates and Credit to Business Sector

Despite the Bank adopting an accommodative monetary policy stance since 2009 as portrayed by Figure 7, this environment has been accompanied by a fluctuating growth in credit extension to the business sector.

**Figure 7: Interest Rates and Credit to Business**

Source: Central Bank of Swaziland

This phenomenon indicates the lack of appetite by the country’s financial institutions in terms of extending credit that is needed to spur economic growth. This calls for the country’s financial institutions to revisit their core and primary role of extending credit if the country wants to achieve
high economic growth rates. Furthermore, another challenge is the dominance of South African firms in the local economy. This may mean that credit required by these firms is sourced across the border, in the form of re-invested earnings.

1.4 Research Problem

The effect of interest rates on the performance of some macroeconomic variables in Swaziland is of a serious concern. There is a general consensus that high interest rates cause problems for aggregate economic performance, although there is much less agreement about the relationship between interest rates and these economic fundamentals like economic growth, inflation, investment, credit extension, asset prices and other variables, and how interest rates affect economic activities at the macroeconomic level. This has generated a significant debate both theoretically and empirically. One important question about the nexus between monetary policy (interest rates in particular) and economic fundamentals is to what extent do economic players change their behaviour in response to changes in interest rates in Swaziland.

1.5 Purpose of the Study

The aim of this study is to strengthen the understanding of how monetary policy, and in particular interest rate setting, affects the Swaziland economy. Effective monetary policy depends on a central bank having a firm understanding of the link between its actions and its objectives. As previously stated, the main objective of the CBS is to foster financial sector stability conducive to economic development in Swaziland. This objective has traditionally been pursued by formulating and implementing sound monetary policy through the use of interest rates. In light of changes in the economy and to better anchor inflation expectations, CBS is now in the process of redefining its monetary policy framework. Uncovering how the Swaziland economy responds to changes in interest rates has accordingly gained importance.

The main goal of this research is to provide empirical evidence on the linkage between interest rates (discount rate, liquidity requirement, and reserve requirement), financial variables (money supply, asset prices, and credit extension) and economic variables (economic growth, inflation, investment). The main questions being dealt with are:

- What kind of relationship exists between interest rates and other economic fundamentals like real GDP, credit extension, money supply, investment?
- Do interest rates have superior predictive abilities in predicting real GDP, credit extension, money supply, and investment?

2.0 EMPIRICAL LITERATURE

Studies looking at monetary policy transmission in Africa suggested that the interest rate channel is generally weak, and that the credit and exchange rate channels are more important although not always very strong. In particular, Buigut (2009) found the interest rate channel to be of relatively little importance in the transmission of monetary
policy to output and prices in the East African region. Another study by Simatele (2003) used a vector autoregression (VAR) methodology and also found the exchange rate channel to be the most important and further concluded that bank lending in Zambia is not driven by monetary policy but rather by demand. A more recent study by Baldini (2012), which used a dynamic stochastic general equilibrium model, confirmed the presence of the exchange rate channel in Zambia but also pointed to a role for the credit channel.

Bernanke and Blinder (1992) published an important paper titled “Inside the Black Box: The Credit Channel of Monetary Policy Transmission”, in which they established a new monetary consensus. In their paper, they claimed that short-term interest rate could be regarded as the measurement of monetary policy. Their results showed that interest rate has an effect on real output through credit using the Structural Vector Auto Regression (SVAR) approach and the Granger causality tests.

Cheng (2008) adopted econometric techniques and studied the effect of macroeconomic elements as exchange rate, saving reserve, interest rate and money supply on Shanghai securities composite index to measure if monetary policy has any impact on stock prices. He mainly adopted the VAR modelling and Granger causality testing and found that exchange rate changes have a definite effect on stock prices while interest rate and savings have little effect on stock prices but money supply has significant impact on stock prices. Evidence shows long run coordinating relationship between stock prices and monetary aggregates respectively. Charles (2012) examined the impact of monetary policy on the Nigerian economy. He employed the Ordinary Least Squares (OLS) Method to analyse data between 1981 and 2008. The results of the analysis revealed that monetary policy represented by money supply exerts a positive impact on GDP growth and Balance of Payments (BOP), but negative impact on the rate of inflation. He suggested that monetary policy should facilitate a favourable investment environment through appropriate exchange rates, interest rates, and liquidity management mechanism and the money market should provide more financial instruments that fulfill the need of the ever growing sophistication of operations. He stated three models to represent the impact of monetary policy on Nigerian macroeconomic variables with the independent variables being money supply, liquidity ratio and cash ratio while the dependent variables were inflation rate, GDP, and BOP.

Saymeh and Orabi (2013) investigated the effect of interest rate, inflation rate, and GDP on macroeconomic growth in Jordan over the period 2000 to 2010. From the Johansen test performed, it was found that all four equations had significant existence of cointegration at 1 per cent or 5 per cent for the trace and maximum eigenvalue statistic. It was therefore opined that a long term equilibrium relationship existed among variables. Granger Causality results showed that only inflation causes interest rate while others are independent, hence no causality. However, regression results to check for
impacts of both inflation and interest rates on growth rate found that inflation has significant effect on growth rate while only prevailing interest rate has significant influence on growth rate. Lastly, testing for interest rates, inflation rates, and GDP all together, found that current GDP and one lag GDP have influence on growth rate.

Fuhrer and Moore (1995) presented a structural model that captures the dynamic negative correlation between real output and the short-term interest rates. At the same time, they estimated the VAR model and found that the behaviour of long-term interest rate is similar to that of short-term interest rate, and long-term interest rate also predicts the future output well. Barran, Coudert, and Mojon (1996) used a VAR model to show that the impact on output from monetary policy shock is quite similar in time and in scale across countries. Their research also suggested that the credit channel could be effective in European countries, because credit supply tends to contract more after a negative monetary policy shock although the empirical results found in Germany and France do not support the hypothesis. Their results also showed that the GDP significantly declines in Germany, Austria and the Netherlands when long-term interest rates are introduced into the VAR model, although this effect is not as strong as that found in the U.K. and Italy. They interpreted this result as indicating that the credit supply mainly depends on the short-term interest rate in the U.K. and Italy.

Peersman and Smets (2003) established the standard VAR model for the Euro area from 1980 to 1998 to investigate the impulse response of the main macroeconomic variables to an unexpected monetary policy shock. A temporary increase in the short-term nominal interest rate and real interest rate is likely to be followed by a fall in output and a real appreciation of the exchange rate. Prices are stickier and only start to decline several quarters later. Their results are similar to those found in the U.S using similar methods. Moreover, the impulse response appears to be stable over the long sample periods.

They also explored the reaction of components of GDP and other macroeconomic variables to a monetary policy shock. The most significant contribution to GDP decline is accounted for by investment. The magnitude of impulse response of investment is three times as that of GDP, but private consumption is less extent to the response of GDP. Their findings revealed the immediate response of M1, but a slower effect on M3 and credit aggregate data. The long-term interest rate shows features that are consistent with the expectation of term structure theory. In addition, they also pointed out that the share price responds more quickly and deeply after the impact, although house prices are more sluggish.

Cheng (2006) applied both recursive and non-recursive structural vector autoregression (SVAR) to monthly data in Kenya for 1997-2005 and found some evidence for the presence of the traditional transmission channels. A contractionary monetary policy, an exogenous increase in the short-term interest rate, the measure of monetary policy used in the paper, leads to an initial increase
in the price level (the price puzzle) followed by a falling price level that is statistically significant for about two years following the shock. In response to a contractionary monetary policy, output rises initially but falls eventually, though the decline is not statistically significant. Shocks to the interest rate explain a much larger fraction of inflation (30 per cent) than output (10 per cent), consistent with the results from the impulse response analysis. Positive shocks to interest rates lead initially to a depreciated exchange rate but the exchange rate eventually appreciates for about two years, which suggests the presence of the strong impact of exchange rate pass-through to inflation.

In a similar fashion, Maturu, Maana, and Kisinguh (2010) applied the same methodology as Cheng (2006) to study MTM in Kenya using quarterly data from 2000 to 2010. In contrast to Cheng (2006), Maturu, Maana, and Kisinguh (2010) regard M3 as the monetary policy instrument. They found that an exogenous shock to M3, an expansionary monetary policy, has no effect on real output, but leads to rising prices for almost 18 months, which is also statistically significant. A positive shock to the interest rate leads to falling prices, much like Cheng but the effect is not statistically significant, in marked contrast to Cheng’s finding. A shock to M3 explains as much of inflation variability as a shock to interest rate in Cheng’s. Both studies applied the non-recursive SVAR model of Kim and Roubini (2000), and found that the results are the same as the recursive model. Neither study explores the relative importance of various channels of MTM though Maturu, Maana, and Kisinguh (2010) make an attempt, but the methodology does not pin down the channels. Buigut (2009) applied structural VAR methods to annual data for Tanzania in 1984-2005, and found evidence that interest rate shocks have weak and insignificant effects on output and inflation. Too few observations in this study may account for the large confidence bounds.

3. METHODOLOGY

3.0 Introduction

The major objective of this paper is to assess the impact of the interest rates on macroeconomic variables in Swaziland. Therefore, identifying the link between monetary policy activities and these variables is very important in order to gain a better insight and understanding of the relationships, since changes in monetary policy variables play an important role in several channels. Therefore, it would be important to determine how contractionary or expansionary accommodative, neutral or tight monetary policy affects the general performance of the economy. The general approach is to determine if there is a long run relationship (cointegration) between monetary policy variables and macroeconomic variables, and what the nature of that relationship is.

Using monthly data from 1990 to 2015, the Johanson and Jeselius (1988) test for cointegration is applied. Whenever cointegration is found to exist, the SVAR model is applied. The Granger (1969) causality test was applied to test for the existence and direction of causality. The variance decomposition and impulse
response analysis were applied to complete the analysis. The Augmented Dickey Fuller (ADF) and Phillips Perron (PP) tests were conducted to test for the presence of unit roots in the data.

3.1 Unit Root tests

A stationary series can be defined as one with a constant mean, constant variance and constant auto covariance for each given lag (Brooks, 2002). The stationarity or otherwise of a series can strongly influence its behaviour and properties. In stationary time series, shocks will be temporary and overtime their effects will be eliminated as the series revert to their long run mean values. On the other hand, non-stationary time series will necessarily contain permanent components. Therefore, the mean and/or variance of a non-stationary time series will depend on time, which leads to cases where a series has no long run mean to which the series returns, and the variance will depend on time and will approach infinity as time goes to infinity (Asterou and Hall, 2007).

3.2 Tests for Causality

The concept of causality due to Granger (1969) is appropriate and used by most of the studies for testing the causal relationship between macroeconomic variables. According to the Granger causality approach a variable Y is Granger caused by X, if Y can be predicted better from past values of Y and X than from past values of Y alone, and vice versa. Four patterns of causality can be distinguished; unidirectional causality from X to Y, unidirectional causality from Y to X, feedback or bi-directional causality, and no causality.

3.3 Cointegration

The purpose of cointegration tests is to determine whether the variables in our model are cointegrated or not. Gujarati (2003) suggests that cointegration of two or more-time series indicates the presence of a long-run or equilibrium relationship between them. The economic interpretation of cointegration is that if two or more series are linked to form an equilibrium relationship spanning the long-run, then even though the series themselves may be non-stationary, they will move closely together over time and their difference will be stationary. A set of variables is defined as cointegrated if a linear combination of them is stationary. A more simpler definition is that when two or more variables are integrated in the same order, say I(1), and there is a linear combination between them that is stationary, I(0), then the variables are said to be cointegrated.

There are several ways of testing for cointegration, among others; there is the Engle-Granger approach which is residual based and the Johansen and Julius technique which is based on maximum likelihood estimation on a VAR system. The latter was applied in this part of the study since the former is most suitable in a bivariate system. The minimum of the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) was used for lag length selection.
3.4 The Structural Vector Autoregression Model (SVAR)

The VAR models are the most widely used methodology to analyse monetary policy transmissions. The use of VARs for monetary policy analysis started with the seminal work of Sims (1980) and its recursive methodology has been used widely. In fact, most studies of monetary policy transmissions as reviewed by Mishra, Montiel, and Spilimbergo (2010) have used VARs, with the majority of studies using recursive VARs. In that regard, for this study we use the standard recursive SVAR. The basic structural VAR model in our study is very large and contains nine endogenous variables. The matrix form of the equation of the VAR model is selected as follows:

\[ AY_t = \sum_{i=1}^{p} B_i Y_{t-i} + \varepsilon_t \]

Where; \( Y \) is the vector containing the nine endogenous variables. \( A \) is a square matrix of coefficients to be estimated. \( \varepsilon \) is a vector of serially uncorrelated, and mutually orthogonal structural disturbances and \( p \) is the number of lags.

The structural model represented by the above system must be identified for the purpose of policy analysis and must be given economic interpretation (Leeper et al., 1996). A reduced form of the model, which is obtained by multiplying both sides by \( A^{-1} \) is specified as follows:

\[ Y_t = A^{-1} \sum_{i=1}^{p} B_i Y_{t-i} + \varepsilon_t \]

Where \( (\varepsilon_t) \) is a vector of serially uncorrelated, but not necessarily orthogonal, reduced form disturbances. In that regard, the relationship between the reduced form VAR residuals \( (\varepsilon_t) \) and structural shocks \( (\varepsilon_t) \) can be expressed as follows:

\[ \varepsilon_t = A_0 \varepsilon_t. \]

Based on the Cholesky decomposition of the reduced form VAR, we have to impose constraints that define matrix \( A_0 \) as a lower triangular matrix. The identification scheme follows the original paper by Sims (1980), whereby the Cholesky decomposition is applied to the contemporaneous parameter matrix \( A_0 \). Thus, the order of the variables is similar to many studies used in the context of VARs in advanced economies, including Sims (1992), and is as follows; output, inflation rate, policy rate, asset prices (bonds), money supply, credit to business, credit to households, savings, and investments.

The matrix form of the SVAR model can be expressed as follows:

\[
\begin{bmatrix}
\varepsilon_{\text{GDP}} \\
\varepsilon_{\text{CPI}} \\
\varepsilon_{\text{PPI}} \\
\varepsilon_{\text{TBRI}} \\
\varepsilon_{\text{MS}} \\
\varepsilon_{\text{CRRI}} \\
\varepsilon_{\text{SRRI}} \\
\varepsilon_{\text{INR}}
\end{bmatrix} =
\begin{bmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
a_{21} & 1 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
a_{31} & a_{32} & 1 & 0 & 0 & 0 & 0 & 0 & 0 \\
a_{41} & a_{42} & a_{43} & 1 & 0 & 0 & 0 & 0 & 0 \\
a_{51} & a_{52} & a_{53} & a_{54} & 1 & 0 & 0 & 0 & 0 \\
a_{61} & a_{62} & a_{63} & a_{64} & a_{65} & 1 & 0 & 0 & 0 \\
a_{71} & a_{72} & a_{73} & a_{74} & a_{75} & a_{76} & 1 & 0 & 0 \\
a_{81} & a_{82} & a_{83} & a_{84} & a_{85} & a_{86} & a_{87} & 1 & 0 \\
a_{91} & a_{92} & a_{93} & a_{94} & a_{95} & a_{96} & a_{97} & a_{98} & 1
\end{bmatrix}
\begin{bmatrix}
\varepsilon_{\text{GDP}} \\
\varepsilon_{\text{CPI}} \\
\varepsilon_{\text{PPI}} \\
\varepsilon_{\text{TBRI}} \\
\varepsilon_{\text{MS}} \\
\varepsilon_{\text{CRRI}} \\
\varepsilon_{\text{SRRI}} \\
\varepsilon_{\text{INR}}
\end{bmatrix}
\]

Where the left hand side of the equation contains a vector of residuals in the reduced form, and in the right hand side is the squared matrix \( (A_0) \) of coefficients associated with lagged variables and structural shocks through the column vector \( (\varepsilon) \).
The econometric identification of monetary policy shocks is crucial to any model specification, including SVARs. The SVAR identification exercise followed in this paper is explained as follows;

- The ordering of output and price level at the beginning is because they react to an innovation in policy rate with a lag due to their slow movement in nature.

- The policy rate is ordered after output and inflation. This is consistent with the practice that the policy rate or other interest rates (e.g., T-bill rate against which policy rates may be benchmarked) are increasingly being used by Central Banks as main instruments of monetary policy. Placing the interest rate after inflation also reflects the idea that central banks change the policy rate after observing the inflation path.

- Money supply is considered as one of the main instruments of monetary policy. So shocks to money supply are considered shocks to monetary policy, thus the money supply innovation comes after controlling for VAR innovation in interest rates.

- Credit to the private sector is placed after the policy rate because commercial banks react with a delay to grant loans and change loan terms following a shock to monetary policy. So credit is allowed to respond to changes in policy rate. The ordering also allows a loosening of monetary policy to be transmitted to credit expansion and a subsequent impact on inflation and output with a lag, whenever the credit channel is effective.

- Finally, savings and investments are placed last because they respond to innovations in macro fundamentals contemporaneously.

Due to the large number of variables and in pursuit of parsimonious models, 3 models will be estimated, with the core one (Model 1) with the variables; discount rate, inflation rate, money supply, output, credit to households, credit to business, asset prices (bonds), and indirectly savings and investment. These are the same variables which will be used in the VAR to test for cointegration. In Model 2, the discount rate will be replaced by the liquidity rate, while in model 3, it will be replaced by the reserve requirement as shown below.

Model 1:  
\[ d\gamma = \log\text{GDP}_{t-1} + \log\text{CPA}_{t-1} + \text{TRR}_{t-1} + \log\text{MS}_{t-1} + \log\text{BCX}_{t-1} + \log\text{Sav}_{t-1} + \epsilon_t \]

Model 2:  
\[ r_t = \log\text{GDP}_{t-1} + \log\text{CPA}_{t-1} + \text{TRR}_{t-1} + \log\text{MS}_{t-1} + \log\text{BCX}_{t-1} + \log\text{Sav}_{t-1} + \epsilon_t \]

Model 3:  
\[ r_t = \log\text{GDP}_{t-1} + \log\text{CPA}_{t-1} + \text{TRR}_{t-1} + \log\text{MS}_{t-1} + \log\text{BCX}_{t-1} + \log\text{Sav}_{t-1} + \epsilon_t \]

The impulse response and variance decomposition analysis will be carried out to determine the effects of various shocks in the estimated model. The impulse response function in a VAR analyses dynamic effects on the system when the model received the impulse of say one standard deviation shock. The variance decomposition reveals some amount of vital information and explanation of the contribution of each variable to other variables in the system. In essence it shows the amount the forecast error variance of
each of the variables that can be explained by exogenous shocks to the other variables in the system.

3.5 Diagnostic Checks

Once the model has been estimated, it will be subjected to various diagnostic tests, which assess the stochastic properties of the model, such as residual autocorrelation, heteroskedasticity, normality, and model stability.

3.6 Data

This study used monthly data from 1990M01 to 2015M12 to examine both short run and long run relationships between the policy rates and the other stated variables. Yearly data was interpolated to monthly data where possible. Data was obtained from the Central Bank of Swaziland.

4.0 EMPIRICAL RESULTS AND ANALYSIS

4.1 Unit root tests

Stationarity tests are pre-tests in any regression analysis to avoid spurious regression. As previously stated, testing for stationarity is the same as testing for the presence of a unit root in a time series. Whenever a time series is found to contain a unit root, then that series is not stationary and need to be differenced to attain stationarity. Table 1 in appendix A presents the results of both the ADF and PP tests for stationarity.

A variable is stationary if the ADF statistic is greater than the MacKinnon critical values for the rejection of the hypothesis for a unit root. All the variables, were found to be non-stationary at their levels because the ADF and Phillips-Perron test statistics are smaller than the MacKinnon critical values for the rejection of hypothesis for unit roots and therefore had to be differenced to make them stationery. As shown in Table 1, in all the variables the null hypothesis of non-stationary is rejected at least at 5 per cent significance level for both the ADF and Phillips-Perron test statistics except for the ADF test on CPI. The results suggest that all the variables are integrated of order one, that is they are I(1).

4.2 Granger causality tests results

The results in Table 2 (Appendix A) show that in Model 1, the discount rate has unidirectional causality relationship with real GDP, savings, household credit, consumer price index, and treasury bills rate (asset prices). According to the results the discount rate does cause all these mentioned variables but there is no reverse causation from the mentioned variables to the discount rate. This is because the F-value is statistically significant in all these cases leading to the rejection of the five null hypotheses. This means that any changes in the country’s discount rate would have an impact on real GDP, savings, household credit, consumer price index, as well as the asset prices.

Model 2 depicts that the liquidity requirement Granger causes real GDP as evidenced by the statistically significant F-statistic at 1 per cent (Table, Appendix A), hence it is essential for the Bank to pay attention to this variable as a monetary policy tool in order to influence economic activity in the
long run. This is very true in the sense that any change in the liquidity requirement will have an effect on the liquidity of the commercial banks thereby affecting their ability to extend credit.

The results also show a unidirectional causality from savings to liquidity requirement. However, these results are not of very much significance in light of the fact that the savings variable is not a monetary policy variable, hence the Bank can never have much influence on it. Unidirectional causality was also found to run from liquidity requirement to CPI, which means any change in this variable affects the level of prices in Swaziland.

Results from Model 3 (Table 4, Appendix A) indicate a unidirectional causality from reserve requirement and two economic macro variables which are real GDP and consumer price index. This is evidenced by the fact that the F-statistic is statistically significant at 1 per cent and 5 per cent respectively, leading to the rejection of the two null hypotheses. Any changes in the reserve requirement variable by the Bank will have an effect on the growth prospects of the economy together with effects on prices.

4.3 Cointegration tests

The essence of cointegration is to establish if the linear relationship between the variables is stationary. If the null hypothesis of no cointegration is rejected then the linear combination of the variables is stationary, hence a non-spurious long-run relationship exists between the variables and as such, consistent estimates of the long run relationship is evident. To test for cointegration between these variables, the Johansen test is applied. The first step in conducting the test was to identify the optimal lag length, whose results are shown in Table 5 below.

### Table 5: VAR Lag Order Selection Criteria

<table>
<thead>
<tr>
<th>L</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.29e-12</td>
<td>-1.835614</td>
<td>-1.722571</td>
<td>-1.7903</td>
</tr>
<tr>
<td>1</td>
<td>3.07e-26</td>
<td>-33.20411</td>
<td>-32.07368*</td>
<td>-32.751*</td>
</tr>
<tr>
<td>2</td>
<td>2.44e-26</td>
<td>-33.43702</td>
<td>-31.28921</td>
<td>-32.576</td>
</tr>
<tr>
<td>3</td>
<td>2.36e-26*</td>
<td>-33.4738*</td>
<td>-30.30838</td>
<td>-32.205</td>
</tr>
<tr>
<td>4</td>
<td>2.40e-26</td>
<td>-33.46429</td>
<td>-29.28171</td>
<td>-31.789</td>
</tr>
<tr>
<td>5</td>
<td>2.85e-26</td>
<td>-33.30195</td>
<td>-28.10198</td>
<td>-31.219</td>
</tr>
<tr>
<td>6</td>
<td>3.66e-26</td>
<td>-33.07052</td>
<td>-26.85316</td>
<td>-30.580</td>
</tr>
<tr>
<td>7</td>
<td>4.59e-26</td>
<td>-32.86647</td>
<td>-25.63172</td>
<td>-29.968</td>
</tr>
<tr>
<td>8</td>
<td>5.00e-26</td>
<td>-32.81258</td>
<td>-24.56045</td>
<td>-29.507</td>
</tr>
</tbody>
</table>

The minimum of the Akaike Information Criterion (AIC) and the final Prediction Error (FPE) showed a lag order of 3 while that of the Schwartz Bayesian Criterion (SBC) and Hannan Quinn (HQ) showed a lag order of 1 as the optimal lag length. With these conflicting results and from literature, results of the AIC and FPE were used which showed 3 as the optimal lag length. The second step is to choose the appropriate model, and the Pantula (1989) principle, which involves the estimation of the three most relevant models and the presentation of the results from the most restrictive hypothesis, was applied as shown in Table 6 (Appendix A). From the results, all the models show the existence
of cointegration vectors, furthermore, both the trace test and the maximum eigenvalue test selects Model 2 as having at most two cointegration vectors. That shows that there is cointegration among the variables, and model 2 automatically becomes the best model to be used for the estimations since it has more cointegration vectors. Since cointegration has been found to exist, we proceed to estimate the SVAR.

4.4 Structural VAR results

Having established the existence of cointegration and some causality among the variables, we proceed to estimate the SVAR in order to capture the accounting innovations (variance decomposition and impulse response) among the variables. We start by applying various diagnostic tests to our models to test for stability. The results for the Portmanteau Test for serial correlation in all the models indicate that there is generally no evidence of serial correlation and the LM test for heteroscedasticity shows no evidence of heteroscedasticity in all models. All the models failed the normality tests, indicating that the residuals are not normally distributed. As noted by Harris (1995), non-normality in the residuals is acceptable if some of the variables are weakly exogenous. Figure 7 (Appendix A) reports the inverse roots of the characteristic autoregressive polynomials of each of the three models. According to Lütkepohl (1991) the estimated SVAR is stable (stationary) if all roots have modulus less than one and lie inside the unit circle. If the SVAR is not stable, certain results such as impulse response standard errors are not valid.

4.5 Impulse Response Functions and Variance Decomposition

Since our emphasis is on tracing the impact of the monetary policy transmission to the wider economy, this section will outline the response of the other endogenous variables in the model to a one-time shock in the policy rate through the impulse response functions. An impulse response function traces the effect of a one-time shock to one of the innovations on current and future values of the other endogenous variables. In our case, the monetary policy transmissions of interest are the interest rate channel, credit channel, and the asset price channel. That is because we have no control of the exchange rate channel and no immediate available data on the expectations channel. Hence the shock will be on the policy rate (discount rate, liquidity requirement, and reserve requirement) and we observe the responsiveness of its own shock and that of the other endogenous variables. Figure 8 (Appendix A) shows the response of the macroeconomic variables to a one-time shock on the discount rate in the thirty-six-month horizon.

As shown in Figure 8, the positive shock to the discount rate is immediately and highly significant in the asset prices (TBR) and the business sector credit as expected from economic theory. That means it results to a rise in the prices of assets and a fall in demand for credit from businesses. However, the shock in asset prices becomes insignificant after 24 months as investors adjusts to the new rates. The shock becomes significant after 20 months in the household credit, although there was an observed
gradual fall in the demand for household credit over the months. Savings rose slightly although insignificant, which means it substituted the appetite for borrowing since the shock in the discount rate. Investment also rose, although its significance was after 12 months, and became insignificant again after 24 months.

Generally, the response of money supply to a shock in the discount rate is insignificant. That is due to the free flow of the Rand in the economy due to CMA membership. The response of GDP and CPI is insignificant, although falling after an initial small rise. It is interesting to note the gradual fall in CPI which shows the success of the positive shock in the discount rate in curbing inflation. Overall this analysis shows that the interest rate (discount rate), asset price and credit channels are significant in transmitting monetary policy in Swaziland.

However, it is important to also analyse the contributions of these channels to the major economic variables, which are GDP and CPI. That can be attained through the variance decomposition as shown in Table 7. The variance decomposition indicates the relative importance of the various shocks on the variable of interest over different horizons.

From Table 7 (Appendix A), it is evident that inflation is the highest contributor to variations in GDP in the 36 months’ horizon as it contributes about 15.3 per cent in the thirty sixth month, followed closely by business sector credit at 15.2 per cent. The low contribution of household credit shows that households borrow mostly for consumption purposes. Asset prices and savings were also found to contribute very little compared to investment, which was expected.

Our main variable, the discount rate, contributes about 6.1 per cent to variations in GDP after 36 months, which shows the success of this policy rate. Of note is that its contribution is higher than the likes of money supply and investments. The contributions of the variables to variations in the inflation rate are shown in Table 8 (Appendix A).

From the table, the major contributors to variations in CPI are the asset prices (14.7 per cent) and GDP (13.3 per cent). In our previous analysis we had observed the success of our policy rate in curbing inflation, however this table presents a different story as the discount rate, at 0.63 per cent is found to be very insignificant in its contributions to the variations in CPI, even surpassed by money supply at 1.8 per cent. That shows that the interest rate channel, through the discount rate, is not very strong in transmitting monetary policy. However, this failure in curbing inflation could be a result of external factors, particularly import prices. Another interest rate instrument which the Bank uses is the liquidity requirement. Figure 9 (Appendix A) shows the impulse response of the same variables due to a positive shock in the liquidity requirement.

The results from this model are almost in tandem with those of the discount rate, particularly for GDP and CPI. However, the major variables which are significantly
affected by this shock are the household credit and savings. That is because a rise in the liquidity requirements affects commercial banks, which in turn slows down in lending, which encourages saving. That is evidenced by the significant fall in household credit and a significant rise in savings. Although both insignificant, business credit also falls whilst investment rises.

Unlike in the discount rate model, asset prices are the least affected by the shock in liquidity requirement. That might be because most of these assets (treasury bills and bonds) are classified as liquid assets and are already embedded into the liquidity requirement. The causal effect of these variables to the major economic variables (CPI and DGP) is explained in the variance decomposition in Tables 9 and 10 (Appendix A).

CPI at 15.2 per cent is the major contributor to variations in GDP, followed by business credit and asset prices at 14.9 per cent and 8.8 per cent respectively in the thirty sixth month. The liquidity requirement, just like the discount rate, is found not to be significant in contributing to variations in GDP in the 36 months’ horizon. The causal variations in the CPI is shown in Table 10.

At 8.9 per cent, GDP is found to be the major contributor to variations in the CPI in the thirty sixth month, followed by the liquidity requirement at 4.9 per cent in the thirty sixth month. These results show the importance of the liquidity requirement in curbing inflation, since its contribution is more significant than the discount rate.

Furthermore, the contribution of money supply to variations in inflation is at 2.9 per cent, better than in the discount rate model. The last policy rate is the reserve requirement, whose impulse response graphs is shown in Figure 10 (Appendix A).

Generally, the results of this model are very similar to those of the liquidity requirements model. That could be explained by that the reserve requirement is a component of the liquidity requirement. Just like in the previous model, the impact of the shock in the reserve requirement is significant in the household credit and savings variables, as expected from economic theory. That shows the strength of the credit channel in transmitting monetary policy in Swaziland. The causal relationship to GDP and CPI are shown in Tables 11 and 12 (Appendix A).

CPI, business credit and asset prices are the major contributors to variations to GDP, results which are similar to those found for the liquidity requirement, albeit in different per centages. All the policy rates, except the discount rate, are not significant in explaining variations in GDP in the models, however it is a different story for CPI as shown in Table 12, where the reserve requirement is one of the major contributors.

The major contributor to variations in CPI in the 36-month horizon is GDP, just like in the other models. It is closely followed by the reserve requirement at 5.8 per cent, and money supply at 3.6 per cent. Worth noting is that the contributions of the reserve requirement and money supply to variations in the CPI is higher in this model than in
the liquidity requirement model. That is because of the direct link between money in circulation and the reserve requirement, which is strictly in cash.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions
The main goal of this research was to provide empirical evidence on the linkage between policy rates and financial variables (money supply, asset prices, and credit extension) and economic variables (economic growth, inflation, investment). There are three policy rates which the CBS uses in its pursuit of financial stability; the discount rate, liquidity rate, and the reserve requirement. Hence this paper estimated three models which involves each of the policy rate and the other variables to assess the relationships.

The paper started by testing the stationarity of the variables and they were all found to be non-stationary at their levels, and needed to be differenced once to attain stationarity. The lag length selection criteria chose 3 to be the optimal lag length. Cointegration results shows the existence of a long run relationship among the variables. Granger causality tests show that the discount rate has unidirectional causality relationship with real GDP, savings, household credit, consumer price index, and treasury bills rate (asset prices). Unidirectional causality from liquidity requirement to GDP and CPI was found, and from reserve requirement to real GDP and consumer price index.

A structural VAR was then estimated for the three models, which was found to be generally stable. The results show that a positive shock to the discount rate is immediately and highly significant in the asset prices (TBR) and the business sector credit as expected from economic theory. That means it results to a rise in the prices of assets and a fall in demand for credit from businesses. Major variables which are significantly affected by the liquidity requirement shock are the household credit and savings. That is because a rise in the liquidity requirement affects commercial banks, which in turn slows down lending, which encourages saving. Generally, the results of a shock in the reserve requirement are very similar to those of the liquidity requirements model. That could be explained by that the reserve requirement is a component of the liquidity requirement.

Variance decomposition results, show that variations in GDP are mostly caused by CPI, business credit and asset prices in all the models. However, it is liquidity and reserve requirements which were found to have more effect to variations on CPI than the discount rate, which shows the weakness of the discount rate in influencing inflation. Generally, the results show the existence of monetary policy transmissions in three channels, which are interest rate channel, credit channel, and asset price channel, but are not very strong. The results are almost at par with Chileshe, et. al. (2014) who found that the direct link from interest rates to output and inflation in Zambia has historically been weak and that monetary aggregates have, at least until recently, had a greater role in the monetary transmission mechanism. Furthermore, Cheng (2006)
found that variations in the short-term interest rate accounts very little for output fluctuations in Kenya.

5.2 Recommendations

Since this paper has found evidence of monetary policy transmission in the three channels; interest rates, credit, and asset price channels, it is recommended that the Bank continue with utilising the discount rate as its main monetary policy tool. Furthermore, this study has also found that the discount rate contributes more to output growth than to CPI. The other monetary policy tools (liquidity requirement and reserve requirement) were found to contribute more in variations in the CPI than the discount rate. In that regard, this paper recommends a periodic review of this rates, at least after two years, than the current scenario where they are sometimes reviewed after over 5 years.

On the other hand, money supply was found to have insignificant responses to shocks in all the models. That scenario is due to CMA membership, and the paper recommends that open market operations could be the only instrument which could control this variable; although some researchers argue that OMOs only help in government budgetary obligations than controlling the level of money supply in some countries.

On that note, the country needs to improve in its efforts to enhance the transmission of monetary policy by promoting financial deepening and economic development. More generally, the enhanced inclusion of non-bank financial institutions would assist in ensuring that the various monetary policy instruments can continue to be effective in securing the objective of macroeconomic and financial stability.

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Seigniorage Compensation for Swaziland and Policy Implication

Simiso F. Mkhonta

Abstract

Seigniorage compensation for Swaziland is found to depend on Emalangeni in circulation in Swaziland besides the obvious effect of an increase in ZAR/Rands in circulation in South Africa. Where a per cent increase in Emalangeni in circulation in Swaziland at time t decreases seigniorage compensation by 0.186 per cent and a per cent increase in Emalangeni in circulation at time t-1 decreases seigniorage compensation by 0.134 per cent through both substitution and base effects respectively. Thus a conservative monetary policy is recommended to sustain seigniorage upwards, to arrest inflationary pressures and sustain the fixed exchange rate.

Key Words: Seigniorage, CMA, currency, compensation

1. Introductory background

Swaziland through the Central Bank receives seigniorage compensation according to the Trilateral Agreement between the Common Monetary Area (CMA) which came into existence in 1974. Before the Trilateral Agreement existed an informal arrangement existed among Botswana, Lesotho, South Africa and Swaziland. Botswana though opted out of the formal monetary arrangements that were signed thereafter. The Trilateral Agreement comprised Lesotho, South Africa and Swaziland. The agreement culminated into a Multilateral Agreement when Namibia joined in 1992, shortly after attaining independence.

From 1st April 1986 Swaziland ceased the legal status of the South African Rand (ZAR) under Article 5 of the Bilateral Monetary Agreement between The Government of the Kingdom of Swaziland and The Government of the Republic of South Africa. According to Langa (1986) huge depreciation of the ZAR contributed to Swaziland ceasing the legal status of ZAR in Swaziland. Consequently, the obligation of South Africa to make compensatory payments to Swaziland in terms of Article 6 of the Trilateral Agreement ceased on 31st March 1986.

Even though the ZAR stopped to be legal tender in Swaziland in April 1986, the Central Bank maintained the parity peg to the ZAR and economic agents continued trading in the ZAR in the domestic economy unchanged at the rate of one is to one. On 19 September 2003 the legal status of the ZAR was reinstated hence the payment of seigniorage compensation.

2. Seigniorage Calculations

The seigniorage compensation is calculated using the formula stated in the agreement as two thirds of X per cent of Y, where X represents the annual yield to redemption at which most recent issue of long-term domestic South African Government stock was offered prior to the 31st day of December immediately preceding the annual payment date and Y represents the relevant agreed
The formula for the calculation of seigniorage can be mathematically represented as follows:

\[ Y(T) = Y(T)_{t-1} + Y(T)_{t-1} \times (1.2/100) \Delta RSA(R)_{t} \]

\[ Y(R) = Y(T) - Y(E) \] \hspace{1cm} (1)

Where: 
- \( Y(R) \) = total Rands in circulation.
- \( Y(T) \) = total notes and coins in circulation.
- \( Y(E) \) = total emalangeni in circulation.
- \( \Delta RSA(R)_{t} \) = average growth in rand notes and coins in circulation.

\[ \text{Compensation} = \frac{2}{3} \times (X \times Y(R)) \] \hspace{1cm} (2)

And \( X \) is the returns on South African government bonds.

3. Analysis of the Movements in Seigniorage Compensation.

Seigniorage compensation for Swaziland has been generally on the increase before cessation of the Rand as legal tender in Swaziland and after resumption of compensation payment as seen in the Figure1 (Appendix B).

The formula used to calculate seigniorage compensation has remained unchanged. Driving the increase in the seigniorage compensation was increased ZAR in circulation in South Africa, increase in Emalangeni/SZL in circulation at time t and an increase in Emalangeni/SZL in circulation in time t-1 as shown in equation 3 below.

\[ \%\Delta Ct = f(\alpha_1 \%\Delta RSA(R)_t - \alpha_2 \%\Delta Y(E)_t + \alpha_3 \%\Delta Y(E)_{t-1} + \alpha_4 dX + \varepsilon) \] \hspace{1cm} (3)

where;
- \( \%\Delta Ct \) = change in seigniorage compensation in per cent.
- \( \%\Delta RSA(R)_t \) = change in South African Rands in circulation in South Africa in per cent.
- \( \%\Delta Y(E)_t \) = change in Emalangeni in circulation in per cent.
- \( dX \) = percentage change in Returns on SA government bonds (10yrs and over).

These are the variables that interplay to give seigniorage compensation given the parameters of 2/3 and 1.2 per cent in the formula.

3.1 Expected Signs of Variables

- The higher the growth in Rands/ZAR in circulation in South Africa the higher the per cent change in seigniorage compensation.
- The higher Emalangeni/SZL in circulation at time t the lower the per cent change in seigniorage compensation.
- The higher Emalangeni/SZL in circulation at time t-1 the higher will be the per cent change in seigniorage compensation.
- The higher the returns on South African bond the higher the seigniorage compensation.
3.2 Estimation Results
\[
\%\Delta C_t = 1.615 (\%\Delta RSA(R)_t) - 0.186 (\%\Delta Y(E)_t) \\
(0.000) \quad (0.1553)
\]
\[-0.134(\%\Delta Y(E)_{t-1}) + 8.849(dX) + \epsilon \\
(0.0871) \quad (0.000)
\]
\[R^2 = 0.924721 \]
\[DW = 2.3846.\]

3.3 Results Interpretation

The results show no autocorrelation due to a Durbin Watson statistics of approximately 2. The explanatory power of the regression is high at 0.92 and there is only one insignificant variable at 15 per cent attesting to the absence of multicollinearity. Heteroscedacity is not a problem for estimation but would cause problems when forecasting has to be done. The seigniorage compensation formula has two parameters as stipulated above being a factor of 1.2 per cent of change in Rand/ZAR in circulation and a factor 2/3 of the Rand/ZAR in Swaziland. The variables results are as follows;

- 1% change in growth in Rand/ZAR in circulation leads to a 1.615 per cent change in growth in seigniorage.
- 1% growth in Emalangeni/SZL in circulation at time t reduces the change in seigniorage by 0.816 per cent and it is not significant but becomes significant with a lag. This is because Emalangeni in circulation are subtracted from total money in circulation in Swaziland including Rands which is grown annually by the per cent change in Rands in circulation in South Africa (see equation 1). The variable captures the substitution effects of Emalangeni against Rands as they grow within the Swaziland economy subject to the level of economic activity.
- 1% growth in Emalangeni/SZL in circulation at time t-1 reduces the change in seigniorage by 0.134 per cent because it is part of the base for the Rands and Emalangeni in the following year. Emalangeni at t-1 with a negative sign therefore show that monetary policy in Swaziland is generally conservative through the base effect of Emalangeni at t-1.

1% growth in returns on South African bond lead to \[\frac{91.151}{(100-8.849)}\] per cent reduction in seigniorage compensation. Note should be taken that South Africa pays the opportunity cost of the Rand circulating locally had they been invested in South African bonds (refer to equation 2).

Appendix B graph 2 shows a fall in the growth of seigniorage as the Rand/ZAR in circulation in South Africa grows at a dampening rate. The falling increase in Emalangeni in circulation also leads to a dampening of the growth in seigniorage compensation.

4. Substitution and Base Effects of Emalangeni in Circulation(Y(E)t)

Rands/ZAR trickle into the domestic economy mainly through export trade with South Africa and SACU receipts and the rate at which they circulate in the domestic economy is determined by the competing volume of Emalangeni in circulation. With high
volumes of Emalangeni /SZL in circulation economic agents have the leeway of setting the Rand/ZAR aside for transactions in the South African Economy leading to a fall in seigniorage. More in particular with low economic growth being experienced an increase in Emalangeni in circulation coupled with an increase in Rands will lead to Rands reverting back to South Africa due to shortage of goods to chase domestically. The free flow of capital between South Africa and Swaziland dampens any inflationary effects that may arise from the inflow of the Rand/ZAR. This effect can be referred to as the substitution effect. The variable, (Y(E)t), therefore has assumed the expected sign of negative, meaning that Emalangeni growth have the tendency to push Rand/ZAR out of the domestic economy. This suggests that a somewhat expansionary monetary policy is in play.

However, the variable Y(E)t-1 captures the base effect by either increasing or decreasing the base for Rands and Emalangeni in circulation for the following year. Thus this variable captures the base effects and as with the results it shows that base effects have been low, attesting to conservative monetary policy, as shown by the negative sign of Y(E)t-1 in the results.

Thus from the seigniorage formula and results, it is found that Y(E)t shows expansionary monetary policy through the substitution effect by replacing Rands/ZAR and reducing seigniorage compensation in process yet Y(E)t-1 shows conservative monetary policy by at the same time by reducing seigniorage compensation through lower base effects. Ultimately both results sum up to show that under the fixed exchange rate regime the monetary authorities pursue prudent monetary policy.

Total money in circulation in Swaziland including Rands has increased at a decreasing rate as shown in graph 5 and 6 leading to a decreasing rate of increase in seigniorage compensation and as the change in Rands in circulation South Africa effect outweigh the substitution and base effects Emalangeni in circulation in Swaziland seigniorage is set to be on a sustainable upwards trajectory.

5. Policy Recommendations

Due to the above results, a conservative monetary policy is recommended to contain the increase in Emalangeni/SZL in circulation for the seigniorage compensation to be sustainable on an upward trajectory. This is because of the negative relationship which Emalangeni/SZL in circulation has with a growth in seigniorage compensation both at time t and t-1. Thus there ought to be a steady balance in the growth in Emalangeni/SZL in circulation to avoid a sub-optimal growth in seigniorage compensation both through the optimization of the sum of the substitution effect and the base effect so that growth in and Rands/ZAR and returns on South African government bonds outweigh the effects. The growth in Rands/ZAR in circulation in South Africa and returns of South African government bonds are taken purely as exogenous factors and thus regarded as given. Swaziland has fairly pursued conservative and prudent monetary policy as shown by falling growth in Emalangeni/SZL in circulation in graph 4. This has resulted
in the seigniorage compensation increase from R221 535 234 in 2015 to an estimated R242 412 369 in 2016. A conservative monetary policy thus is recommended to sustain the upward trajectory of seigniorage compensation, contain inflation and sustain the fixed exchange rate regime.

REFERENCES


The Impact of Monetary Policy Changes on Credit Extension

Sive Kunene

Abstract

The purpose of the study was to determine the impact of monetary policy rates (discount rate, reserve requirement and liquidity requirement) on credit extension to; vehicles, housing, distribution and tourism, transport and communication, construction, manufacturing, and agriculture and forestry using monthly data from 2006 to 2015. Three models were estimated in line with the policy rates. The ADF and PP test were used to test for stationarity and the variables were integrated of I(0) and I(1). The Johansen test Trace Statistic results showed the presence of cointegration. The SVAR impulse response results revealed that a positive shock on the discount rate has a negative significant impact on credit extension to; distribution and tourism, construction, and agriculture and forestry. However, the response was marginal. The variance decomposition results revealed that the discount rate is the most effective policy rate. A shock on the discount rate causes 11.5, 10.8, 36.9 and 12.2 per cent variation on credit extension to; housing, distribution and tourism, construction, and agriculture and forestry, respectively over a 36 months’ period. A shock on the reserve requirement has a major impact on credit extension to; housing, construction, manufacturing, agriculture and forestry causing 6.7, 7.5, 6.3 and 7.0 per cent variation. A shock on liquidity requirement causes 4.0, 4.2, 6.4, and 4.1 per cent variation on credit

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extension to; vehicles, housing, manufacturing, and agriculture and forestry, respectively. The effects of the shocks are more significant in the medium term than in the short term.

Key words: monetary policy, cointegration, causality, SVAR

1.0 Introduction

Generally, there is broad consensus about the important contribution which monetary policy can make to improve the economic prospects of a country. However, in Swaziland, the efficacy of monetary policy in terms of its ability to address economic cycles and shocks has been put into question since the 2008/2009 financial crisis. One of the major challenges facing Swaziland is sluggish economic growth, averaging 2.39% between 2008 and 2015 (CBS, 2016). Some of the country’s main policy documents like the National Development Strategy cite limited credit extension to the private sector as one of the major reasons for the country’s poor economic performance in spite of the financial sector being fairly developed. World Bank (2014) also notes same. The monetary authority through its monetary policy stance plays a crucial role in determining credit extension and hence this study focuses on the impact of monetary policy changes on credit extension to the private sector in Swaziland. The monetary policy decisions are transmitted to the economy through the monetary policy transmission channels.

While the primary responsibility of the Central Bank is to ensure price stability, the Bank also recognizes the need to stimulate the economy, if it is slow at that time. One way through which the Bank can stimulate the economy is by lowering the discount rate and this benefit can be passed on by banking institutions to the private sector which in turns leads to increased consumption and investment spending. Ciccarelli, Maddaloni and Peydro (2010) assert that the role played by the financial sector, in particular the banking sector in affecting economic activities through the supply of credit has become a central issue for both policy makers and academics. There is vast literature on how monetary policy affects credit extension to the private sector; however, the precision of its outcomes is more country specific and hence the need to investigate its effects at country level (Ciccarelli, Maddaloni & Peydro, 2010).

Loayza and Schmidt-Hebbel (2002) assert that understanding how monetary policy is transmitted to the economy helps in “determining the most effective set of policy instruments, the timing of policy changes and hence the restrictions which the Central Bank is faced with.” On the basis of the foregoing discussion, it is important for a monetary authority to have more evidence of the effects of monetary policy changes on the economy. Using a Structural Vector Auto Regressive (SVAR) approach, a study by the Central Bank of Swaziland in 2016 revealed that the credit extension channel in the country is not very strong. However, only the total credit to the private sector was investigated. The results of this study have implications on the effectiveness of the monetary policy in the country and
therefore necessitates further investigations and hence this study is conducted.

Specifically, the study seeks to determine the impact of monetary policy changes on bank credit extension to the business sector (agriculture and forestry, manufacturing, construction, distribution and tourism, transport and communication) and households (housing and vehicles) in Swaziland.

The study focuses on the impact of monetary policy on credit extension without separating demand factors from supply factors which is a limitation. Cyrile (2015) notes that failure to disentangle demand and supply loan effects leads to an over estimation of the effects of monetary policy on the supply of loans. On another note the study omits credit extension to “real estate” which otherwise could have been of great interest as this industry is growing fast in Swaziland. Data for real estate started being recorded separately in 2010 which gives a shorter period for modelling and hence the omission of the variable.

The study is divided into 6 sections. Section one is the introduction followed by section 2 which briefly presents stylized facts about the economy of Swaziland. Section 3 presents literature on the impact of monetary policy on macroeconomic variables whiles section 4 presents the methodology of the study. The results are presented in section 5 and the conclusion and recommendations are presented in the last section.

2.0 Monetary policy in Swaziland

The objective of Swaziland’s monetary policy is to promote price and financial stability which ensures a stable and sound financial system, so as to foster financial conditions conducive for economic development (CBS Order, 1974). Swaziland is a member of the Common Monetary Area (CMA) and its monetary policy formulation is largely influenced by its membership to the CMA. Other members of the CMA are Lesotho, Namibia and South Africa. All currencies of the other three CMA members are pegged at par with the South African Rand and the Rand is a legal tender in these countries. Pegging the Lilangeni to the South African Rand is an intermediate goal for monetary policy in Swaziland.

Due to the pegging, any shock in the South African exchange rate is fully transmitted to the Swaziland unit as there is no exchange rate adjustment between Swaziland and South Africa. There is also free flow of capital between Swaziland and South Africa. The fixed exchange rate and free capital flow between Swaziland and South Africa implies limited monetary policy independence for the country. Swaziland’s major monetary policy tools are the discount rate, liquidity requirement and the reserve requirement. The discount rate is the Central Bank’s main monetary policy tool and it mirrors that of South Africa.

2.1 Swaziland’s Domestic Credit to the Private Sector

Figure 1 (Appendix C) indicates that credit extension to the private sector as a percentage of GDP has been relatively
comparable with that of Botswana and Lesotho but fare below that of Namibia. For Swaziland, the trend indicates that from 2010 credit extension to the private sector has been on a slightly downward trend, dropping from 24.1 per cent in 2010 to 20.4 per cent in 2015. The reduction in credit extension to the private sector as a percentage of GDP has implications to private sector investment spending which may hamper efforts aimed at spurring economic growth.

Worth noting is that credit extension in countries which have managed to develop faster like Mauritius had an average of 67 per cent of GDP between 1990 and 2015 whiles Swaziland has only managed to have an average of 18.0 per cent within the same period. This is not to attribute credit extension as the sole driver of economic development as there are other fundamentals like structural issues which are also key.

3.0 Review of Literature

3.1 Theoretical Literature

Peek and Rosengren (2013) assert that even though the traditional interest rate channel remains intact as a monetary policy transmission mechanism, the importance of the credit channel in augmenting the impact of monetary policy on the economy has gained credibility. The credit channel, also known as the “credit view” is not necessarily perceived as an independent alternative to the interest rate view, but “as a set of factors that amplifies and propagates the interest rates effects” (Bernanke & Gertler, 1995). Similarly, Zurlinden (2005) asserts that economist view the credit channel as an extension of the money channel rather than an alternative. It focuses on the important role which is played by banks in the economy. Literature on new theories of monetary policy as reviewed by Janjua, Rashid and Ul-Ain (2014) confirms the importance of banks as part of the monetary transmission mechanism.

There are two underlying assumptions for the credit channel; i) borrowers are bank-dependent and ii) outside financing for banks is more expensive than traditional deposit mobilization (Ali et al., 2012). Bernanke and Gertler (1995) explains the credit channel in two possible ways; the balance sheet channel and the bank lending channel. The balance sheet channel posits that a tightening monetary policy would impose an adverse shock on the borrowers’ net worth (due to a decline in cash-flows or a shock on the value of collateralisable assets) which raises the external finance premium. Higher borrowing costs are expected to dampen spending and production, thus amplifying the effects of the shock (Ali et al., 2012, Bernanke & Gertler, 1995, and Peek & Rosengren, 2013).

Cyrille (2015) asserts that “the bank lending channel hypothesis the existence of a channel for monetary policy transmission through bank credit.” In the aftermath of a contractionary monetary policy, banks’ lending policies are more likely to change (Cyrille, 2015). The response of banks to the monetary policy is known as the centric view of monetary policy and it supposes that bank loan financing reduces in response to a contractionary monetary policy (Janjua, Rashid & Ul-Ain, 2014 and Peek & Rosengren, 2013). A tighter monetary policy
reduces both bank reserves and deposits and therefore affects the supply of bank loans (Cyrile, 2015, Davoodi, Dixit & Pinter, 2013, and Bernanke & Gertler, 1995). The weakening of the banks’ deposit base makes them to be unable to continue with their lending projects without the use of external sources of finance (Kashyab & Stein, 1994 as cited by Janjua, Rashid & Ul-Ain, 2014).

The centric view is more obtaining in cases where it is costly for banks to find alternative financing sources (Ali et al., 2012). An alternative would be for banks to adjust their balance by reducing their portfolio of securities (Zurlinden, 2005); however, Cyrille (2015) argues that when banks’ liquidity decrease, they are more likely to reduce their supply of loans as opposed to selling their securities which they have in their portfolios.

### 3.2 Empirical literature

Findings by Bernanke and Blinder (1992) in the US revealed that a restrictive monetary policy impulse reduces aggregate loans as well as economic activity. Using a Structural Vector Autoregression (SVAR) approach, Bernanke and Blinder (1992) revealed that interest rates have an effect on output through credit. Janjua, Rashid and Ul-Ain (2014) used the fixed effects estimator to determine the impact of monetary policy on banks’ loans supply and found a significant negative relationship between monetary measures and bank’s loan supply. The findings further revealed that even though a contractionary monetary policy had a higher burdening effect on small banks, aggregate lending by all banks decreases.

Cyrille (2015) disentangled demand and supply loan effects of monetary policy in the Central African Economic and Monetary Community (CEMAC) and found that economic activity is a powerful determinant of the demand for loans. An intriguing result from the study was a positive relationship between the loan rate and the demand for loans. Explaining this result, Cyrille (2015) stated that this indicates that borrowers are willing to finance their consumption and investment spending at whatever rate of interest. This might be a result of a concentrated banking industry where borrowers do not have alternative financing options.

Results by Barran, Coudert and Mojon (1996) revealed that in European Countries credit supply tends to shrink more after a contractionary monetary policy which suggested the presence of a credit channel. However, this was not the case in all countries as the findings did not support such in Germany and France. The results further indicated that credit supply in the U.K. and in Italy mainly depended on the short-term interest rates.

In the sub-Saharan African countries, low interest rates stimulate bank lending to the private sector which in turn boosts domestic investment (Ndikumana, 2014). Results by Ndikumana (2014) revealed a negative and significant relationship between interest rates (discount rate, market interest rates and treasury bills, and bank lending rate) and domestic credit. All three monetary policy indicators included (discount rate, Treasury bill rate and lending rate) were found to be negatively related to private
sector investment. Explaining the results, Ndikumana (2014) states that the negative relationship between treasury bills’ interest rate and domestic credit indicates a crowding out effect in which high interest rates prompt commercial banks to invest in government securities which are safer than lending to the private sector. On the contrary, Simatele (2003) used the vector autoregression (VAR) approach to study the effects of monetary policy in Zambia and the results revealed that bank lending was driven by demand rather than monetary policy.

4.0 Methodology

4.1 Introduction

The major objective of the study was to determine the impact of monetary policy on credit extension to different business sectors and households in Swaziland. It would be important to understand how a contractionary or expansionary monetary policy affects credit extension to the business sector and to households.

The study uses monthly data spanning from 2006M01 - 2015M12 and starts by testing for stationarity of the series using the Augmented Dickey Fuller (ADF) and the Philips Perron (PP) tests. The Johanson (1988) test is used to test for cointegration. The Granger (1969) causality test is used to test for causality. The paper follows the methodology of Dlamini and Skosana (2016) in assessing the “Relationship and Causality between Interest Rates and Macroeconomic Variables in Swaziland”. Hence the paper seeks to broaden the research by assessing the impact of the three policy rates on the components of credit extension.

To the best of the author’s knowledge from reviewing previous studies, there is no specific study which has simultaneously modelled the impact of monetary policy on credit extension to different business sectors and households and this posed a challenge in terms of ordering the variables in the model. However, there are studies which have modelled the effects of monetary policy on credit extension to individual industries/sectors e.g. Iacoveello and Minetti (2007) focused on mortgage. In the absence of studies which have simultaneously modelled credit extension to different industries, the study uses general economic theory in trying to order the endogenous variables. Basically those variables which are less likely to be influenced by other variables are ordered first. The order of the variables therefore is as follows; credit to; vehicles, housing, distribution and tourism, transport and communication, construction, manufacturing and agriculture and forestry. The matrix form of the SVAR model can be expressed as follows;

Where the left hand side of the equation contains a vector of residuals in the reduced form, and in the right hand side is the squared matrix (A0) of coefficients associated with lagged variables and structural shocks.
through the column vector ($\boldsymbol{\pi}$).

The econometric identification of monetary policy shocks is crucial to any model specification, including SVARs. As alluded to above, the absence of literature on which variables are most likely to affect which variables led to the researcher to use general economic theory and own perception. The SVAR identification exercise followed in this paper is explained below.

Vehicles and housing were ordered first and second since they are less likely to be affected by the other endogenous variables but can have an effect on the other variables. Credit extension to distribution and tourism comes in third and it is likely to affect transport and communication which is ordered fourth. Construction comes in fifth in the ordering since it is likely to react to all the variables ordered before it like vehicles, housing, distribution and transport. Manufacturing comes after construction as it is likely to respond to the demand for construction. Agriculture and forestry is ordered last after manufacturing as it is likely to react to manufacturing of inputs. Worth noting is that on the other side, agriculture is key to manufacturing in Swaziland as it provides raw materials; however, the ordering in this study is such that agriculture and forestry respond to manufacturing as explained above.

Since the number of variables is large, in pursuit of parsimonious models, 3 models are estimated. Model 1, which is the core model has the following variables; discount rate, credit to; vehicles, housing, distribution and tourism, transport and communication, construction, manufacturing, and agriculture and forestry. In Model 2, the discount rate is replaced by the reserve requirement, while in Model 3, it is replaced by the liquidity requirement as specified below.

Model 1: $\Delta r_t = \log \text{VEH}_{t-1} + \log \text{HOU}_{t-1} + \log \text{DT}_{t-1} + \log \text{TC}_{t-1} + \log \text{CON}_{t-1} + \log \text{MAN}_{t-1} + \log \text{AGF}_{t-1} + \epsilon_t$

Model 2: $\Delta r_t = \log \text{VEH}_{t-1} + \log \text{HOU}_{t-1} + \log \text{DT}_{t-1} + \log \text{TC}_{t-1} + \log \text{CON}_{t-1} + \log \text{MAN}_{t-1} + \log \text{AGF}_{t-1} + \epsilon_t$

Model 3: $\Delta r_t = \log \text{VEH}_{t-1} + \log \text{HOU}_{t-1} + \log \text{DT}_{t-1} + \log \text{TC}_{t-1} + \log \text{CON}_{t-1} + \log \text{MAN}_{t-1} + \log \text{AGF}_{t-1} + \epsilon_t$

Impulse response and variance decomposition analysis are carried out to determine the effects of shocks in the estimated models. The impulse response function in a VAR analyses traces the effects on the system when the model received say one standard deviation shock. The variance decomposition reveals the amount of contribution of each variable to other variables in the system. In essence it shows the amount the forecast error variance of each of the variables that can be explained by exogenous shocks to the other variables in the system.

4.5 Diagnostic Checks

After estimation, the model was subjected to various diagnostic tests in order to assess its stochastic properties which includes residual autocorrelation, heteroskedasticity, normality and model stability.

4.6 Data

Monthly data spanning from 2006M01 to 2015M12 was used to examine both short
run and long run relationships between monetary policy rates and credit extension to the private sector. Data was sourced from the Central Bank of Swaziland.

5.0 Empirical Results and Analysis

5.1 Unit Root Tests

Testing for stationarity is a prerequisite for modelling time series data in order to avoid spurious regression. As stated under the methodology section, the study uses the ADF and the PP tests to test for unit roots and the results are presented in Table 1 (Appendix C). A series with a unit root is not stationary and therefore has to be differenced to attain stationarity. A variable is stationary if the ADF test statistic (absolute value) is greater than the Mackinnon critical value.

Housing, distribution and tourism, transport and communication, manufacturing, and agriculture and forestry were found to be stationary at levels, I (0) whiles construction, vehicles, discount rate, liquidity requirements and reserve requirement were integrated of order one, I(1). Since credit to construction and vehicles, discount rate, liquidity requirements and reserve requirement were non-stationary at levels, they were differenced once in order to make them stationary. As indicated in Table 1 (Appendix c), the null hypothesis of non-stationarity for the differenced series is rejected at 1% level for the variables. Zivot (2000) supports the modelling of I(0) and I(I) in SVAR. Investigating the causes of the early millennium economic slowdown, Peersman (2005) used SVAR which incorporated three I(1) variables and one I(0) variable.

5.2 Cointegration Tests

Variables are said to be cointegrated if their linear relationship is stationary. The null hypothesis of no cointegration is rejected if the linear combination of the variables is stationary, meaning the variables are cointegrated, otherwise we fail to reject it. The study used the Johansen test to test for a long term relationship between the variables. Before testing for cointegration the study started by estimating the optimal lag length and the results are presented in Table 2 (Appendix C).

As mentioned in the methodology section, the study uses the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) since they are the most commonly used methods in monetary policy studies. Both the AIC and SC suggest an optimal lag order of 1 which is what the study the uses. The Hannan Quinn (HQ) and the Final Prediction Error (FPE) also suggest an optimum lag length of 1.

Table 3 (Appendix C), presents the cointegration test results. Model 2 and 3 under the Trace Statistic indicate the presence of one cointegrated equation, meaning that the variables are cointegrated. However, the Eigenvalue indicates no cointegration of variables. Based on the Trace statistic results, the study continues to model the SVAR.

5.3 Granger Causality Test

The Granger causality test results between the discount rate and the endogenous variables are presented on Table 4 (Appendix C). The study used an optimum lag length
of 8 as recommended by the LR. The results indicate that there is bidirectional causality between discount rate and credit extension to housing and construction. The insignificance of causality between the discount rate and the other endogenous variables indicates that credit extension to the private sector is more demand driven than supply driven. Borrowers are willing to borrow at any interest rate to satisfy their investment and consumption spending. This somehow has the potential of presenting a challenge in terms of the discount rate being an effective monetary policy tool for these variables.

Table 5 (Appendix C) presents the Granger causality test results between the reserve requirement as a monetary policy tool and the endogenous variables. The results indicate the presence of a bidirectional causality between reserve requirement and credit extension and construction. A unidirectional causality from reserve requirement to credit extension to housing was also found. The overall results indicate a weak causality between the reserve requirement and the selected variables.

The results presented on Table 6 (Appendix C) indicate that there is a unidirectional causality from liquidity requirement to credit extension to distribution and tourism. The results also revealed a bidirectional causality between liquidity requirement and credit extension to construction. Again, the results indicate weak causality between liquidity requirement and credit extension to the endogenous variables.

5.4 Structural VAR Results

The study starts by conducting diagnostic checks on the three models in order to check for stability. All three models passed the LM test indicating that there is no serial correlation. However, all three models failed the Portmanteau Test for serial autocorrelation and the normality test. The Generalized Leased Squares was used in order to correct for heteroscedasticity; however, the models still failed the Portmanteau Test. Harris (1995) notes that non-normality in the residuals is acceptable if some of the variables are weakly exogenous. The inverse roots of the characteristic autoregressive polynomials of each of the three models are presented in Figure 4 (Appendix C), below. In order for a SVAR to be said to be stationary (stable), all roots should have a modulus less than one and lie inside the unit root circle (Baum, 2013 and Lütkepohl, 1991). The results indicate that all three models are stable as their modulus are less than one and lie within the unit root circle.

5.5 Impulse Response Functions and Variance Decomposition

This section presents the response of the variables in the model to a one-time positive shock in the policy rates through the impulse response function. The impulse response function traces the effects of a one-time shock to one of innovations on current and future values of the endogenous variables. This study focuses on the effects of monetary policy changes (discount rate, reserve requirement and liquidity requirement) on credit extension to the private sector in Swaziland.
Figure 5 (Appendix C) presents the impulse response of the variables to a one-time shock in the discount rate. The results indicate that only four variables respond significantly to a one-time shock on the discount, namely; the discount rate (own shock), credit extension to; distribution and tourism, construction, and agriculture and forestry. Credit extension to distribution and tourism responds significantly after 6 months and does not recover to its initial level within the 36 months’ period whiles credit to construction falls and recovers to its normal level after 25 months. Credit extension to agriculture and forestry marginally falls as a result of a positive shock on the discount rate and recovers after 18 months. The response of all these variables is weakly significant. Credit extension to housing and manufacturing respond negatively with a gradual fall as a result of the shock in the discount rate; however, their response is insignificant. The response of credit extension to vehicles is against a priori expectation as it responds positively but insignificantly. The insignificant effect as well as the marginal response of the significant variables indicate that credit extension in Swaziland is more demand driven than supply driven and the discount rate is ineffective in determining credit extension some sectors.

The variance decomposition results on Table 7 indicate that a positive shock to the discount rate as a monetary policy tool causes 11.5, 10.8, 36.9 and 12.2 per cent variation on credit extension to; housing, distribution and tourism, construction, and agriculture and forestry, respectively over a 36 months’ period. This indicates the importance of the discount rate as an effective monetary policy tool employed by the Bank. It is, however, worth noting that the effects are more significant in the medium term than in the short.

The results presented on Figure 6 (Appendix C) indicates that a one-time positive shock on the reserve requirement is only significant to its own shock, otherwise it does not have a significant impact on the endogenous variables. Even though the shock on reserve requirement does not have a significant impact on the endogenous variables, the results indicate that there is generally a marginal decline in credit extension as a result of a positive shock in reserve requirement except for credit extension to vehicles. The study does not present the decomposition results for model 2 since the impact of reserve requirement to credit extension to the endogenous variables is insignificant.

The variance decomposition results on Table 8 indicate that a shock to the reserve requirement as a monetary policy tool has sizeable impact on credit extension to; housing, construction, manufacturing, and agriculture and forestry causing 6.7, 7.5, 6.3 and 7.0 per cent variation, respectively over a 36 months’ period. The shock causes minimal variation on credit extension vehicles with 0.9 per cent, and distribution and tourism with 1.6 per cent. The effects of the policy on the overall appears to be increasing over the 36 months’ period and it is more significant in the medium term than in the short term.
Figure 7 Appendix C) indicates that a positive shock to liquidity requirement does not have a significant impact on the endogenous variables but only to its own shock. Even though it does not have a significant impact, the results indicate a general decline in credit extension as a result of the shock except for credit extension to vehicles. The response of the endogenous variables appears to be similar to those of reserve requirement as a monetary policy tool. The study does not present the decomposition results for model three since the impact of liquidity requirement to the endogenous variables was insignificant.

The results presented on Table 9 (Appendix C) indicate that a shock on liquidity requirement as a monetary policy instrument has major effects on credit extension to; vehicles, housing manufacturing, and agriculture and forestry causing 4.0, 4.2, 6.4 and 4.1 per cent variation over the 36 month’s period, respectively. The results also indicate that a shock on liquidity requirement has minimal effect on credit extension to transport and communication, causing a variation of 0.9 per cent.

6.0 Conclusion and Recommendations

6.1 Conclusion

The purpose of the study was to determine the impact of monetary policy on credit extension to the private sector in Swaziland, with a special focus on selected business sectors and household variables. The Bank uses three monetary policy rates in its pursuit of financial stability, namely; the discount rate, reserve requirement and liquidity requirement. This paper therefore estimates three models involving each of the policy rates against credit extension to; vehicles, housing, distribution and tourism, transport and communication, construction, manufacturing, and agriculture and forestry.

The paper starts by testing for stationarity of the variables. The variables were found to be stationary at I(0) and I(1). The Johansen test Trace Statistic results revealed the presence of cointegration whiles the Maximum Eigenvalue Statistic results indicated that there is no cointegration. On the basis of the Trace Statistic results of the presence of at least one cointegrating equation, the study uses a structural vector autoregressive model. The Granger causality results revealed that that there is a bidirectional causality between the discount rate and credit extension to housing and construction. The other endogenous variables had an insignificance relationship with the discount rate. The test also revealed a bidirectional causality between reserve requirement and credit extension to construction and a unidirectional causality to credit extension to housing. There was an insignificant relationship between the reserve requirement and the other variables. Lastly, a unidirectional causality from liquidity requirement to construction, and distribution and tourism was found. Again, there was an insignificant relationship between liquidity requirement and the other variables.

The study further estimated a structural vector autoregressive model between the policy rates and credit extension to
the private sector. The impulse response results revealed that a positive shock to the discount rate has a significant negative effect on credit extension to; distribution and tourism, construction, and agriculture and forestry. However, the impact was marginal, indicating a weak relationship. The reserve requirement and the liquidity requirement shocks had insignificant impact on credit extension to the selected endogenous variables. However, even though insignificant, the variables responded negatively to the shocks, except for credit extension to vehicles. The impulse response also indicated that the reserve requirement and liquidity requirement effects are similar. An explanation to this would be that the reserve requirement is a component of liquidity requirement.

The variance decomposition results indicate that a shock to the discount rate causes 11.5, 10.8, 36.9 and 12.2 per cent variation on credit extension to; housing, distribution and tourism, construction, and agriculture and forestry, respectively over a 36 months’ period. This indicates the importance of the discount rate as an effective monetary policy tool for the Bank. It is, however, worth noting that the effects are more significant in the medium term than in the short term. The variance decomposition results also revealed that a positive shock on the reserve requirement has major effects on credit extension to; housing, construction, manufacturing, agriculture and forestry causing a 6.7, 7.5, 6.3 and 7.0 per cent variation, respectively. A positive shock on the liquidity requirement causes 4.0, 4.2, 6.4, and 4.1 per cent variation on credit extension to; vehicles, housing, manufacturing, and agriculture and forestry, respectively. On the overall, especially the discount rate and the reserve requirement, their effects are more significant in the medium term than in the short term.

6.2 Recommendations

Based on the findings of the study in which the discount rate was found to be the most effective policy rate in determining credit extension to the private sector, the Central Bank should continue using the discount rate as the main monetary policy tool. Even though not as effective as the discount rate, the reserve requirement and the liquidity requirement are also effective monetary policy tools and therefore should be reviewed timeously for their improved effectiveness.

REFERENCES


The Impact of External Shocks on Effectiveness of Monetary Policy in Swaziland

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Abstract

The aim of the paper is to assess the impact of external shocks on the effectiveness of monetary policy in Swaziland. The Johansen cointegration test shows that there is a cointegrating relationship among the variables and are found to be unstable in levels, but stable in the differences where two roots are outside the unit circle and no unit root lies outside the unit circle respectively. Heteroscedasticity and Serial correlation is found not to exist in the series. A shock in the international price of oil seen as a market surprise direct effect results in high changes domestic inflation which then peters out in the tenth period attesting to the efficacy of monetary policy as the domestic discount rate counters the high inflationary pressures by first being accommodative due to growth concerns but then rises to tame inflation in the second and third period only to be accommodative in later period as inflation slows down. The movement of monetary policy in a downwards and upwards fashion in times of direct external shocks and the slowing down of inflation shows efficacy and flexibility in monetary policy. Indirect shocks emanating from a shock in the USA inflation rate, South Africa Inflation Rate, and the Exchange rate of the US dollar to the local unit push up domestic inflationary pressures with them petering out in the tenth period, though a shock in South Africa inflation keeps inflationary pressures more elevated. In the variance decomposition analysis, the USA discount rate shocks do not have much influence on domestic inflationary...
pressures but South Africa and domestic discount rates have a significant effect on domestic inflationary pressures notwithstanding the observed synchronisation of monetary policy in the three countries as shown by the monetary policy correlation matrix. The impulse response function shows that monetary policy is effective in midst of external shocks even though exercised in a flexible manner. External shocks effects on inflation both directly and indirectly should therefore be reined in through monetary policy. Coordination of monetary policy in industrial nations should also be noted to have occurred according to Mohamed, Fredj and Duc (2013).

**Keywords:** external shocks, unrestricted VAR, external shocks, monetary policy.

### 1. Introduction.

Swaziland has experienced greater openness and higher integration into the regional as well as world economy in the last two decades through its increased trade with South Africa which is regarded as an emerging economy with greater interaction with the world economy. The role of the emerging economies in the world economy has increased with time (Nguyen et al., 2013). Swaziland’s openness according to the World Bank trade data as a per cent of GDP was 101 per cent in 2011 rising to 103 per cent in 2015. In the first quarter of 2015 trade with South Africa stood at 92 per cent and rest was with other countries. In Swaziland, the share of total trade with South Africa vis-à-vis the rest of the world stands above 90 per cent. This exposes Swaziland to shocks transmitted from South Africa.

The dependence and inter linkage with South Africa is deeper than the trade figures suggest as Swaziland has the local unit, Lilangeni pegged at par to the South African Rand under the Common Monetary Area. The Common Monetary Area was formed on April 1, 1986 as the Trilateral Monetary Agreement involving the Kingdom of Lesotho, the Kingdom of Swaziland and the Republic of Namibia. Namibia joined the common currency area after independence in 1992. The currency union was initially the Rand Monetary Area treaty entered into in December 1974 comprising South Africa, Botswana, Lesotho and Swaziland. Botswana opted out of the monetary union then known as the Rand Monetary Area in 1975 and is till to date pursuing a floating exchange rate regime against South Africa.

The common currency area implies that all three countries namely the Kingdom of Lesotho, Kingdom of Swaziland and Republic of Namibia surrender their monetary policy to that of South Africa as they peg their local units to the South African Rand (ZAR). This leads to a harmonisation of interest rates in the common monetary area with the Kingdom of Swaziland, Kingdom of Lesotho and the Republic of Namibia tracking interest rates in South Africa to anchor the fixed exchange rate. Any shocks from South Africa squarely fall in these economies as there is no exchange rate adjustment between them and South Africa. This monetary arrangement has been maintained by monetary authorities in Swaziland, Lesotho and Namibia as the exchange rate anchors inflation to that of
South Africa and promotes trade, noting that the Rand is legal tender in the three countries. The Central Bank of Swaziland’s interest rate decision responds positively to changes in interest rates in South Africa generally to anchor the exchange rate and inflation to South Africa’s. The strong trade links with South Africa has resulted in a co-movement of inflation rates of the two countries and has served monetary policy decision well in Swaziland.

Influences of the developed world on Swaziland have increased as South Africa got more integrated into the world economy. According to Visa South Africa, South Africa in 2011 scored 61.1 points rising to 66.7 points at the end of 2013 in the Visa Africa Integration Index. Monetary policy in South Africa has at many times considered monetary policy decisions in the US in its monetary policy decisions with the fear of a hike in the US leading to reversal of capital to US and a fall in the South African Rand.

This has been pronounced predominately in the monetary policy decision that led to a hike in the discount rate in South Africa in late 2015 from 5.75 per cent in June 2015 to 6.25 per cent in November 2015 (SARB Monetary Policy Statements May-November 2015). Swaziland’s monetary policy decisions on interest rates track that of South Africa with the local unit set not to surpass the local circulation of the South African Rand so as to maintain the nominal inflation anchor of the parity fixed exchange rate regime with South Africa. With Swaziland tracking monetary policy decisions in South Africa, and South Africa taking serious consideration of US monetary policy decisions. US monetary policy decisions will definitely affect monetary policy decision in Swaziland by extension. Swaziland has all along benefited from the responsible monetary policy conduct of the South African Reserve Bank (SARB) which adopted inflation targeting in 2000.

The paper picks four variables as external shocks to the economy; the US monetary policy, US inflation, Exchange rate (ZAR/USD) and the international prices of oil vis-à-vis the response of monetary policy and inflation in the Swazi economy. Wakeford (2006) observes four oil price shocks that had implication for the rand/dollar exchange rate hence the exchange rate of the Rand to the US dollar is also shock. The paper in an aerial view looks at the transmission of shocks via the role the large-country/US monetary policy reaction in a synchronising fashion with other industrial countries and the influence the shocks on monetary policy in South Africa and subsequently Swaziland. (Nilufer Ozdemir 2010). Influences from international markets which Nilufer Ozdemir (2010) refers to direct shocks also examined in the form oil price shocks. The paper is structured as follows; Section 2 presents oil price shocks, inflation rates and monetary in Swaziland, South Africa and United States descriptive relationship. Section 3 is a review of international oil price shocks, Section 4 is the literature review, Section 5 to Section 9 are the analysis of results, some concluding remarks, observations and recommendations.
1. Oil Price Shocks, Inflation Rates and Monetary Policy in Swaziland, RSA and the USA

The graphical relationship of the variables in the investigation of external shocks on monetary policy in Swaziland is explained mainly by oil price as the main variable considered to have triggered monetary policy shocks. The external shocks besides oil are the discount rates of South Africa and the US, the exchange rate of the Swazi Lilangeni to the US Dollar as it takes its cue from the parity to the South African Rand and the inflation rates of South Africa and the US.

The data set unfortunately starts from 1980 to 2010 and falls short of capturing the oil price shocks of 1973-74 and 1979-80 and only captures fully the Gulf war oil price shocks of 1990 and the pre-2008 global financial crisis oil price shocks.

There is a prima facie relationship in the discount rates where the discount rates in South Africa take their cue from monetary policy movements in the United States to stem capital flight and protect the value of the Rand. Interest rates movement have also been driven by shocks in the international price of oil as seen by a graphical positive relationship between the price of oil and monetary policy. The inflation rates also move together, showing a symmetric transmission of shocks most probably emanating from international oil prices.

1.1. First Oil Price Shocks.

The first oil price shocks of 1973-74 which resulted from the Organisation of Oil Exporting Countries (OPEC) exercise of its oligopolistic power and the embargo on oil exports to the US and the Netherlands seen as pro-Israel in the Arab-Israel war led to a fall in the rand/dollar exchange rate and inflation soared from single digit in 1972 to double digits of 17.8 per cent in final quarter of 1974.

1.2. The Second Price Shocks.

The second oil price shocks of 1979-80 led to a bout of international inflationary pressures leading to rising interest rates in the US. The Fed did not respond strongly to the first oil price shocks compared to the second where it took a more radical stand on the appointment of Paul Volcker as the news Chairman. In the graph 2.1, the two-period moving average trend also rose in 1979-80 as oil prices shot up.

Figure 1: Changes in Swaziland Inflation Rate

Source: Central Statistical Office.
1.3. The Third Oil Price Shock.

The third oil price shock was triggered by the Invasion of Kuwait by Iraq in August 1990 where oil prices hiked from $17 per barrel in July 1990 to an average of $35 per barrel in October 1990 which was however short lived with prices dropping to below $20 per barrel by February 1991 as the US rescued Kuwait. Domestic inflation though showed signs of increasing during this period.

1.4. The Fourth Oil Price Shock.

The fourth oil price shock leading to the world financial crisis in 2008 resulted from increased demand for oil in particular the US and from emerging markets like China. The price of crude oil rose from US$25 per barrel in 2003 to a high of US$78 per barrel in July 2006. The US consumer prices rose by 2.27 per cent in 2003 to 3.85 per cent in 2008. South Africa and Swaziland consumer price inflation alike rose from an average of 5.84 per cent in 2003 to a high point of 10.04 per cent in 2008 and 7.40 per cent in 2003 to a peak of 12.60 per cent in 2008 respectively. This invariable affected the conduct of monetary policy in Swaziland as the Central Bank of Swaziland tracked monetary policy decisions taken by the SARB, where the SARB raised the discount rate in 2008 during the beginning of the financial crisis as the price of food and fuel shot up only to fall at the back of demand deficiency due to the resultant credit crunch and massive loss of values in stocks. Swaziland as shown in graph 2 invariable transmit oil price shocks into the inflation outcome hence the effects on monetary policy.

Swaziland is more intertwined with South Africa than trade may suggest as the two countries are members of the South African Customs Union together with Namibia, Botswana and Lesotho. Swaziland’s government budget is more than 50 per cent supported by the revenue that accrues from South Africa Customs Union (SACU) where South Africa makes a lion’s share contribution to the SACU common revenue pool. A slump in the South African economy whether induced internally or externally affects the common revenue pool of SACU which supports the member’s government revenue and the impact is therefore transmitted to the other partners in the customs union via the fiscal route. Swaziland has a low level of development in financial markets thus contracting most effects from South Africa through trade in goods and services and the share received from the SACU common pool. Fiscal policy is however not subject of the present research.

2. Literature Review.

It is observed that in the last two decades the world economies have become more integrated globally, both in real and financial sectors. Nguyen, Tran and Le (2014) observe that the most important aspect of financial integration is that global economies show co-movements in most of the economic variables such as inflation, unemployment, GDP growth in general. The co-movements exist at periods where prices are falling or in times of crisis such as during the global financial crisis in 2008. They investigate the impact of external shocks emanating from the global economy as well as the US
on macroeconomic variables in 7 East-Asian countries for the period 2001-2012 using a structural VAR model. They found that the US monetary and oil price shocks more explain the variance/fluctuations in macroeconomic variables in the 7 East-Asian countries. The US monetary and oil prices impulse response shocks cause symmetric ripples across the macroeconomic variables of the 7 East-Asian countries. The significance of the degree of integration in the real and financial sector in the transmission of external shock is underscored by the co-movement of economic variables in East-Asian economies during the 1997-1998 Asian crises.

Nilufer Ozdemir (2010) observes Mexico’s two pronged reaction to the two oil price shocks the World oil markets experienced in the 1970s: an increase from 2.80 dollars to 12 dollars per barrel between 1973 and 1974 and from 15 US dollars to 40 US dollars per barrel in 1979. The US did not react to the first price shocks keeping interest rates low and Mexico enjoyed rising revenues due to oil exports fetching higher in world markets which benefit cannot accrue to Swaziland as it is not an oil exporting country. An oil price shock for Swaziland means that higher inflation is transmitted directly through the import of higher priced oil and if South Africa responds by increasing interest rates, pushing Swaziland to an even worse position and possible stagnant growth. The cushion of exporting oil enjoyed by Mexico is not available for Swaziland which may likely exacerbate Swaziland’s situation.

Mexico peso is directly flexible to the US dollar and Swaziland is indirectly flexible due to its peg to the Rand. Therefore, shocks in the US dollar or any other currency are transmitted 100 per cent to the local unit through the Rand due to the parity between the Rand and US dollar. If the Rand falls 20 per cent against the US dollar the lilangeni will also fall by 20 per cent to the US dollar. The transmission of prices could be kept at bay by the flexible exchange rate with the US dollars but the fixed exchange rate regime of the Rand and Lilangeni does not offer relief for that. If the origins of the external shock are from high oil prices leading to a strengthening of the US dollar then the Local Unit will suffer.

If the origins of the external shocks are from the big country (South Africa) Swaziland still stands to suffer through change in market values and topped by reaction and non-reaction of the big country where there are two forces at play 1; reaction of the markets...
and 2; policy responses of the big country to an originating shock (indirect effects). Many authors have eluded the second effect which Nilufer Ozdemir (2010) addresses and adopting from his extension of the analysis I seek to analyse external shock on Swaziland in that light with South Africa being the big country and the US being the industrialised country.

There are co-movements of variables in the East-Asian countries when there is an external shock; Corsetti et al, 1999 and Kaminsky et al., 2003 argue that it is because the countries are high open and interdependent.

The high openness degree and interdependence/rapid intra-regional trade integration causing symmetric responses to external shocks by the East-Asian economies and as a consequence rising efforts to cooperate in macroeconomic policy issues to deal with the external shocks creates an economic block which can be uniquely studied. Nguyen, Tran and Le (2014) therefore study as to what extent external shocks, namely oil prices shocks, US output shocks and US monetary policy shocks then study the impact of the external shocks on East-Asian countries.

The current study uses the Johansen Cointegration technique in analysis of cointegration in the variables which are tested initially for stationarity using the Augmented Dick-Fuller tests. If the series are all I (1) then we will often assume that a long run relationship between them exists even when there is none.

3. Methodology
3.1. Theoretical Model

The external shocks have to be modelled by first modelling the domestic economy such that it has all the features that respond to external shocks. Nilufer Ozdemir (2010) improves on other studies that look at the impact of external shocks; Canova (2005) analyses the effect of foreign monetary policy shocks on small open economies. Dornbusch (1985) and Izquierdo et al (2007) analyse the influence of large country business cycles on small open economies. Calvo, Leiderman and Reinhart (1993) and Fernandez-Arias (1996) analyse the influence of rates of return in developed countries in explaining capital flows to developing countries. All of these articles analyse the direct effects of the external shocks, ignoring the indirect effects.

Figure 2: Small-Big Country Model.

The assumption is that domestic market consumes both domestic and foreign goods so as to transmit foreign/external shock into the real economy. Thus the Phillips curve is modelled around Svensson (2000) where it is augmented with exchange rate effects.
The Phillips curve for the domestic economy is influenced by next periods inflation expectations and the previous levels, future output gap and the nominal exchange rate (in the absence of reliable data of real effective exchange rate data). Economic agents tend to plan ahead and look at the output gap in their investment decisions thus assuming that future output gaps influence the investment decision of firms with $X(t+1)$;

$$\Pi_t = \alpha \Pi_{t+1} + (1- \alpha)\Pi_{t-1} + \beta X_{t(t+1)} + \alpha_1 e_{t+2} + U_{ts}$$

3.2. Big Country.

South Africa’s monetary policy is to a larger extent influenced by movements in US interest rates and exchange rates which Swaziland tracks to stabilise capital outflows and maintain the fixed exchange rate regime. South Africa monetary policy is forward looking where inflation projections weigh a lot in determining their policy direction coupled with inflationary pressures predominantly emanating from the exchange rate. The error term represents domestic growth consideration for changes in monetary policy.

$$i_{bf} = \beta \Pi_{t+1} + \beta e_t + \beta i_{bf} + U_{tbf}$$

The Structural Vector Error Correction Model is deduced from Big Country, Small Country Model framework where South Africa variables are included in the model to address the indirect effects that Nilufer Ozdemir (2010) takes into account as the Big Country as opposed to many authors. Nilufer Ozdemir (2010) in a nut shell first incorporates the role of large- country monetary policy coordination in influencing shocks. Second he categorises the type of external shocks into the direct effects ensuing from international markets surprises and indirect effects which pass through another country before reaching the small open economy.

4. Data and Methodology Framework

The paper uses annual data over the period 1980 to 2012 due to the lack of exchange rate data going as far back as 1972. The Unrestricted Vector Autoregression Model is adopted to investigate external shocks originating from the global economy, US monetary policy, and the South African economies impact on the transmission of monetary policy in Swaziland. The data set consists of 7 variables (Table 1, Appendix D), which detects the impact of external shocks on the domestic monetary policy; annual average inflation rate (SAAI), and annual discount rate (SAADR). The external shocks are represented by the South African annual average discount rate (SAAAADR), South African average annual inflation rate (SAAI), international oil prices (IPO), US annual average inflation rate (USAAAI), and US average annual discount rate (USAAADR).

5. Data Analysis.

The Johansen cointegration is used to test for cointegration in the variables and the model is run using the unrestricted vector auto-regression. The unrestricted VAR should satisfy stability conditions in particular the Jarque-Bera normality test for the unrestrictiveness of the VAR to render the impulse response function and the variance decomposition analysis plausible.
5.1 Data Testing Procedure: Determine whether the series are I(1). This is equivalent to determining whether or not they contain unit roots.

(a) Provided the series are I(1), one estimates the parameters of the cointegrating relation.

(b) This is done to see if the least square residuals ût appear to be I(0) or not.

(c) All variables of the same I(d) are not necessarily cointegrated; they might not have a long run relationship and the Johansen cointegration test shows that they have a long run relationship and a short-run relationship therefore exists. If they are all I (1) and they do not have a cointegration relationship the a long and short-run relationship cannot exist and therefore the model cannot be estimated.

5.2. Testing for Stationarity of Variables.

The series are tested for stationarity or rather their order of integration. If they are all I(1) they are then tested for cointegration to determine whether they have a long-run and short-run relations.

5.3. Data Conversion.

The data as presented above is in different levels. The inflation rates of Swaziland, South Africa and the USA are different as they are expressed in changes as opposed to the exchange rate and the international price of oil and discount rates. The inflation rates have to be converted to indices in order for a test of the order of integration to be carried out and more importantly to determine the long run relationships in the model. The inflation rates are converted to indices to determine their long-run relationship.

5.4. The Johansen Cointegration Tests

The Johansen’s (1988, 1991) maximum eigenvalue and trace tests are employed to determine the cointegrating rank of the system. In the above time series of variables, one has to run the variables to determine a non-spurious relationship among the variables.

\[ Y_t = \beta_0 + \beta_1 X_{1,t} + \beta_2 X_{2,t} + \ldots\ldots...+ \beta_k X_{kt} + \epsilon_t \]

In general, a regression model for non-stationary time series variables gives spurious results. The linear combination of the variables, dependent and explanatory eliminate the stochastic trends and produces stationary residuals.

\[ Y_t + \bar{\theta}_1 X_{1,t} + \bar{\theta}_2 X_{2,t} + \ldots\ldots\bar{\theta}_k X_{kt} \sim I(0) \]

Approaches to the testing for cointegration by examining the number of independent linear combinations (k) for an m time series variable set that yields a stationary process. By examining the number of independent combinations, we are directly examining the cointegration existence hypothesis.

The Johansen test has two forms: the trace test and the maximum eigenvalue test. Both tests address the Cointegration presence hypothesis with different approaches.
5.5. Trace test Statistics.

The trace test examines the number of linear combinations to be $K_0$ and the alternative hypothesis to $k$ to be greater than $k_0$.

$H_0 : K = K_0$

$H_A : K > K_0$

To test for the existence of Cointegration using the trace test, we set $K_0 = 0$ (no cointegration), and examine whether the null hypothesis can be rejected. If this the case, then we conclude there is at least one cointegrating relationship. We therefore have to reject the null hypothesis to establish the presence of Cointegration between the variables. Variables can be integrated of the same order but would not result in a Cointegrating set of variables Erik Hjalmarsson and Pär Österholm (2007). Erik Hjalmarsson and Pär Österholm (2007) noted that using the Monte Carlo techniques that it can be shown that in a system with near-integrated variables, the probability of reaching an erroneous conclusion regarding the cointegrating rank of system is generally substantially higher than the normal size.

The trace statistics under the Johansen test on the variables integrated of the same order gives the following results: that is on variables (1) International price of oil, (2) US average annual inflation index, (3) US discount rate, (4) South Africa discount rate, (5) South Africa average annual inflation index, (6) SD discount rate, (7) Exchange rate ZAR/USD which are all integrated of the order one.

5.6. Unrestricted Cointegrating Rank Test (Maximum Eigenvalue).

With the maximum eigenvalue test, we ask the same central question as the Johansen test. The difference, however, is an alternative hypothesis:

$H_0 : K = k_0$

$H_A : K = k_0 + 1$

6. Results.

6.1. Unit Root tests/Stationarity Test.

The variables are found to be non-stationary when tested for stationarity using the Dicky-Fuller test with a constant and a trend. The lag-length is selected by choosing the lagged term of the series where the t-statistics is greater than 1.61.

The results on Table 2.1 indicate that all variables are stationary in first differences. The inflation long-run relationship and short-run relationship can therefore be estimated. The inflation rates are taken as are in the estimation of the long-run as they are expressed in differences. They are tested for stationary before running the short-run. USA inflation, SA inflation and Swaziland inflation are found to be stationary in level of year on year per cent change in the inflation indices representative of form of differencing.

7. Model Specification in Levels.

The variables (1) Swaziland inflation index, (2) South Africa inflation index (3) South Africa average discount rate, (4) Exchange rate (ZAR/USD), (5) International price of oil, (6) USA inflation index, (7) Swaziland
average annual discount rate, and (8) USA discount rate are all integrated of order one. The discount rate is excluded to avoid a non-singular matrix and infallibility of the test. The variables are arranged in the following way and subjected to the Johansen Cointegration Test:

(1) Swaziland Annual Discount Rate, (2) South Africa Inflation Index, (3) South Africa Annual Discount Rate, (4) Exchange Rate (ZAR/USD), (5) International Price of Oil, (6) USA Inflation Index and (7) USA Annual Discount Rate.


The variables can be selected in the following order for them to be tested for cointegration: (1) SD discount rate (2) SA inflation index (3) SA discount rate (4) Exchange rate ZAR/USD (5) International price of oil (6) US Inflation index (7) US discount rate. Vratislav IZAK (2004) observed in the paper on Public Debt Service, Interest Rate and Fiscal Variables in Transition Countries that adding more variables by including a full set of variables creates a near singular matrix, which cannot be subjected to all the econometric tests that should give us, confidence on the stability and strength of the model. The Swaziland Discount rate as one variable indicative of monetary policy coupled with Swaziland Inflation is dropped temporarily from the model but later introduced after the econometric tests are done. The relationship of the variables in the two models should not vary and stability of the model should not be lost as it will be shown.

7.1.1. Unrestricted Cointegration Rank Trace Test.

The trace statistics shows that there are 3 cointegrating relationships where the trace statistics; (46.73) < the 0.05 critical value; (47.86). There exists a long-run and short-run relationship among the series.

7.1.2. Unrestricted Cointegration Rank Maximum Eigen value Test.

The maximum eigenvalue test shows that there is 1 Cointegrating equations at Max-Eigen Statistics of 38.14915 < 0.05 critical value of 40.07757. There exists a long-run and short-run relationship among the variables.

7.1.3. Residuals Graphs.

The error terms are graphical stable but an AR stability test is done to ascertain the stability of the model in the long-run.

7.1.4. Stability Test of the System.

The stability test is performed on the system and the AR Root table shows that the system is unstable with two dots falling just outside of the circle.

**Figure 3: AR Graph Stability Test.**
The long run model (estimated in levels) stability tests is found to be instable. The instability of the model renders any further tests redundant. The long-run impulse response function shocks will explode and not return to their long-run path attesting to the instability of the model in the long-run and an insignificant long-run relation among variables. External shocks are therefore highly likely to manifest strongly in monetary policy in Swaziland in the short-run and die out in the long-run. This could be attributed to prudent monetary policy in Swaziland as it positioned at running a credible fixed exchange rate regime.

### 7.1.5. The Johansen Long run Cointegration Estimation Impulse Response Function.

The Johansen cointegration yields the following long run impulse response of domestic discount rates to shocks in (1) the domestic discount rate (2) South Africa Inflation (3) South Africa discount rate (4) Exchange rate (ZAR/USD) (5) USA discount rate (6) USA inflation (7) International oil price.

**Figure 4: Swaziland Discount Rate Response to a Shock in South Africa Consumer Price Index.**

The long run relationship of the discount rate and Swaziland consumer price index does not conform to theory and practice where one would expect Swaziland discount rate to rise in the fixed exchange rate system. In the long-run there is no significant relationship. Shocks in the exchange rate do not in the long run lead to a rise in the interest rates but Due to the weak stability of the model the shocks do not conform to theory.

**Figure 5: Response of Swaziland Discount Rate to a Shock in the Exchange Rate of ZAR to USD.**

The Unrestricted VAR is therefore estimated in differences and logs as follows; Swaziland Inflation rate, South Africa Inflation rate, Log change in the ZAR/USD exchange rate, log change in South Africa discount rate, Log change in International oil prices, log change in USA average annual discount rate and USA inflation rate. Richard A Ashely and Randal J. Verbrugge (2009) found that, after concerns whether time series displaying substantial persistence should be modelled as a vector autoregression in levels or in differences, differenced regressors should be used, but that over differencing a model yields
poor impulse response function confidence interval coverage. Evidence indicated that model specification tests in VAR models on the levels of the data yield poorly sized tests and HP-filtering the data and then estimating a VAR model in levels yields even worse results.

8. The Model Specification Differences.

The variables that are run in differences in differences and the variables not in per cent are logged and then first differenced. To avoid non-singular matrix and to enable the carrying out of all the statistical tests Swaziland discount rate is eliminated from the model. The Swaziland discount rate is then included in the model after the tests are carried out and only the stability test. Then the impulse response function and variance decomposition is done to determine the response of the Swaziland Discount rate to external shocks as opposed to Swaziland inflation.

(a) Swaziland Inflation rate, South Africa Inflation rate, Log change in the ZAR/USD exchange rate, log change in South Africa discount rate, Log change in International oil prices, log change in USA average annual discount rate and USA inflation rate.

The trace statistics shows that there are two cointegration relationships where the 0.05 value is greater than the trace statistics. The maximum Eigen value test shows that there are two cointegrating relationships at 0.05 level. There generally a stability in the error terms with most of the movement within the band.

8.1. Stability Test of the System.

The stability is performed to ascertain the stability of the error terms hence the model.

Figure 6: Stability Test AR Root.

The AR graph shows stability in the model. No root lies outside the unit circle and the unrestricted VAR satisfies the stability condition.

8.2. Serial Correlation Test.

A serial correlation test is performed in the model using the autocorrelation LM test to test whether the model has been underspecified. This would show in the correlation of the error terms and most likely stability conditions can hardly be satisfied by the VAR. The serial correlation test shows absence of serial correlation and with the first lags error terms are not all significant showing no serial correlation.

8.3. Residual Heteroscedasticity Tests-No Cross Terms.

The parameters estimated by the unrestricted VAR have to be unbiased estimations. The presence of heteroscedasticity in a data series which means the variance of the series are not constant leading to estimation of parameters that are unstable throughout the
data series. The impulse response function and variance decomposition analysis is likely to unreliable.

Table 5.2. Residual Heteroscedasticity Tests.

<table>
<thead>
<tr>
<th>Chi-sq</th>
<th>Df</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>811.1855</td>
<td>784</td>
<td>0.2434</td>
</tr>
</tbody>
</table>

Test shows the absence of heteroscedasticity where there is no relationship detected in the variances suggesting that they close to zero and do not vary in time to show a relationship.

8.4 Normality of Residuals Tests.

The error terms have to be normally distributed for the model to stable and reliable in its estimations. The Jarque-Bera test is performed on the model.

Table 5.3. Normality Tests

<table>
<thead>
<tr>
<th>Component</th>
<th>Jarque-Bera</th>
<th>Df</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.137466</td>
<td>2</td>
<td>0.5662</td>
</tr>
<tr>
<td>2</td>
<td>1.031989</td>
<td>2</td>
<td>0.5969</td>
</tr>
<tr>
<td>3</td>
<td>3.796376</td>
<td>2</td>
<td>0.1498</td>
</tr>
<tr>
<td>4</td>
<td>0.421647</td>
<td>2</td>
<td>0.8099</td>
</tr>
<tr>
<td>5</td>
<td>2.696188</td>
<td>2</td>
<td>0.2597</td>
</tr>
<tr>
<td>6</td>
<td>1.046420</td>
<td>2</td>
<td>0.5926</td>
</tr>
<tr>
<td>7</td>
<td>1.619313</td>
<td>2</td>
<td>0.4450</td>
</tr>
<tr>
<td>Joint</td>
<td>11.74940</td>
<td>14</td>
<td>0.6264</td>
</tr>
</tbody>
</table>

Application of the Jarque-Bera test shows that the JB statistics is about 11.75, and the probability of obtaining such a statistic under the normality assumption is about 62 per cent. Therefore, we do not reject the hypothesis that the error terms are normally distributed.

8.5 Impulse Response of Domestic Variables to External Shocks.

On satisfaction of reliability of the model through the performance of the statistical tests and treating the data to satisfy the stability condition, heteroscedasticity, serial correlation and normality tests the impulse response function is performed on the model. The graphs show the impact of external shocks on inflation that is the deviation of the inflation rate from its long-run path due to an external shock. The residuals are $\sum u_t = 0$ in the long run and the shocks shift the inflation rate out of its long-run path.

8.5.1 Impulse Response Function of External Shocks on Domestic Inflation and Exchange Rate.

(a) Indirect Effects External Shocks.

Figure 7: Shock on South Africa Consumer Price Index on Domestic Inflation.

The shock in South Africa inflation leads to an increase in domestic inflation away from its long-term equilibrium. Domestic inflation remains elevated above the equilibrium...
value to settle at its equilibrium in the ninth period after the shock.

**Figure 8: Impact of a Shock of South Africa’s Discount Rate on Swaziland Inflation.**

A shock is South Africa discount rate leads to a general fall in Swaziland inflation but in the beginning of the third period. South Africa discount rate affects domestic discount rate with a lag.

**Figure 9: Impact of a Shock in USA Discount Rate Impact on Swaziland Inflation and Impact of a Shock in USA Discount Rate to the Exchange Rate (ZAR/USD).**

Swaziland inflation reacts by falling and then rising to a shock in the US discount rate. The domestic inflation rate rises as the shock in the US discount rates leads to fall in the domestic unit resulting in less competitive imports pushing up domestic inflation.

**Figure 10: A Shock in USA Inflation Impact on Swaziland Inflation**

There would generally be mild inflationary pressures created domestically by a rise in the US inflation as the US increases interest rates to bolster the US dollar in the process.

(b) Direct Impact of External Shocks on Swaziland Inflation and Exchange Rate.

**Figure 11: Shock on the International Price of Oil Impact on Swaziland Inflation.**

A shock in the international price of oil leads to a slight rise in domestic inflation from its long-term path remaining volatile with
upward bias to settle at its long-term path in the ninth period.

**Figure 12: Shock on Exchange Rate (ZAR/USD) Impact on Domestic Inflation.**

A shock in Swaziland inflation leads to a rise in Swaziland inflation away from its long run path in the first period but converges to the long-run path and stabilizes in the tenth period. If there is a shock in the Swaziland inflation like it happened before the Global financial crisis in 2008 inflation shot up only to better out later in the years.

Swaziland inflation responds by rising to a fall/shock in the exchange rate only to stabilise in the tenth period.

**Figure 13: Shock on International Price of Oil Impact on Exchange Rate.**

The years towards the financial crisis are distinct from the period of the late 80s and 90s which are associated with the great moderation where economies were moving to adopt the Washington Consensus (The US led macroeconomic paradigm that was adopted around 1980) Thomas Pillay (2011) responsible for moderating most of the economic variables. The shocks to inflation emanated from an oil price shock instigated by strong demand (James D. Hamilton (2009)) resulted in a shock on Swaziland domestic inflation transmitted mainly from the Big Country South Africa but died out in later years.
8.5.2 Impulse Response Function Model Specification including Swaziland Discount Rate

Due to the near singular matrix when running 8 parameters with 33 observations as Vratislav IZAK (2004) observed the Swaziland discount rate is dropped in the first estimation and the statistical tests are run successfully. The Swaziland discount rate is reintroduced in the model where not much variation is observed among the relationship of the parameters should not be the case and the stability of the model is maintained. The impulse response function and variance decomposition is done to determine the influence of external shocks on the Swaziland Discount rate to determine the efficacy of monetary policy in the midst of external shocks.

8.5.3 The Stability tests of the Model including Swaziland Discount Rate.

When including the domestic discount rate in the model the model is still found to be stable.

Figure 15: AR Root Stability Test.

There is no root that lies outside the unit circle and the unrestricted VAR satisfies the stability condition.

(d) Indirect Effects on Domestic Discount Rate.

Figure 16: Response of Swaziland Discount Rate to Shock in SA Inflation.

Swaziland discount rate responds by falling to a shock only to rise in the third period. Indirect effects of a shock in SA inflation do not immediately affect the domestic discount rate but ultimately leads to higher domestic discount rates.

Figure 17: Response of Swaziland Discount Rate to US Inflation.

Swaziland inflation responds by rising only in the third period to shocks in US inflation showing a weak response to US inflation.
Swaziland discount rate responds by rising to shocks in the US discount rate as South Africa counters any possible capital flight following a shock in US interest rate.

Swaziland discount rates respond by rising to shocks in SA discount rate due to the Swaziland pegging the local unit to South Africa’s but monetary policy remains flexible to other factors in particular economic growth causing it to fall at sometimes.

Domestic discount rates respond with a lag to a shock in international oil prices with Swaziland taking more of its cue from the interest rate trajectory in South Africa.

Domestic discount rates respond with a lag to shocks in the exchange rate as Swaziland takes cognisance of interest rate movement in South Africa predominately. Swaziland
Domestic inflation is more sensitive to external shocks than does the domestic discount rate. Direct shocks (International oil prices and the exchange rate) do not invite a quick response in the domestic discount rate but instead responds quickly to South Africa discount rate and US discount rate. The tight monetary policy though is exercised with flexibility as seen by downward pressure on the domestic discount rate long-run path with rising and falling in later periods. The domestic discount rates response almost follows the pattern as the response of South Africa’s discount rate to South Africa’s shock in South Africa’s inflation attesting to the existence of symmetric shocks right from the USA and points to a synchronisation of monetary policy.

9. Efficacy of Monetary Policy

A shock in Swaziland inflation emanating from an oil price shocks is transmitted as below leading to high domestic discount rates. The tight monetary policy though is exercised with flexibility as seen by downward pressure on the domestic discount rate long-run path with rising and falling in later periods. The domestic discount rates response almost follows the pattern as the response of South Africa’s discount rate to South Africa’s shock in South Africa’s inflation attesting to the existence of symmetric shocks right from the USA and points to a synchronisation of monetary policy.

Figure 22: Precursor Analysis to Efficacy of Monetary Policy.

The efficacy of monetary policy remains resilient even when responding to external shocks; inflation is reduced generally and stabilises in the tenth period. During the height of the financial crisis after there was a shock in the international price of oil.

9.4 Variance Decomposition Analysis.

9.4.1 The Importance of External Shocks in the Variance of Domestic Inflation excluding Domestic Discount Rate Variables.

The variance decomposition is run to determine the influence each external shock on domestic inflation.

(a) South Africa inflation influence on domestic inflation rises from 0.19 per cent in the second period to 6.15 per cent in the tenth period.

(b) The exchange rate rises from 1.75 per cent in the second period to 8.41 per
cent in the tenth period.

(c) South Africa discount rate rises from 0.66 per cent in the second period to 7.54 per cent in the tenth period.

(d) The international price of oil influence on domestic inflation rises from 0.18 per cent in the second period to 4.42 per cent in the tenth period.

(e) The US discount rate influence rises from 0.0136 per cent in the second period to a high of 18.40 per cent in the tenth period.

(f) The US inflation falls from 8.08 per cent in second period to 5.33 per cent in the tenth period.

The importance of external shocks on the variance of inflation falls is small but increases with time remaining less influential than domestic shock/domestic inflation. Domestic shocks more explain the variance in domestic inflation. The US discount rate has great influence on domestic discount rate because it influences South Africa discount rate which in turn influences domestic discount rate. The movement in interest rates will invariable have a huge impact on inflation trajectories in the three countries. The influence of South Africa discount rate is reduced when introducing domestic discount rate attesting to the domestic efficacy of monetary policy where the influence of domestic interest rates on domestic inflation rise to 10 per cent and stabilise at 9 per cent in the ninth and tenth period. The impact of USA inflation is also reduced with the US discount rate maintaining its influence at 18 per cent supporting the presence of synchronisation in monetary policy in Swaziland, South Africa and the United States. The USA discount rate has a high degree of influence as the South African monetary authorities put more weight to the exchange rate and capital flight consideration when the USA adjustments interest rates. External shocks that affect the domestic inflation predominately are domestic discount rates, exchange rate (ZAR/USD) and the US discount rate.

Figure 24: The Variance Decomposition of Swaziland Inflation.

Percent SWD Inflation variance due to SWD Inflation

Percent SWD Inflation variance due to SWD Discount Rate

Percent SWD Inflation variance due to Exchange Rate (ZAR/USD)

Percent SWD Inflation variance due to USA Discount Rate
9.5 The Importance of External Shocks in Variance of Domestic Discount Rate.

The variance of domestic discount rate relies heavily on itself, Swaziland Inflation, South Africa Discount rate and US discount rate due to the strong link in interest rate movement in the South Africa and the US. SA inflation follows in its importance in determining the domestic discount rate as shown by table 8 in appendix C.

(a) Swaziland inflation influence on Swaziland discount rate rises from 23 per cent to peak at 25 per cent in the third period falling to 20 per cent in the tenth period.

(b) The discount rate influence on itself falls from 76.51 per cent in the first period to 21 per cent in the tenth period.

(c) South Africa inflation rises from 0.00 in the first period to a high of 6.86 per cent in the second period falling down to 4.77 per cent in the tenth period.

(d) The exchange rate influence on the domestic discount rate rises from 0 to 11 per cent in the tenth period.

(e) The influence of oil prices rises to 7.83 per cent and stabilises at 6 per cent.

(f) At US discount rate influence on domestic discount rate rises from 5 per cent to stabilise 12.98 per cent.

The variance in the domestic discount rate is mainly driven by domestic inflation other than external shocks and shows that monetary policy decisions are more based on domestic factors and responsiveness of monetary policy to domestic inflation rate shocks is effective even though domestic discount rates are predominately driven by South Africa interest rates.

Figure 25: The Variance Decomposition of Domestic Discount Rate.

![Percent SWD Discount Rate variance due to SWD Inflation Discount Rate](image1)

![Percent SWD Discount Rate variance due to SWD Inflation](image2)

![Percent SD Discount Rate variance due to SA Discount Rate](image3)

![Percent SWD Discount Rate variance due to USA Discount Rate](image4)

External shocks that predominately drive domestic interest rates are the South African discount rate and the US discount rate depicting a degree of monetary policy synchronisation. Again it can be
noted that external shocks influence on variance domestic inflation increases with that influence on the variance of domestic discount rate declining.


The correlation matrix shows a strong presence of monetary synchronisation among Swaziland, South Africa and the United States. There is a strong correlation of monetary policy movements between Swaziland and South Africa with a correlation of 86 per cent. The correlation of monetary policy between South Africa and the United States is lower but positive at 40 per cent and it gets even lower for Swaziland and the United States at 20 per cent.

Table 6. Monetary Policy Correlation Matrix.

<table>
<thead>
<tr>
<th></th>
<th>SWD</th>
<th>SA</th>
<th>USA</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWD</td>
<td>1</td>
<td>0.863373</td>
<td>0.200876</td>
</tr>
<tr>
<td></td>
<td>0.863373</td>
<td>1</td>
<td>0.436933</td>
</tr>
<tr>
<td>USA</td>
<td>0.200876</td>
<td>0.436933</td>
<td>1</td>
</tr>
</tbody>
</table>

The influence falls with the fall in the interaction of the two countries economically. Mohamed Arouri, Fredj Jawadi and Duc Khuong Nguyen (2012) observe that there was increased synchronisation of monetary policy over the period 2005-2009 as well as their lead-lag causal interactions suggesting that all the above could be under a coordinated policy response the industrial nation namely, the United Kingdom, France and the United States.

Table 7. Summary of External Shocks on Swaziland Inflation and Discount Rate.

<table>
<thead>
<tr>
<th>Shocks</th>
<th>Swaziland Inflation</th>
<th>Swaziland Discount Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa Inflation</td>
<td>Rises slightly from long-term path</td>
<td>Fall to rise later</td>
</tr>
<tr>
<td>South Africa Discount Rate</td>
<td>Rises slightly initially and then falls</td>
<td>Rises</td>
</tr>
<tr>
<td>Exchange Rate (ZAR/USD)</td>
<td>Rises after noticeable at end of third period</td>
<td>Falls</td>
</tr>
<tr>
<td>Oil Price</td>
<td>Rises</td>
<td></td>
</tr>
<tr>
<td>US Inflation</td>
<td>Rises</td>
<td>Falls</td>
</tr>
<tr>
<td>US discount Rate</td>
<td>Fall shortly and then rises</td>
<td>Rises</td>
</tr>
</tbody>
</table>

In summary Swaziland inflation responds to South Africa inflation, South Africa discount rate, the exchange rate and US inflation but is slow to react to US discount rate.

Domestic discount rate responds with a lag to South Africa inflation, exchange rate and US inflation but responds quickly to shock in South Africa discount rate and US discount rate.

Inflation in Swaziland responds strongly to South Africa inflation, South Africa discount rate, the exchange rate and US inflation immediately and responds strongly to oil prices in the third period. Monetary policy in Swaziland is influenced strongly by monetary policy in South Africa and the United States.
and thus responds late to shocks to South Africa’s inflation, the exchange rate and US inflation. Monetary policy conduct in Swaziland is slow to counteract inflationary pressures from South Africa inflation, the exchange rate and US inflation but is effective in controlling monetary policy.

The influence of external shocks in the variance of monetary policy is pronounced in the long-term rising from a mere average of 3 per cent in the first periods to an average of 6 per cent in the final periods yet the influence of external shocks on the variance of domestic inflation rise from 5 per cent to 41 per cent in the final periods. Even though monetary policy is less driven by external shocks which play a greater role in driving inflation, monetary policy remains efficient in bringing down inflation because internal shocks remain above 50 per cent in explaining the variance in inflation.


The external shocks, which are international oil prices and US monetary policy, have been cited in literature by Thi Lien Hoa Nguyen, Thu Giang Tran and Thi Hong Minh Le (2013) as important in determining the cause of monetary policy in the world. Perhaps it is because of their high integration to the world economy as evidenced by the general acceptance of the US dollar making it a world reserve currency. The non-responsiveness of the FED in the first oil price shock wrought a phenomenal event in as much as their radical reaction to the second oil price shocks of 1978-79. The reaction in the second instance sent world debt skyrocketing as all and sundry followed the FED’s drastic hike of interest rates. According to a study by Jian-Ye Wang, Iyabo Masha, Kazuko Shirono, and Leighton Harris (2007), Swaziland’s closeness to South Africa and the pegged exchange rate is significant in transmitting monetary policy shock both from internally and externally.

External Shocks basically cause a ripple effect across countries that have strong trade links and through transmission from a country less traded with to a country more traded with. South Africa in our instance transmits significant shocks to Swaziland from its major trading partners as seen in correlation matrix where the relationship of Swaziland’s monetary policy with South Africa is at 86 per cent and by extension South Africa’s monetary policy is influenced by the United States of America 44 per cent.

Observations

Swaziland’s monetary policy is mostly driven by domestic economic sentiments as it remains flexible to growth concerns domestically by lagging rates behind those of South Africa but cautious of consistency with the fixed exchange rate against South Africa leading to a degree of correlation in the two countries’ monetary policies. The high values of the correlation matrix have shown a synchronisation of monetary policy with the United States setting the general tone of monetary policy as they choose to or not to react radically to external shock in particular oil price shocks. The less restrictive the US will react to a shock in oil price will also invite less aggressive monetary policy from emerging markets. The even balance
of power among the industrial nation calls for a cooperation in monetary policy less of the price (interest rates) taking that exists among the industrial and emerging market. Non-synchronisation among the industrial nation with their even balance of power in trade would put emerging market monetary in dilemma leading to over attracting international capital and sterilisation cost and under attracting international capital currency threats.

Response to research question; efficacy of monetary policy in the midst of external shock; Domestic monetary policy remains resilient under external shocks with inflation responding by falling and stabilising in the long-run (tenth- period) as shown in the impulse response function derived from the Unrestricted VAR found to have two cointegrating equation at the 0.05 level in the trace cointegration test and two cointegrating relationships at 0.05 level with the maximum Eigen value test attesting to the existence of a long-run and short run relationship among the I(1) series where $\Sigma t = 0$.

It is recommended that an external shock emanating from primarily international oil prices, US inflation rate, exchange rate, South Africa inflation and South Africa discount rate be taken into serious consideration in conducting monetary policy in Swaziland and not wait for the external shocks to manifest in domestic inflation before monetary policy reacts. Swaziland, at most instances, takes a cue from movements in monetary policy in South Africa when the other external factors have already shown the direction of inflationary pressures. Swaziland could react by increasing the discount rate in light of external inflationary pressures like high oil prices to be more efficient in keeping inflation low and then could later ease to a relatively accommodative monetary policy stance in consideration of sluggish growth and equate or lag the discount rate below that of South Africa. Swaziland instead waits for monetary policy reaction in South Africa and manifestation of inflationary pressures in the domestic inflation outcomes to react setting Swaziland a bit late in reacting resulting in a higher inflation trajectory than it could have been had Swaziland been proactive with domestic inflation by reacting to inflationary pressures sooner.

REFERENCES.


The Impact of Discount Rate Differential with South Africa on Capital Flight in Namibia and Swaziland

Simiso Fabian Mkhonta

Abstract

The paper analyses the relationship between interest rate differentials in Namibia and Swaziland vis-à-vis South Africa, where the two countries belong to a monetary union the CMA, and its impact on capital flight. Using the Johansen, Juselius cointegration analysis suggested in Johansen, Juselius (1990), Oxford Bulletin of Economics and Statistics Johansen, Juselius (1992) technic and the Vector Error Correction Model, the paper found that higher rates in Namibia and Swaziland than in South Africa lead to capital flight to South Africa in the long run because of the dominance of South Africa in the CMA. Higher interest rates in Namibia and Swaziland than in South Africa lead to capital being attracted from Namibia and Swaziland real sector to their financial markets but due to the gravity of South Africa in region find their way to the South African real sector for better economic risk in the real sector. The model shows that Namibia and Swaziland interest rates differential with South Africa have a significant negative effect on net portfolio investment which is used as a measure for capital flight. A percentage increase in interest rate differential for Namibia and Swaziland have a long run positive impact on capital flight of 4.09 and 7.26 per cent respectively owing the disparity in the development of their financial markets with Namibia’s higher interest rate differential even though unable to curb capital flight in the long-run but better than Swaziland’s capital flight. The impulse response function shows that capital flight reduces economic growth in Namibia and Swaziland. The Granger causality tests show that the interest rate differential, budget deficit and economic growth all cause capital flight giving credence to the model specification. The dominance of South Africa in the CMA as Sylvanus and Ikhide (2010) alludes to have significant effect in the direction of the capital. Swaziland and Namibia budget deficit and economic growth are found not to significantly influence capital flight in the long run. The interest rate differential is insignificant in correcting to its long run path in the short term for Swaziland and significant for Namibia pointing to Namibia’s better developed financial market than Swaziland. Monetary policy is therefore more sensitive to financial sector developments in the short run in Namibia than in Swaziland due to their commensurate disparity in financial markets developments.

Keywords: Interest Rate Differential, Capital Flight/Net Portfolio Position, CMA.

1. Introduction.

This paper analyses capital flight from Swaziland and Namibia which are under the Common Monetary Area (CMA) comprising Lesotho, Namibia, Swaziland (LNS) and South Africa.

In 1972 the International Monetary Fund as
well as the Bank of England recommended that Lesotho, Swaziland and Botswana negotiate jointly with South Africa for a modified and more clearly defined monetary relationship. The outcome of the negotiations gave birth to the Rand Monetary Area agreement in December 1974. Botswana, though, with an economy less dependent on South Africa than Lesotho and Swaziland announced its withdrawal from the negotiations and its intention to set up its own Central Bank, the Bank of Botswana and issue its own currency, the pula.

South Africa has the biggest economy in the CMA with a GDP of USD 314,572 million in current prices in 2015. The other three economies in the CMA are small and heavily dependent on South Africa with Namibia GDP at USD 11,492 million, Swaziland at USD 4,118 million and Lesotho at USD 2,278 million in current prices in 2015 according to the World Bank. The South African repo rate is the relevant policy instrument for these economies as opposed to the LNS countries’ central bank rates and the LNS economies may not be able to undertake independent monetary policies (Sylvanus Ikhide 2010). The geographic close proximity of the LNS countries to South Africa embolden the strong economic ties in the CMA coupled with the LNS membership to the South African Customs Union (SACU) (see Appendix 3).

Divergence of monetary policy in terms of discount rate from that of South Africa by the LNS would probably lead to the South African Rand being attracted or deflected from the LNS countries depending on the discount rate differential among the LNS countries and South Africa.

The efficacy of the discount rate differential in attracting the South African Rand to the LNS countries or deflecting it to South Africa is of great interest to the stability of the monetary union. Sylvanus Ikhide (2010) further observes that given the asymmetry of shocks, the LNS countries may reduce their rates lower than those in South Africa to stimulate their respective economies but at the risk of capital outflows from the LNS economies and the monetary authorities must offset the flows by purchasing the South African Rand in order to keep the exchange rate unchanged but such a move is limited by the amount of foreign exchange reserves held by the government.

The LNS central banks have therefore tracked the South African Reserve Bank repo rate to stabilise the parity peg of the Loti, Namibian dollar and Lilangeni to the South African Rand and enhance business confidence. Be that as it may, there seems lately to a desire by the monetary authorities of the LNS countries to be seen to be responding to domestic factors through monetary policy, in particular using the discount rate as domestic factors diverge from those of South Africa (Sylvanus Ikhide 2010). The relevance of South Africa monetary policy to the LNS countries hinges on the symmetry of shocks and an asymmetry render the LNS defenceless in responding directly to shocks other than being preoccupied with maintaining stability in the fixed exchange rate. Can Swaziland and Namibia respond to domestic factors and simultaneously maintain confidence in the stability of the parity fixed exchange rate with South Africa? Even though Sylvanus
and Ikhide (2010) allude to the fact that the high development of the South African economy and its concentrated tentacles in the LNS economies dwarf the efficacy of interest rates of the LNS in stalling capital flight, it would be interesting to find out if lower rates in the LNS would exacerbate capital flight so as to inform monetary policy decision making in the LNS in terms of the discount rate as a monetary policy tool.

2. Swaziland and Namibia Interest Rate Trajectory.

Swaziland has maintained a negative interest rate differential with South Africa in instances where there was a differential and in most cases has kept the same level of discount rate as the repo rate in South Africa (Figure 1). The monetary authorities have exercised limited flexibility in equating the domestic discount rate to that of South Africa. Namibia has in most instances kept the repo rate above South Africa’s (Figure 2).

Figure 1: Swaziland and South Africa Discount Rate.

Figure 2. Namibia and South Africa Discount Rate.

The paper therefore seeks to calibrate the level at which the South African Rand is deflected to South Africa or attracted to the Namibia and Swaziland countries as capital flight due to their discount rate differential vis-à-vis South Africa’s. I note that there could be broader capital outflows resulting from the discount rate differential but the study focuses on portfolio investment which is deemed to be sensitive to interest rates and supported by literature as a measure for capital flight when looking at interest rate differential.

The paper is structured as follows, after the introduction in Sections 1 and 2 the paper looks at the Commercial banks in Swaziland purchase of government paper, their reserve requirement and the trajectory of net portfolio investments/capital flight in section 3. Section 4 is the literature review, Section 5 is the Model and Data, Selection 6 is the Methodology, Section 7 are Data sources and Limitation, Section 8 are Empirical results for Swaziland, Section 9 are Swaziland Model results interpretations, Section 10 are the...
Impulse Response function for Swaziland, Section 11 are Namibia empirical results, Section 12 are Interpretation of Namibia results and Section 13 is the conclusion.

3. COMMERCIAL BANKS PURCHASE OF GOVERNMENT PAPER, RESERVE REQUIREMENT AND NET PORTFOLIO INVESTMENT IN SWAZILAND.

Swaziland commercial banks have participated in the purchase of government paper which have been translated to excess reserves of the banking system placed with the Central Bank. This could have been caused by risk aversion by banks, possibly emanating from the avoidance of investing in the domestic real sectors as seen in figure 3 below.

Figure 3. Net Portfolio Investment, Commercial Banks Purchase of Government Paper and Surplus Deficiency in Commercial Banks Reserve Requirement.

Source: Central Bank of Swaziland Quarterly Review.

Therefore, besides the interest rate differential as a cause for capital flight, the lack of viable investment in the real sector could be a factor causing capital flight. This can be seen in the figure 3 above where the purchase of government paper by commercial banks is reflected in the increase in excess reserves and net portfolio investment. As the banks reduce their investment in government paper they opt to invest in South Africa for better risks and higher real sector returns as seen in the general deterioration of the net portfolio investment.

4. LITERATURE REVIEW

Capital flight has been a problem since the early twentieth century in Europe and United States of America gaining momentum again in the 1980s (Albert Makochekanwa 2007). Capital flight was observed from countries like Russia and Argentina offering lower or negative interest rates to mainly higher interest rate offering countries like the Republic of China towards the end of the twentieth century after the great depression from 1929 to 1936. The end of the twentieth century saw countries like Venezuela featured prominently in capital flight in the 1980s as one year’s total export income left through illegal means in the midst of an oil price glut depressing oil prices the mainstay of the Venezuela economy. The 1990s saw a reversal of capital of the then popular Asia tigers in the 1997 Asian financial crisis that started in Thailand in July 1997 extending into a financial contagion as debt-to-GDP ratio soared and current account deficits worsened. Fears of a default by Argentina led to capital flight in 2001. As late as just
before the British referendum capital flight was witnessed with a net capital outflow of £77 billion.

A foregoing historical narrative shows that capital flight is characterised by a massive exodus of capital from the economy as J.W. Fedderke and W Lui (2002) note. They note that capital flight is not just employed to refer to normal capital outflows and can be differentiated from normal capital flows by three criteria namely, the volume of the capital flow should be massive, its nature is associated with risk in particular the possibility of an asymmetric distribution of risk across domestic and international assets and it responds to a policy shift or rather a shock.

The most relevant conceptualisation for capital flight for this study is the second position where capital flight stems from the asymmetric distribution of assets risks across nations. Interest rate differential of assets across nations gives rise to asymmetric risk and may trigger capital flight. Erhard Radatz and Adjmal Sirak (2014) point out that factors like interest rate differentials and changes in economic growth lead to foreign exchange movements around the world. With the fixed exchange rate regime by the smaller CMA members against South Africa interest rate risk is not eliminated by exchange rate movement as Erhard Radatz and Adjmal Sirak (2014) observe that interest rate differentials are on average offset by exchange rate movements and negate any systematic gains for an investor attempting to earn money from them directly. Covered interest rate parity therefore exists in the CMA set up where interest rate differential from that of South Africa’s by the smaller states has not led to a commensurate adjustment of the spot rate between each of the smaller states and South Africa thus not offsetting the exchange rate risk more so because inflation rates among CMA members move in tandem see appendix 12 due to strong trade links among them. Should inflation rates diverge then interest rate risks should be absorbed by changes in the exchange rate. Interest rate therefore is important in determining the cross country risks in particular where the exchange rate is fixed and across country inflation rates are tend to diverge.

The CMA smaller members with their fixed exchange rate regimes against South Africa theoretically put a cap on the budget deficits they run. Fiscal policy expansion with fixed exchange rate lead to excess demand for foreign exchange, in the case of the CMA this could lead to an increase in the demand for the South African Rand. Excess demand for the South African Rand should be relieved by the Central banks of smaller economies in the CMA by buying the South African Rand but in the process would result in an increase in domestic money supply.

Barbara et al (2007) show that a rise in the government deficit financed by future taxes generate a decumulation of external assets, leading to a speculative attack and forcing the monetary authorities to abandon the peg. Krugman (1979) concludes that when the government’s willingness to use reserves to defend the peg (of course assuming that government deficit has led to a run down in
reserves and more reserves have to be raised to defend the peg) is uncertain there can be a series of crises in the capital flows out of the country.

Wang, et al (2007) note the significant effect the South African Customs Union (SACU) receipts play in stabilising their fiscal position. They further note that the inflows of SACU receipts, which are in South African Rand are important for the LNS countries’ balance of payments. The fiscal deficit then becomes crucial in the determination of capital outflows/flight in the smaller economies where deficits are predominately driven by a fall in SACU receipts as noted by Barbara et al (2007) and Krugman (1979). Chin-Hong Pauh and M. Affendy Arip (2012) studied the determinants of capital flight in Malaysia and discovered that all variables (real GDP, budget position, treasury bills, foreign direct investment and stock market) had a significant impact on capital flight. Real gross domestic product with a negative sign, the budget deficit/position with a negative sign, treasury bills rate with a negative sign, foreign direct investment with a positive sign and the stock market with a positive sign.

The fiscal deficit, performance of the economy in terms of growth and interest rate differential are from the foregoing literature primary in determining capital flight.

5. Model and Data Selection.

The conceptualisation of capital flight will vary according to the nature of analysis being undertaken. Capital flight can respond to both economic and political factors and depending on what factors are of interest to the researcher the definition of capital flight should be tailored thus. The factor that is pondered over in this study is interest rate differential which falls under economic factors and the account that is relevant or rather sensitive to interest rates in the balance of payments accounts are portfolio investments. Capital should therefore be looked in that light for the sake of this study. Capital flight in literature is popularly measured using the following measures:

(i) The balance of payments approach popularised by Cuddington 1987 which uses the sum of private short-term capital outflows and errors and omissions.
(ii) The direct measure used by the Bank of England (1989) report and Lessard & Williamson’s (1987) which Fedderke and W Lui (200) elaborate. Capital flight in this instance is measured as the cross-border bank deposits by private residents of the country.
(iii) The indirect measure used the World Bank (1985), Guaranty (1986) and Pastor (1990), which captures the change in a country’s foreign assets.

The study uses the balance of payments approach as a measure of capital flight (Cuddington,1987) and used by Chin-Hong Puah and Affendy Arip (2012) where the portfolio investment assets outflows and net errors and omissions are taken as a measure of capital flight for Lesotho, Namibia and Swaziland.
Fedderke and W. Liu (2002) use exchange rate adjusted interest rate differential, South Africa real growth rate, and risk variables entailing over/undervaluation of the exchange rate, political risk index and political repression index. Swaziland and the other CMA countries all pursue a fixed exchange rate with South Africa precluding exchange rate risks in adjusting interest rate differentials. Chin-Hong Puah and Affendy (2012) find out that real gross domestic product is found to be negatively related to capital flight where an increase in the real gross domestic product leads to a fall in capital flight, attributing the relationship to increased investor confidence.

Fedderke and Liu (2002) finds capital flight to be responsive to interest rate differential and to the aggregate real growth rate with the theoretically correct signs and they further find out that capital flight is more responsive to the interest rate differential and aggregate demand than normal capital flows. They find capital flight and normal capital flows are found to be both highly responsive to political risk.

Puah and Arip (2012) find that foreign direct investment encourages capital flight due to the strengthening of the Malaysian currency due to an inflow of foreign direct investment. The existence of a fixed exchange rate regime among South Africa, Lesotho, Namibia and Swaziland precludes the possibility of foreign direct investment in Lesotho, Namibia and Swaziland strengthening the respective local currencies against the South African rand and any other currency as the local units of the smaller economies in the CMA mirror the movement of the South African rand against any other currency.

The LNS countries are seen as having underdeveloped financial markets hence the stock market leading to negligible financial flows among LNS except South Africa (Sylvanus Ikhide and Ebson Uanguta (2010). Sylvanus Ikhide and Ebson Uanguta (2010) further observe that though nominal interest rates are relatively close in the CMA, the perception of country risks by investors varies and the size of the SA financial market, dominance of the banking market by SA banks and country risk perception all combine to ensure significant flows from LNS to South Africa. One though would expect the interest rate differential to have an impact on capital flight in particular lower interest rates in the LNS.

Interest rate differential, the budget deficit and economic growth are therefore selected to explain capital flight in the model with higher interest rates in the LNS expected to have negative effect on capital flight. The budget deficit is expected to have a negative effect on capital flight and economic growth also have a negative on capital flight.

The model specification in this study can be represented by the following equation:

$$ CFGDP = \beta_0 + \beta_1 \text{Intrdiff} + \beta_2 \text{BDGDP} + \beta_3 \text{GDPgr} + \mu \ldots \ldots \ldots (1) $$

Where;

- $ CFGDP =$ ratio of capital flight to GDP; $\text{Intrdiff} =$ interest rate differential;
- $ BDGDP =$ ratio of budget deficit to GDP and $\mu =$ error term.
The interest rate differential is defined as the Namibia and Swaziland repo rate less South Africa repo rate. The same model is applied for both countries.

6. Methodology.

The Augmented Dicky Fuller (ADF) unit root test is used to test the variables for stationarity for each country. The Johansen and Juselius (1990) cointegration test to test whether there exists a long run equilibrium relationship among the variables. After determining that the variables are cointegrated and have thus have a long run relationship, the Error Correction Model is estimated by normalising the cointegrating vector with respect to capital flight Chin-Hong Puah and M. Affendy Arip (2012).

Impulse response functions and variance decomposition are run to appreciate the influence of interest rate differential on capital flight. The model to be tested will include the following variables as independent variables; real GDP growth, budget deficit, interest rate differential and capital flight/net portfolio investment as the dependent variable. All variables are expressed in percentage form hence there is no need to take their logs.

The model has to be selected for a lag length and the commonly used lag length criterion is Akaike Information Criterion (AIC) which shows that the lag length to be used in the Vector Auto Regression (VAR) is one. Braun and Mittnik (1993) observe that a critical element in the specification of VAR is the determination of the lag length in order to validate the impulse response function and variance decomposition. The lag lengths that is greater than the VAR lag order selection criteria causes an increase in the mean-square-forecasts and less lag lengths often cause autocorrelation of error terms hence a misspecification of the VAR resulting in unreliable impulse response function and variance decomposition analysis. W. Douglas McMillin and Omer Ozciek (1999) find the AIC to outperform the other criterion especially the SIC and PIC. Usually, for annual data the maximum lag length is set at 1 and for quarterly data it is set at 4. The maximum lag length is therefore set in accordance to the frequency of the data. Data below 60 observations the AIC and FPE are more efficient Lewis V, K-S (2004).

7. Sources and Limitations Data.

The data is sourced from the Central bank of Swaziland quarterly report review and the Bank of Namibia quarterly bulletin. The data set is short; from 2010 to 2016 with only 25 observations thus limiting the number of independent variables to be included in the model. Other variables are not produced in quarterly time intervals such as GDP growth and the budget deficit. The proxies for development of the financial sector could not be obtained.

8. SWAZILAND EMPIRICAL RESULTS

(a) Stationarity Tests and Lag Length Selection.

The Augmented Dicky-Fuller (ADF) is used to test the variables for stationarity.
Table 1. ADF Test at Levels.

<table>
<thead>
<tr>
<th>Variables (levels)</th>
<th>Lag length</th>
<th>ADF test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept + trend</td>
<td>5</td>
<td>-1.746830</td>
</tr>
<tr>
<td>Net-portfolio investment + Errors &amp; Omissions (CFGDP)</td>
<td>5</td>
<td>-1.746830</td>
</tr>
<tr>
<td>Budget deficit</td>
<td>4</td>
<td>0.026024</td>
</tr>
<tr>
<td>Interest differential</td>
<td>1</td>
<td>-2.402530</td>
</tr>
<tr>
<td>GDP growth</td>
<td>1</td>
<td>-0.158105</td>
</tr>
</tbody>
</table>

If the variables are of the same order of integration, then they are cointegrated and thus can be estimated in a model and the Johansen and Juselius (1990) cointegration test can be performed to determine the cointegrating vectors. The variables are found to be non-stationary at levels.

Table 2. ADF Test at First Differences.

<table>
<thead>
<tr>
<th>No-trend and intercept</th>
<th>Lag length</th>
<th>ADF test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net-portfolio investment + Errors and Omissions (CFGDP)</td>
<td>0</td>
<td>-6.711211***</td>
</tr>
<tr>
<td>Budget deficit</td>
<td>1</td>
<td>-2.870756***</td>
</tr>
<tr>
<td>Interest differential</td>
<td>1</td>
<td>-4.215332***</td>
</tr>
<tr>
<td>GDP growth</td>
<td>1</td>
<td>-2.732068***</td>
</tr>
</tbody>
</table>

Notes: *** significant at 1 per cent, ** significant at 5 per cent, *significant at 10 per cent

All the variables are found to be non-stationary at their levels and stationary at first difference and therefore the Johansen, Juselius (1990) cointegration test is performed.

b. Lag Selection Criterion.

Table 3. VEC Lag Length Criterion Test.

<table>
<thead>
<tr>
<th>Lag</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0.097*</td>
<td>9.0017</td>
<td>9.798*</td>
<td>9.190*</td>
</tr>
<tr>
<td>2</td>
<td>0.3179</td>
<td>10.066</td>
<td>11.365</td>
<td>10.439</td>
</tr>
<tr>
<td>3</td>
<td>0.2714</td>
<td>9.5162</td>
<td>11.896</td>
<td>10.076</td>
</tr>
<tr>
<td>4</td>
<td>0.2931</td>
<td>8.5593*</td>
<td>11.733</td>
<td>9.3070</td>
</tr>
</tbody>
</table>

AIC criteria select four lag length and most of the criteria select one lag length. One lag length is selected on the strength of that most criteria selected one.

c. Johansen and Juselius Cointegration Test.

Using the 1 lag length selected by the AIC the Johansen, Juselius cointegration tests Trace statistics shows 4 cointegrating equation and the Max-Engen value test also show 4 cointegrating equations.

The ECM is estimated by normalising the cointegrating vector with respect to capital flight: The following normalising equation is obtained:

d. Swaziland Long run Equation Results.

\[
\text{CFGDP} = 6.711 - 7.255 \text{Intrd} - 0.423 \text{BDGDP} + 1.418 \text{GDPgr}\ 
\]

\[\text{[3.187]} \quad \text{[1.660]} \quad \text{[-1.468]}\]

\[\text{GDPgr} \quad \text{(2)}\]
Table 4. Swaziland Short Run Results.

<table>
<thead>
<tr>
<th>D(CFGDP)</th>
<th>D(BDGDP)</th>
<th>D(GDPGR)</th>
<th>D(intrdiff)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.801171</td>
<td>0.667315</td>
<td>0.185982</td>
<td>-0.00900</td>
</tr>
<tr>
<td>(0.30247)</td>
<td>(0.30787)</td>
<td>(0.09927)</td>
<td>(0.02015)</td>
</tr>
<tr>
<td>[-2.64875]</td>
<td>[2.16756]</td>
<td>[1.87351]</td>
<td>[-0.44672]</td>
</tr>
</tbody>
</table>

Table 5. Heteroscedasticity and serial correlation tests

| VEC Residual Heteroscedasticity Tests. |
|----------------|----------------|
| Joint Test      |                 |
| Chi-sq.  Df Prob | 99.46586 100 0.4963 |

| VEC Serial Correlation Tests |
|-----------------------------|-----------------|
| Lags | LM-Stat | Prob |
| 1    | 6.091602 | 0.9871 |
| 2    | 8.528993 | 0.9315 |
| 3    | 12.16940 | 0.7322 |
| 4    | 43.53241 | 0.0002 |
| 5    | 11.17545 | 0.7985 |

The VEC residual serial correlation test rejected the null hypothesis of presence of autocorrelation and the VEC residual heteroscedasticity test rejects the null hypothesis of presence heteroscedasticity. The parameters are therefore best linear and unbiased satisfying the Gaussian classical linear assumption of zero mean value $\mu$ and no relationship in the error terms (which also shows stability of the model in estimating the independent variable) with the absence of serial correlation. The independent terms are found to have homoscedastic variance.

9. Model Interpretation of Results.

As shown in equation (2), the interest rate differential is found to be negatively related to net portfolio outflows and highly significant whereas the budget deficit and growth in GDP are all found to be insignificant and negatively and positively related to capital flight respectively. The interest rate differential is negatively related to capital flight which is explained in the model as the balance of portfolio investments.
A percentage increase in interest rate differential lead to a 7.26 per cent increase in capital flight/deterioration of net portfolio investments. Therefore, an increase in the interest rate differential where domestic interest rates would be above those of South Africa would lead to a deterioration in portfolio investments in the economy hence capital flight. This is a result from local investors placing their investments in the high yield domestic financial assets which are in turn invested in South Africa as generally preferred investment location because of lower perceived risks and generally higher returns in particular in the real sector. In the same spirit Hippolyte Fofack and Leonce Ndikumana (2014) find that higher interest rates for 39 countries in Africa in the period over 1970-2010 do not result in stemming capital flight. Sylvanus and Ikhide (2010) also assert to the dominance of South Africa in attracting foreign investment. Graph 4 shows the relationship between capital flight and interest rate differential between Swaziland and South Africa. The impact of the budget deficit and capital flight in correcting to their long-run path in the short term is found to be significant with the budget deficit exploding by 0.67 per cent per quarter from its long run path and capital flight converging by 0.80 per cent per quarter to its long run path.

The budget deficit and economic growth are both found to have insignificant impact on capital flight in the long run.

Graph 4. Capital Flight/Portfolio Investment Position and Interest Rate Differential Swaziland.

Source: Central Bank Quarterly Review.

Table 6. Granger Causality Tests.

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Reject</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDGDP does not Granger cause CFGDP</td>
<td></td>
</tr>
<tr>
<td>Interdiff does not Granger cause CFGDP</td>
<td></td>
</tr>
<tr>
<td>GDPgr does not Granger cause CFGDP</td>
<td></td>
</tr>
</tbody>
</table>

Table 6 shows the granger causality tests from the ECM results; where interest rate differential, budget deficit and GDP growth are found to granger cause capital flights. Interest rate differential is found to granger cause GDP. The dependent variable all therefore cause capital flight in the short run.
10. Swaziland Impulse Response Functions.

The response of capital flight to interest rate shock is found to move downwards as seen in the graph 2 below. A shock in the interest rate differential results in an increase in capital flight as shown by a movement of capital flight to the negative territory.

Graph 5. The impact of a Shock in the Discount Rate differential on Capital Flight.

The dominance of South Africa in attracting portfolio investment is the cause for the decline in net portfolio investment as a positive shock is introduced in the discount rate differential.

A positive shock in net portfolio investment leads (negative shock in Capital Flight) lead to higher levels of GDP.

Graph 6. The Impact of a negative Shock in Capital Flight on GDP growth.

In conclusion, the impulse response function shows that shocks in the interest rate differential would ultimately lead to lower growth as the capital flight increases and economic growth falls. Capital flight therefore leads to lower economic growth.

11. Namibia Empirical Results.

a. Stationarity Tests.

The ADF is used to test the variables for stationarity.

Table 7: ADF Test for Stationarity at Levels.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Lag Length</th>
<th>ADF test</th>
<th>Lag length</th>
<th>SIC criterion</th>
<th>Augmented Dicky-Fuller test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Net-Portfolio Investment + Error and Omissions</td>
<td>1</td>
<td>-5.515203***</td>
<td>6</td>
<td>8.783040</td>
<td>-2.173593</td>
</tr>
<tr>
<td>Budget deficit</td>
<td>1</td>
<td>-3.316625***</td>
<td>6</td>
<td>9.565633</td>
<td>-2.724817</td>
</tr>
<tr>
<td>Interest differential</td>
<td>1</td>
<td>-3.773571***</td>
<td>6</td>
<td>12.27036</td>
<td>-2.54016</td>
</tr>
<tr>
<td>GDP growth</td>
<td>1</td>
<td>-3.316625***</td>
<td>6</td>
<td>10.49661</td>
<td>-1.206620</td>
</tr>
</tbody>
</table>

1.077756* 8.783040 9.572949* 8.981700
1.089241 9.565633 11.14545 9.962953
0.369730 9.900628 12.27036 10.49661
0.095066 7.692934* 10.85257 8.487574*
The variables for Namibia are found to be non-stationary at their levels.

Table 8. First Differencing ADF Tests.

The variables were all found to be stationary at first differences.

b. Lag Selection Criterion.

Table 9. VAR Lag Order Selection Criteria.

The lag selection criterion selected for the model is one lag length for the FPE and SC and 4 lag lengths for HQ and AIC criterion. Because of few observation i.e. less than 60, one lag length is chosen.


Using the 1 lag length selected by the AIC the Johansen and Juselius (1990) cointegration tests Trace statistics shows 4 cointegrating equation and the Max-Engen value test also show 4 cointegrating equations. The ECM is estimated by normalising the cointegrating vector with respect to capital flight: The following normalising equation is obtained:

d. Namibia Long-run Equation

\[
\text{CFGDP} = 0.577 - 4.093 \text{Intrdiff} + 0.046 \text{BDGDP} + 0.320 \text{GDPgr}
\]

\[
[-1.150] \quad [2.958] \quad [-0.413]
\]

Table 10. Namibia Short-run Results

<table>
<thead>
<tr>
<th>D(CFGDP)</th>
<th>D(BDGDP)</th>
<th>D(GDPGR)</th>
<th>D(Intrdiff)</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.350675</td>
<td>0.264071</td>
<td>-0.240406</td>
<td>-0.096578</td>
</tr>
<tr>
<td>(0.2426)</td>
<td>(0.2744)</td>
<td>(0.18775)</td>
<td>(0.03726)</td>
</tr>
<tr>
<td>[-1.71683]</td>
<td>[0.61780]</td>
<td>[-1.28046]</td>
<td>[-2.59178]</td>
</tr>
</tbody>
</table>

e. Heteroscedasticity and Serial Correlation Tests.

Table 11. Heteroscedasticity and Serial Correlation Tests Results.

<table>
<thead>
<tr>
<th>Heteroscedasticity tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joint Test.</td>
</tr>
<tr>
<td>Chi-sq       Df         Prob</td>
</tr>
<tr>
<td>83.96216      80         0.3591</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Serial Correlation tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lags        LM-Stats    Prob</td>
</tr>
<tr>
<td>1           16.33955    0.4295</td>
</tr>
<tr>
<td>2           5.377486    0.9935</td>
</tr>
<tr>
<td>3           12.51493    0.7078</td>
</tr>
<tr>
<td>4           58.91812    0.0000</td>
</tr>
<tr>
<td>5           7.405838    0.9646</td>
</tr>
</tbody>
</table>

The VEC residual heteroscedasticity test with no cross term show that there is no heteroscedasticity. The VEC residual serial correlation test show that there is no serial correlation.

f. Stability Test.

No root lies outside the unit circle; the VAR satisfies the stability condition.

12. Model Interpretation of Results.

The interest rate differential is found to have a negative effect on capital flight and is statistically significant. As the interest
rate differential widens the net portfolio investment deteriorates leading to capital flight suggesting that capital inflows are not retained in the Namibian economy confirming Sylvanus and Ebson (2010) assertion that better rates in the LNS do not stall capital flight because of the dominance of South Africa. Capital flight is persistent due to better risks in South Africa. Therefore, higher interest rates in Namibia ultimately lead to capital flight in the long run. A percentage point increase in the interest rate differential in Namibia results in an increase in capital outflow of 4.1 per cent in the long run. In the short run, the impact is significant but minimal where a percentage point increase results in capital outflows increasing by a mere 0.097 per cent. Lower interest rates differentials tend to stem the capital flight exacerbated by a hype of higher domestic interest rates. Higher interest rate differentials attract investments from domestic investors which in turn is invested in South Africa causing capital flight due to generally better risk and returns in South Africa Sylvanus and Ebson (2010).

Higher interest rates are therefore expected to have a long run negative impact on capital inflows as they dampen domestic business confidence. In graph 7 the negative relationship is attested. Higher discount rates in Namibia than in South Africa have seen net portfolio investment achieving a negative balance. At a period where interest rate differentials have been high in Namibia vis-à-vis South Africa capital flight has resulted as seen as shown in the graph 7, in a negative net portfolio balance.

Graph 7. Namibia Portfolio Outflows/ Capital Flight and Interest Rate Differential with South Africa.

Source: Bank of Namibia Quarterly Bulletin.

a. Granger Causality Tests.

Table 12. Granger Causality Tests Results.

<table>
<thead>
<tr>
<th>Null Hypothesis</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>BDGDP does not Granger cause CFGDP</td>
<td>Reject</td>
</tr>
<tr>
<td>Intrdiff does not Granger cause CFGDP</td>
<td>Reject</td>
</tr>
<tr>
<td>GDPgr does not Granger cause CFGDP</td>
<td>Reject</td>
</tr>
</tbody>
</table>

The discount rate differential, GDP growth and the budget deficit are all found to determine capital flight in the short run thus rejecting the hypothesis of no granger causality though only discount rate differential is found to converge to its long run path in the short term.


The interest rate differential is found to have a negative impact on capital flight in that it leads to a deterioration of net portfolio investment balances in the balance of payments.
Graph 8. The Impact of a Shock in the Discount Rate Differential to Net Portfolio Investment.

Response of Capital Flight to Discount Rate Differential in Namibia

A negative shock to capital flight lead to higher GDP growth. Net portfolio investment inflow increase leading to higher GDP growth levels.

Graph 9. The Impact of a negative Shock in Capital Flight on GDP growth.

Response of GDP Growth to shocks in Capital Flight

14. Conclusion.

Higher interest rate differentials in Swaziland and Namibia vis-à-vis South Africa lead to capital flight in the long run. Hyppolyte Fotack and Leonce Ndikumana (2014) found that despite high interest rates and improved macroeconomic stability African countries have experienced high capital flight over the past decade. Neither the domestic interest rate nor the interest rate differential with the rest of the world have an impact on capital flight. They conclude that conventional theory of stemming capital flight through high interest rates is ineffective. Domestic higher interest rates are therefore seen to compromise economic growth. Sylvanus Ikhide and Ebson Uanguta (2010) presupposes capital flight with interest rates in the LNS lower than those in South Africa and focuses on the degree of monetary policy dependence of the LNS on South Africa interest rates, where they find a strong dependence. Lower interest rate differential though leads to a more stable net portfolio investment balance account as opposed to higher interest rate differentials due to the dominance of South Africa in the CMA and the subsequent high economic activity attracted to the net portfolio investment account due to higher interest rates in Namibia and Swaziland as opposed to South Africa.

Monetary policy in Namibia converges faster and significantly than in Swaziland in the short run to its long run equilibrium due to the different levels of development of the financial sector as seen in the short run results. Swaziland’s budget deficit is found to be explosive in the short term.

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Direct and Spill-Over Effects of Exchange Rate Volatility on Inflation in Swaziland: An Application of the Multivariate GARCH Model

Bongani P. Dlamini

Abstract

The aim of this paper is to distil both direct and spill-over effects on inflation due to exchange rate volatility using multivariate GARCH Models. Using monthly data from 1990 to 2015, the study adopted the BEKK MGARCH to ascertain the existence of direct and spill-over effects of the exchange rate volatility to inflation. The Diagonal BEKK parameterization of the multivariate GARCH (1, 1) model was adopted to capture the time varying correlation where it exists. The results show that there is evidence of both direct and spill-over effects running from the exchange rate to inflation, but not vice versa. The diagonal BEKK MGARCH results show that each variable is significantly and positively affected by news from its own innovations, however, it is only inflation which is affected by its own volatility innovation. The results further show that conditional correlation was stable and negative prior to 1996, and became highly volatile in the years after that, particularly during financial crises. The results from the CCC MGARCH model shows evidence of co-movement between the variables. Irrespective of the effects of exchange rates volatility on inflation, this study recommends that the country strive to retain the peg with the rand as the benefits outweighs the costs.

Key words: Direct and spill-over effects, exchange rate volatility, inflation, BEKK MGARCH

1.0 INTRODUCTION

The exchange rate is an important macroeconomic policy instrument. Changes in exchange rates have pronounced effects on tradable and non-tradable goods of the trading countries through effects on the relative prices these goods and services. The importance of exchange rates in influencing inflation rates cannot be overemphasised and this makes policy makers worry about the behaviour of both nominal and real exchange rates and also have active interest in their determination. (Obadan, 2007), states that the choice of an exchange rate regime coupled with the right level of the exchange rate tends to be perhaps the most critical decision in an open economy because of the impact of the exchange rate on economic performance, resource allocation, the wealth of citizens, standard of living, income distribution, the balance of payments and other economic aggregates. Thus, the stability of the exchange rate is important for price stabilization. In order to sustain price stability, most central banks intervene in the foreign exchange market
to smoothen short run fluctuations of the exchange rate. However, the effects of the central bank intervention in the foreign exchange market are not straightforward though the efficiency and depth of the foreign exchange market coupled with the nature and credibility of the interventions matter most (Adebayo, 2009).

Inflation appears today to be a world-wide phenomenon, and in many developing countries it has become more than a passing phenomenon. The reason may be that governments in these countries see inflation as a means of promoting growth. In fact, the long history and the way inflation developed in these countries led to different schools of thoughts to suggest that the entire area is subject to a type of inflation pressure peculiar to developing countries which needs a special theory to explain it. But the attempt to identify the underlying cause and cure of inflation in these countries has still remained a very controversial issue.

1.1 Monetary Policy and Exchange Rates Developments in Swaziland

1.1.1 Monetary Policy

The ultimate goal of monetary policy is the attainment of price stability. Likewise, Swaziland’s monetary policy objective as stated in the Central Bank Order is to promote price and financial stability, which ensures a stable and sound financial system, so as to foster financial conditions conducive to economic development in Swaziland. Monetary policy formulation is to a large extent influenced by the country’s membership to the Common Monetary Area (CMA).

The CMA agreement dictates both the monetary and exchange rate policies of the country. According to the agreement, Swaziland’s currency (the Lilangeni) is pegged on a one-to-one basis to the South African Rand (which freely floats with other major currencies). Keeping the exchange rate peg serves as an intermediate goal for monetary policy in Swaziland. To support this exchange rate policy of the currency board, Swaziland has to keep high levels of reserves equivalent to the conventional international standard of 3 months of import cover. Furthermore, there is free flow of capital within the CMA states predominantly from smaller states to South Africa and vice versa. Given the above conditions, the rule of ‘impossible trinity’ creeps in and dictates important monetary policy implications.

According to the ‘impossible trinity’ a country cannot have a pegged exchange rate regime, free capital mobility and autonomy in its monetary policy all at the same time. A country can only do two of these three things. Thus given the Swaziland case under the CMA, free movement of capital and the exchange rate peg imply loss of monetary independence for the country. Swaziland has little scope to undertake discretionary monetary policy in response to domestic developments. The movement of the central bank’s policy tool (the discount rate) has to mirror those of South Africa by implication of the dictatorship of the ‘impossible trinity’ even if Swaziland can wish otherwise, to avoid capital flight (Nxumalo, 2012).

Thus it can be safely said that Swaziland fall under a permanently fixed exchange
rate system because she belongs to a common monetary area. The fixed exchange rate has the disadvantage of precluding the use of monetary policy by the Central Bank of Swaziland. The high proportion of South African imports results in imported inflation, which is partially caused by the depreciation in the rand. The figure below shows movements in the South African Repo-rate and Swaziland discount rates.

Figure 1: South Africa and Swaziland Bank Rates Movements

![Graph showing movements in South African Repo-rate and Swaziland discount rates.](image)

Source: Central Bank of Swaziland

1.1.2 Exchange Rate Developments

The influence of exchange rate towards inflation itself depends on the choice of exchange rate regime in the country. Changes in the exchange rate will have a great impact on the economy as a whole. In the system of floating exchange rates, exchange rate fluctuations can have a strong impact on the level of prices through the aggregate demand (AD) and aggregate supply (AS). On the aggregate supply, depreciation (devaluation) of domestic currency can affect the price level directly through imported goods that domestic consumers pay. However, this condition occurs if the country is the recipient of international prices.

Non direct influence from the depreciation (devaluation) of currency against the price level of a country can be seen from the price of capital goods (intermediate goods) imported by the manufacturer as an input. The weakening of exchange rate will cause the price of inputs to be more expensive, thus contributing to a higher cost of production. Manufacturers will certainly increase the cost to the price of goods that will be paid by consumers. As a result, the price level aggregate in the country increases or if it continues it will cause inflation.

Swaziland’s monetary policy framework is influenced by her membership to the CMA which commands both the monetary and exchange rate policies of the country. Due to Swaziland’s membership in the CMA the country does not have independent monetary and exchange rate policies. Under this arrangement, the lilangeni remains tied to the South African rand at a one-to-one exchange rate.

Figure 2 shows that the exchange rate of the Lilangeni (E) to the Dollar ($) has been on an upward trend, depreciating since the 1980s. The exchange rate rose to E2.20 to US$1 in 1985 and was somehow stable around this rate until 1992. In 1993 it hit the E3 mark and stayed there for three years before depreciating further to E4.30 in 1996. It lost about 29 per cent in 1998 to average E5.53 to the Dollar and has been losing value until it averaged E10.45 in 2002 before it started to regain its value in 2003. Between 2002
and 2013 the local currency has seen ups and downs, gaining about 8 per cent of its value in the entire eleven-year period before losing about 55 per cent in 2015.

**Figure 2: Emalangeni/Dollar Nominal Exchange Rates Trends.**

Source: Central bank of Swaziland

### 1.2 Inflation Trends in Swaziland

South African prices are the dominant factor determining the inflation in Swaziland, even though there seems to be no major study supporting this assertion. However, despite this lack of empirical support, the link is intuitively obvious given that Swaziland’s currency, the Lilangeni, is linked directly to the South African Rand on a one-to-one. Moreover, the extremely strong trade links between the two countries, especially Swaziland’s dependence on imports from South Africa, and the fact that South African retailers operate in Swaziland with common pricing policies, reinforces the view that inflation rates in the two countries must be closely linked. By the end of 2015 approximately over 60 per cent of Swaziland’s exports were destined to, and more than 80 per cent of imports originated from South Africa.

During the 1980s Swaziland experienced high and volatile inflation, with annual headline inflation averaging at about 20 per cent in 1983 and 1987 as depicted by Figure 3. Besides controlling inflation by discouraging borrowing through higher interest, imported component of inflation is curbed by a strong Rand on the back of higher interest rates. Swaziland is also affected by South Africa’s imported inflation through imports from South Africa. Given that inflation targeting started in February 2000 in South Africa where the targeted inflation is the consumer price index excluding mortgages (CPIX) the period under review can therefore be separated into two policy regimes which are pre-inflation targeting and inflation targeting period.

The pre-inflation targeting policy regime period was characterized by targeting intermediate monetary aggregates like money supply growth to anchor inflation. Importance was given to price stability but the time in which price stability would be attained was not defined, hence in the eighties inflation peaked to above twenty per cent and the discount rate tracked behind. The monetary authorities reacted by increasing the discount rate in an attempt to contain inflation. As the discount rate increased, inflation responded by falling and the monetary authorities attained an allowance to reduce inflation. Inflation was again on an upward trend towards the nineties and again there was an increase in the discount rate.

The pre-inflation targeting policy regime period was characterized by tenuous
relationship between the discount rate and inflation because of the nature of monetary policy followed during the era. There are for instance instances where inflation was above the discount rate suggesting that the monetary authorities focus was on money supply growth which later translate into inflation. In such a policy regime there is chance of missing the control of inflation by focusing on intermediate monetary aggregates. During the South Africa’s pre-inflation targeting policy regime period from 1980 to 1999 Swaziland inflation averaged 11.8 per cent.

The inflation targeting policy regime which entails directly focusing on inflation gives a clearer relationship between the discount rate and inflation. The discount rate has always been above inflation and the discount rate under this policy regime reacts to changes in inflation in the context of the established inflation target range of 3 to 6 per cent. As a result of this inflation targeting policy regime in South Africa, Swaziland inflation for the period 2000 to 2015 averaged to a low 7 per cent.

Figure 3: Movements in inflation and Nominal Discount Rates

Source: Central statistical Office and Central Bank of Swaziland

1.3 Stylised Facts about Volatility of Exchange Rates

Financial time series such as, exchange rates, stock returns and other financial series are known to exhibit certain stylized patterns which are crucial for correct model specification, estimation and forecasting. Since the early work of Mandelbrot (1963) and Fama (1965), researchers have documented empirical regularities regarding these series. Due to a large body of empirical evidence, many of the regularities can be considered stylized facts. The most common stylized facts are the following:

- **Fat Tails**

  When the distribution of financial time series, such as exchange rate returns, is compared with the normal distribution, fatter tails are observed. This observation is also referred to as excess kurtosis. The standardized fourth moment for a normal distribution is 3, whereas for many financial time series, a value well above 3 is observed (Mandelbrot (1963) and Fama (1963, 1965) are the first studies to report this feature). Empirical evidence as depicted in Table 1 shows that in the case of Swaziland, exchange rate has a kurtosis value of 2.6 implying that most of the time the exchange rate movements are relatively small, but those occasional periods of turbulence occur with relatively large exchange rate changes. However, it has been also detected that the kurtosis is reduced under time aggregation.

- **Volatility Clustering and Persistence**

  The second stylized fact is periods of volatility clustering which means that large and small values in the log-returns tend to occur in
clusters. i.e., the large changes tend to be followed by large changes and small changes tend to be followed by small changes. This was first put across by Mandelbrot (1963). When volatility is high, it is likely to remain high and when it is low, it is likely to remain low. Volatility clustering is nothing but accumulation or clustering of information. This feature reflects on the fact that news is clustered over time (Engle, 2004).

For practical purposes, what is probably happening is that markets respond to new information with large price movements, and these high-volatility environments tend to last for a while after the initial shock. In the Swaziland exchange rate volatility, large spikes are not dispersed through the data set randomly, but they tend to cluster in specific spots and time periods, and tend to follow previous spikes.

• **Leverage Effects**

In financial markets, it is a stylized fact that a downward movement (depreciation) is always followed by higher volatility. This characteristic exhibited by percentage changes in financial data is termed leverage effects. According to past studies in this field, price movements are negatively correlated with volatility. Volatility is higher after negative shocks than after positive shocks of the same magnitude. This feature was first suggested by Black (1976) for stock returns. He attributed asymmetry to leverage effects. In this context, negative shocks increase predictable volatility in asset markets more than positive shocks. Another explanation of asymmetry is volatility feedback hypothesis. This in case of foreign market, a shock, which increases the volatility of the market, increases the risk of holding the currency (Longmore and Robinson, 2004).

The leverage effect can be simply understood as a negative relationship between returns and volatility which are driven by opposite forces. When negative news reach the market, volatility of the corresponding asset usually increases because of an uncertain future development. Contrarily, the negative news drives the prices down forming a negative return. The leverage effect thus seems less applicable for a country like Swaziland, due to its membership to the Common Monetary Area (CMA) coupled with the small size of the economy which renders it to lack a vibrant financial and money market.

• **Regular Events**

Regular events like holidays and weekends have effects on exchange rate volatility. Studies indicate that volatility of exchange rates returns or percentage changes is lower during weekends and holidays than during the trading week. Many studies attribute this phenomenon to the accumulative effects of information during weekends and holidays, e.g. Theobald and Price (1984).

Exchange rate developments in Swaziland are affected by unanticipated events in South Africa with a tendency to produce higher exchange rate volatility than anticipated events. For example, if the South African cabinet is being reshuffled when expectations of a dissolution are low, exchange rate volatility will be higher than if the cabinet had survived. If the cabinet survives when expectations of a dissolution are high,
exchange rate volatility will be higher than if the cabinet had dissolved. For example, the rapid acceleration in the depreciation of the rand exchange rate in December 2015 has widely been seen as evidence of South Africa’s poor macro policy and ultimately a reflection of worsened foreign investor sentiment following the controversial changes at the National Treasury, during this period the rand depreciated to a 16.6 to the dollar.

1.4 Statement of the Problem
As with many Central Banks world-wide, the Central Bank of Swaziland has the ultimate goal of attaining price stability and sound financial system that is conducive to sustainable economic growth. In recent periods, concerns have been raised about the effectiveness of monetary policy due to eminent inability to deal with inflation episodes mainly due to the fact that a lot of macroeconomic aggregates are interlinked with inflation, which tends to be very sensitive to developments in the exchange rate. Exchange rate volatility spill-overs imply that the international currency markets in different economies have achieved some level of integration into other domestic markets like the goods and services markets.

It further suggests similarity in the underlying economic, institutional structures and that the shocks faced by these domestic markets and the transmission of these shocks through the currency markets are analogous. This paper therefore examines the direct and spill-overs effects of exchange rate volatility on inflation in Swaziland.

1.5 The Importance of the Study
Exchange rate being one of the main macroeconomic indicators, its changes affects exports and imports through changes in their relative prices. Dornbush (1976), indicate that the exchange rate is identified with the relative prices of goods and thus is a determinant of the allocation of world expenditure between domestic and foreign goods. Appreciations of exchange rate cause any trade balance deficit and it affects particularly agricultural products.

Therefore, the importance of the study is to explore the exchange rate volatility on inflation. The liquidity of foreign exchange market is vital for managing exchange rate in a way that is consistent with inflation targeting framework to ensure exchange rate stability. In terms of the relationship between exchange rates and inflation, the most frequently explored issues are how inflation rates react to volatility in exchange rates. Other questions that are crucial to this study are: Is the exchange rate fluctuation a major cause of inflation in Swaziland? From the experience of Swaziland, what kind of relationship (the short and long run) is between exchange rates volatility and inflation during the review period?

1.6 Objective of the Study
The overall objective of this paper is to distil both direct and spill-over effects on inflation due to exchange rate volatility and come up with policy implications based on the empirical findings. The specific objectives of this work are:
   i) To analyse conditional heteroskedasticity within multivariate
GARCH, distinguishing direct effects from spill-over effects of exchange rate volatility in Swaziland.

ii) To provide recommendations of how to contain the effect of exchange rate volatility on inflation.

2.0 LITERATURE REVIEW

2.1 Theoretical Literature

There is very limited literature on the direct and spill-over effects of exchange rate volatility on inflation, however this paper will limit itself to the most related literature. The first part of this chapter begins by presenting the theoretical basis for the link between exchange rate and domestic prices. According to Menon (1995), exchange rate pass through (ERPT) is defined as “the degree to which exchange rate changes are reflected in the destination currency prices of traded goods”. Furthermore, the pass-through relationship draws its theoretical underpinning from the purchasing power parity (PPP) theory that assumes a full impact from changes in exchange rate to domestic prices. In other words, the PPP theory argues that any changes in exchange rates will translate into proportional movements in domestic prices.

Interest in analysing the pass-through relationship began to grow following the collapse of the Bretton Woods system, and was further enhanced by the muted response of the US import prices to large swings in the US dollar during the 1980s, and the failure of inflation rates in industrial countries to accelerate after a major devaluation in the currencies of these countries in 1992 (Bache, 2006). More recently, the low responses of inflation rates in many East Asian countries after the financial crises of 1997-98 and in other developing economies (e.g. Mexico and Argentina) have sparked further research that aims to understand the adjustment puzzle or the incomplete pass-through.

Early literature on the exchange rate pass-through was based on microeconomic foundation that evolved mainly during the 1980s (Bache, 2006). The large subset of the early literature has focused on the analyses of the ERPT at disaggregated micro level (industry level) as it is more appropriate to precisely isolate the effect of the exchange rate on prices of the products (Ghosh and Rajan, 2007). Nonetheless, ERPT is also more often analysed at the aggregated macro level, such as analysing the effect of ERPT on the consumer price index, which is more relevant to monetary policy makers.

Exchange rate can influence inflation directly and indirectly. The direct channel is through the prices of traded final goods and the prices of imported intermediate goods. The indirect channel is through the competitiveness of goods in the international markets and inflation expectations. Both channels become more important with an increase in the degree of openness in the economy. Most of the analytical frameworks that underlie the empirical estimation of the influence of exchange rate on aggregate consumer prices were generally based on microeconomic foundations. The reduced form for the pass-through equation defines the price level as a function of exchange rate plus other hypothesised determinants
of prices. For example:

$$P_t = f(S_t, P_t^*, Y_t)$$

where $P_t$ is the domestic CPI, $S_t$ is the exchange rate, $P_t^*$ is the trading partner CPI, and $Y_t$ is the output gap (Bache, 2006).

As per the empirical findings, the pass-through from exchange rate to inflation rate is incomplete even in the long run, and the exchange rate elasticity of inflation is less than the exchange rate elasticity of import prices. Generally, the size and the speed of adjustments decline along the different price stages; the impact of exchange rate changes is highest on import prices, then producer prices, and lowest on consumer prices. Some additional factors were advanced in the literature to explain the lower response of inflation rate relative to other prices in the distribution chain with respect to changes in exchange rate. The majority of these factors are primarily microeconomic-based, such as the composition of the CPI basket, distribution costs of tradable goods, availability of domestic substitutes, and the optimal pricing strategies of firms. Other factors include demand policies (monetary and fiscal policies) and institutional factors like price regulations, foreign exchange rate controls, and enhanced global competition.

It has also been revealed that the extent of ERPT to inflation rate is generally larger in developing countries compared to more developed ones. Such a difference is more often attributed to factors like the Baumol and Balassa-Samuelson effect, a high share of traded goods, high import content, and limited domestic substitutes which generally reflect the characteristics of small and more open economies. From a policy perspective, given the relatively high ERPT into inflation rate in developing countries the implication is that the monetary authorities in these countries should take into account the underlying relationship between exchange rate and inflation rate and the factors determining such relationship when designing the monetary and exchange rate policies for their economies (Bache, 2006).

2.2 Empirical Literature

Since the global adoption of floating exchange rate system in 1973, literature on exchange rate volatility has grown tremendously. A new set of theories evolved, explaining exchange rate behaviour and how exchange rate dynamics affect macroeconomic variables as well as several attempts to examine volatility of asset prices. Over the years, several studies have applied the GARCH type of models to examine volatility in relation to trade, commodity prices and exchange rates.

Subsequently, research moves away from economic factors to explain volatility and focuses almost entirely on the new ARCH-type of models and their extensions. To model volatility based mainly on the information contained in the historical volatility, Engle (1982) developed the autoregressive conditional heteroscedasticity (ARCH) model, which was later extended into the generalized ARCH (GARCH) model by Bollerslev (1986). From there on, a multitude of models with different specifications have been constructed in order to take
into account the features observed in the financial markets. Bollerslev et al. (1992) and Palm (1996) provided an extensive overview over the earlier family of GARCH models, while Bauwens et al. (2006) looked in particular at the multivariate extensions of the GARCH model.

In order to take into account dependencies between time series in a multivariate setting, Bollerslev (1990) extended the GARCH to include a constant conditional correlation factor, thus obtaining the full covariance matrix, rather than just the single variances as in the standard GARCH structure. Later, Engle and Kroner (1995) began modelling the entire covariance matrix in a dynamic way with the Baba, Engle, Kraft and Kroner (1990) model. While more accurate, a drawback of this model is its large number of parameters which make it impractical for larger data sets; therefore, the more parsimonious scalar and diagonal versions of the BEKK model are usually preferred.

More recently, Engle (2002) extended Bollerslev’s Constant Conditional Correlation (CCC) model to allow the correlations to take a dynamic structure, thus accounting for the time-variation in the correlations between the time series. The properties of this dynamic conditional correlation model (DCC) are more extensively discussed by Engle and Sheppard (2001). At the same time, Tse and Tsui (2002) developed a similar model to the DCC. The main advantage of the models by Engle (2002) and Tse and Tsui (2002) over other correlation models are their parsimony; in its simplest form, only two factors govern the correlation process of the DCC model and thus define the entire matrix, no matter the number of assets. This comes of course at the cost of flexibility as it assumes that all correlations are influenced by the same coefficients.

The GARCH model has dominated the literature on volatility since the early 1980s. The model allows for persistence in conditional variance by imposing an autoregressive structure on squared errors of the process. Engle (1982) noted that although OLS maintains its optimality properties, the maximum likelihood is more efficient in estimating the parameters of ARCH models. Similarly, Lastrapes (1989) observe that ARCH provides a good description of the exchange rate process and that it is broadly consistent with exchange rates behavior. Bollerslev (1990) however introduces a generalized ARCH (GARCH) process that allows for a more manageable lag structure. The ARCH/GARCH literature had recently focused on analyzing volatility of high-frequency data and their benefits.

Andersen and Bollerslev (1998) examined the DM/USD intra-day volatility based on a one-year sample of five minutes returns with emphasis on activity patterns, macroeconomic announcement and calendar effects. They found that market activity is correlated with price variability and that scheduled releases occasionally induce large price changes, but the associated volatility shocks appear short lived. Bollerslev (1990) proposed a multivariate time series model with time-varying conditional variances and co-variances but with conditional correlation. The validity of the model was
illustrated for a set of five European/US dollar exchange rates.

Fang and Miller (2002) also carefully studied the impact of currency depreciation on the stock market in South Korea during the Asian financial crisis. As well as using the unit root test, the cointegration test, and the Granger test. As Granger, Huang and Yang (2000) did, they also used the GARCH-M model on daily data from 03/01/1997 to 21/12/2000, to examine the volatility effect. It is suggested that the stock market in South Korea will be significantly affected by exchange rates. More importantly, three distinct channels through which exchange rates affect stock prices were found. Firstly, stock market returns would be influenced by currency changes. Secondly, there is also a positive relationship between stock market returns and exchange rate volatility. Thirdly, exchange rate volatility also causes an increase in stock market volatility.

3.0 METHODOLOGY

The review of literature had shed some light on the right approach to the methodology of the study on the direct and spill-over effects of exchange rate volatility on inflation in different economies. The review also helped in suggesting a suitable model for this analysis, which are the multivariate GARCH and its extensions. The sample of this study consists of monthly data from 1990 up to 2015.

3.1 Measure of Volatility

Volatility in the exchange rate has varying economic consequences. The first of these is the negative impact exchange rate volatility has on confidence as it makes investment planning and decision difficult. There are numerous approaches in literature to measure volatility, however this study will limit itself to the generalised autoregressive conditional heteroskedasticity proposed by Bollerslev (1986).

3.2 The GARCH models

According to Engle (1995), one of the drawbacks of the ARCH (Auto Regressive Conditional Heteroscedasticity) model specification proposed by Engle, (1982), was that it looked more like a moving average specification than an autoregression. Hence a new idea was to include the lagged conditional variance terms as autoregressive terms, hence the Generalised ARCH (GARCH (p, q)), proposed by Bollerslev (1986), came into being and is specified as follows:

$$
\sigma_t^2 = \mu_0 + \sum_{i=1}^{p} \gamma_i \sigma_{t-i}^2 + \sum_{j=1}^{q} \beta_j \epsilon_{t-j}^2,
$$

which says that the value of the variance now depends both on past values of the shocks, which are captured by the lagged squared residual terms, and on past values of itself, which are captured by the lagged terms. The autoregressive root which governs the persistence of volatility shocks is the sum of $\mu + \gamma$. In many applied settings this root is close to unity, so that shocks die out rather slowly.

3.2.1 Measuring volatility spill-overs

The drawback of the univariate GARCH model is that it is not appropriate when volatility spill-overs are considered. To overcome this limitation, different authors have come up with different approaches, for example,
Hamao et al. (1990), Theodosiou & Lee (1993), and Kim (2001), among others, have applied a two-stage approach. In the first stage, a GARCH model for all of the series is estimated to get standardized residuals and squared standardized residuals. In the second stage, the standardized and squared standardized residuals are substituted into the mean and volatility equations of the exchange rate GARCH model. However, this study will limit itself to the multivariate GARCH Models introduced by Bollerslev et al. (1988).

3.3 Multivariate GARCH Models (MGARCH)

An alternative but more efficient and powerful procedure to capture volatility spill-overs is to employ the multivariate GARCH (MGARCH) model. An MGARCH model helps in defining the dynamic relationships between the variables. Moreover, it captures any possible reciprocal volatility spill-over effects between any pairs of the variables. An important feature that multivariate GARCH models must satisfy is that the covariance matrix should be positive definite. There are several different multivariate GARCH models, however this paper will limit itself to Bollerslev et al. (1988) half-vec (vech) MGARCH model which is called Vec model.

3.4 The Vec Model

This model is more general compared to other subsequent formulations. In the Vec model, every conditional variance and covariance is a function of all lagged conditional variances and covariances, as well as lagged squared returns and cross-products of returns. The model can be expressed as shown below:

\[
vech(H_t) = c + \sum_{j=1}^n A_j \text{vech}(\Sigma_{t-j}\Sigma_{t-j}') + \sum_{j=1}^n B_j \text{vech}(H_{t-j}),
\]

Where is an operator that stacks the columns of the lower triangular part of its argument square matrix, is the covariance matrix of the residuals. The fact that the parameter space of the above MGARCH model has a large dimension and that the estimation procedure requires numerous iterative calculations explains the limited empirical application of the half-vec model. A number of other alternative procedures have been proposed to reduce the parameter space in order to ensure computational feasibility and suitable properties of the conditional covariances, which includes the Baba, Engle, Kraft and Kroner (1990) BEKK-MGARCH and Bollerslev (1990)’s constant conditional correlation (CCC) MGARCH models. In this study, the full BEKK-MGARCH model will be used to distinguish direct from spill-over effects of exchange rate volatility on inflation. Further empirical analysis will be done via the diagonal BEKK-GARCH model and the CCC-MGARCH models which are outlined below.

3.5 BEKK-GARCH models

To ensure positive definiteness, a new parameterization of the conditional variance matrix \(H_t\) was defined by Baba, Engle, Kraft and Kroner (1990) and became known as the BEKK model, which is viewed as another restricted version of the VEC model. It achieves the positive definiteness of the conditional covariance by formulating the model in a way that only squared terms are included in the right hand side of the model, which guarantees the positive value of the variance. The parameters of this model can be configured in different ways, allowing the BEKK model to have a different degree
of restrictions. The most restrictive one is the scalar BEKK, with a and b as scalars. A diagonal BEKK has diagonal matrices as parameters and the full BEKK uses $n \times n$ parameter matrices. The general form of the full BEKK model is as follows:

$$H_t = CC' + \sum_{j=1}^q \sum_{k=1}^K A'_{kj} \otimes \otimes_{t-j} A_{kj} + \sum_{j=1}^p \sum_{k=1}^K B'_{kj} H_{t-j} B_{kj},$$

where $A_{kj}$, $B_{kj}$, and $C$ are $N \times N$ parameter matrices, and $C$ is a lower triangular matrix. The purpose of decomposing the constant term into a product of two triangular matrices is to guarantee the positive semi-definiteness of $H_t$. Whenever $K > 1$ an identification problem would be generated for the reason that there is not only a single parameterization that can obtain the same representation of the model. When $p = q = 1$ the model becomes a BEKK MGARCH (1,1) and takes the form:

$$H_t = CC' + A_{t-j} \otimes A_{t-j}' + BH_{t-j} B',$$

The advantage of the BEKK model is that by definition is positive. The matrices of parameters are multiplied with an arbitrary symmetrical matrix and the transpose of the parameter matrix. This ensures that each term in the model becomes positive semi-definite. In addition, the BEKK model is said to be stationary if all eigenvalues of the matrix have a modulus less than one (Engle & Kroner, 1995).

$$\sum_{j=1}^q \sum_{k=1}^K A_{kj} \otimes A_{kj} + \sum_{j=1}^p \sum_{k=1}^K B_{kj} \otimes B_{kj}$$

For the purpose of this paper, since there are two variables, exchange rate and inflation, and one of the major objective is to capture spill-over effects, the full bivariate BEKK MGARCH (1,1) will be applied in which the first variable will be the exchange rate while the second variable will be inflation, thus the equation can be written as:

$$0 = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{21} \\ \gamma_{12} & \gamma_{22} \end{bmatrix} \begin{bmatrix} u_{1,t-1} \\ u_{2,t-1} \end{bmatrix} + \begin{bmatrix} \beta_{11} & \beta_{12} \\ \beta_{21} & \beta_{22} \end{bmatrix} \begin{bmatrix} \sigma_{01}^{2} & \sigma_{12}^{2} \\ \sigma_{21}^{2} & \sigma_{22}^{2} \end{bmatrix} \begin{bmatrix} u_{1,t-1} \\ u_{2,t-1} \end{bmatrix}$$

When the diagonal BEKK is decomposed into its univariate GARCH models, they are expressed as:

$$\sigma_{1,t}^{2} = a_{11}^{u} + \gamma_{11} u_{1,t-1}^{2} + 2\gamma_{12} y_{1,t-1} u_{1,t-1} u_{2,t-1} + \gamma_{21} u_{2,t-1}^{2} + 2\gamma_{22} y_{2,t-1} u_{1,t-1} u_{2,t-1}$$

$$\sigma_{2,t}^{2} = a_{22}^{u} + \gamma_{22} u_{2,t-1}^{2} + 2\gamma_{21} y_{2,t-1} u_{1,t-1} u_{2,t-1} + \gamma_{12} u_{1,t-1}^{2} + 2\gamma_{11} y_{1,t-1} u_{1,t-1} u_{2,t-1}$$

The first equation ($\sigma_{1,t}^{2}$) and the last equations ($\sigma_{2,t}^{2}$) above are the conditional variance equations for exchange rate and inflation respectively, while the middle equation ($\sigma_{12, t}^{2}$) captures the relationship between the two variables. The parameters $\gamma_{11}$ and $\gamma_{22}$ illustrate the ARCH effect in the two variables. These parameters measure the effect of a previous shock on the volatility of the same variable. Similarly, $\beta_{11}$ and $\beta_{22}$ are GARCH parameters capturing the degree of volatility persistence in each variable.

On the ARCH parameters, the coefficients of captures the direct effects of a previous shock in each variable, either to itself or the other variable. For example, in the first equation captures the direct effect of inflation on the exchange rate volatility,
which is very likely to be insignificant for Swaziland. Similarly, in the last equation captures the direct effect of exchange rate volatility on inflation. On the other hand, the coefficients of \( u_{1,t-1}u_{2,t-1} \) captures the spill-over effects. On the GARCH parameters, the coefficients \( \beta_{ii} \) measures the direct and spillover effects of the last period’s variance in one variable on the current variance in the other variable. The major difference of the full BEKK-MGARCH from the diagonal BEKK-MGARCH is that there are zero’s in the off-diagonal A and B matrices of the later. In its matrix form it is represented as:

\[
\begin{bmatrix}
\sigma_{11,t}^2 & \sigma_{12,t}^2 \\
\sigma_{21,t}^2 & \sigma_{22,t}^2
\end{bmatrix} = \begin{bmatrix}
a_{11} & 0 \\
a_{21} & a_{22}
\end{bmatrix} \begin{bmatrix}
a_{11} & a_{12} \\
a_{21} & a_{22}
\end{bmatrix} + \begin{bmatrix}
\gamma_{11} & 0 \\
\gamma_{21} & \gamma_{22}
\end{bmatrix} \begin{bmatrix}
u_{1,t-1}^2 & \nu_{2,t-1}^2 \\
\nu_{1,t-1}^2 & \nu_{2,t-1}^2
\end{bmatrix}.
\]

Furthermore, the diagonal BEKK representation does not allow for volatility transmissions. When the diagonal BEKK is decomposed into its univariate GARCH models, they are expressed as:

\[
\sigma_{11,t}^2 = a_{11} + \gamma_{11}u_{1,t-1}^2 + \beta_{11}\sigma_{1,t-1}^2,
\]

\[
\sigma_{22,t}^2 = a_{22} + \gamma_{22}u_{2,t-1}^2 + \beta_{22}\sigma_{2,t-1}^2.
\]

The right hand side consists of the conditional correlation matrix \( R \) that is time invariant, meaning that \( R_t = R \). \( D_t \) is a diagonal matrix of \( \{h_{1,t} \ldots h_{n,t}\} \), such as,

\[
D_t = \text{diag}([\sqrt{h_{1,t}}, \ldots, \sqrt{h_{k,t}}]) \text{ where each follows a univariate GARCH process. The conditional correlation matrix is given by } R = [\rho_{i,j}],
\]

and the non-diagonal elements of \( H_t \) are

\[
|H_{t}|_{i,j} = \sqrt{h_{i,t}}\sqrt{h_{j,t}}\rho_{i,j} \quad \forall \ i \neq j
\]

Since the return process \( r_{i,t} \) is modeled with a univariate approach, the desired conditional variances can be expressed in vector form;

\[
h_t = C + \sum_{j=1}^{q} A_j \epsilon_{t-j}^2 + \sum_{j=1}^{p} B_j h_{t-j}^2.
\]

The first term \( C \) is a vector of the intercepts with a size of \( n \times 1 \) and the matrices of the coefficients are \( n \times n \). Furthermore, \( \epsilon_{t-j}^2 = \epsilon_{t-j} \otimes \epsilon_{t-j} \). The advantage of the CCC model is that the computational procedure is more easily performed, because the correlation matrix \( |H_t|_{i,j} \) is constant. However, this means that the model may be too restrictive (Orskaug, 2009). Again since we have two variables we estimate a bivariate CCC-MGARCH (1, 1) model of the following form;

\[
\begin{bmatrix}
\sigma_{1,t}^2 \\
\sigma_{2,t}^2
\end{bmatrix} = \begin{bmatrix}
a_{11} & 0 \\
a_{22}
\end{bmatrix} \begin{bmatrix}
a_{11} & a_{12} \\
a_{21} & a_{22}
\end{bmatrix} \begin{bmatrix}
u_{1,t-1}^2 & \nu_{2,t-1}^2 \\
\nu_{1,t-1}^2 & \nu_{2,t-1}^2
\end{bmatrix} + \begin{bmatrix}
\gamma_{11} & 0 \\
\gamma_{21} & \gamma_{22}
\end{bmatrix} \begin{bmatrix}
u_{1,t-1}^2 & \nu_{2,t-1}^2 \\
\nu_{1,t-1}^2 & \nu_{2,t-1}^2
\end{bmatrix} + \begin{bmatrix}
\beta_{11} & 0 \\
\beta_{21}
\end{bmatrix} \begin{bmatrix}
\sigma_{1,t-1}^2 \\
\sigma_{2,t-1}^2
\end{bmatrix}.
\]

After decomposing into its univariate GARCH models, they are expressed as;

\[
\sigma_{1,t}^2 = a_{11} + \gamma_{11}u_{1,t-1}^2 + \beta_{11}\sigma_{1,t-1}^2
\]

\[
\sigma_{2,t}^2 = a_{22} + \gamma_{22}u_{2,t-1}^2 + \beta_{22}\sigma_{2,t-1}^2.
\]

3.6 The CCC MGARCH Model

The Constant Conditional Correlation model was suggested by Bollerslev (1990), where the time varying covariance matrix \( H \) at time \( t \) is expressed as

\[
H_t = D_tR_tD_t,
\]
The first two equations above represent the conditional variance equations of the two variables (exchange rate and inflation), while the last equation stands for the conditional covariance. Under the assumption of the CCC the dynamics of the covariance is determined by the dynamics of the two conditional variances. The parameters $Y_{11}$ and $Y_{12}$ illustrate the ARCH effect in the two variables, i.e. the effect of a previous shock on the volatility of the same variable, and $\beta_{11}$ and $\beta_{22}$ are GARCH parameters capturing the degree of volatility persistence in each variable. Since the CCC-MGARCH (1,1) model does not allow for cross-sectional dynamics across series, the co-movement between the variables is captured by conditional correlations $P_{12}$, which is calculated as

$$\rho_{12} = \frac{\sigma_{12,t}^2}{\sigma_{1,t} \sigma_{2,t}}.$$ 

3.7 Lag order selection: AIC and BIC

An important step before making the estimations is to determine the lag order of the models. Theoretically one can do this using the autocorrelation function, but in practice this may be difficult. A more formal way is to use an information criterion and choose the order that minimizes the criterion value. Two common criteria are the Akaike Information Criterion (AIC) and the Bayesian Information Criterion (BIC) which will be used in this study.

3.9 Diagnostic Checks

Once the model has been estimated, it will be subjected to various diagnostic tests, which assess the stochastic properties of the model, such as residual autocorrelation, heteroskedasticity, normality, and model stability.

3.10 Data

All the data to be used in this study are secondary data which will be sourced from the Central Bank of Swaziland (CBS) and the Central Statistical Office (CSO).

4.0 FINDINGS AND DISCUSSIONS

4.1 Preliminary data analysis

Preliminary statistics in Table 1 reveal that the normality hypothesis cannot be accepted for both the variables (exchange rate and inflation). This non-normality for both variables might be due to the low kurtosis (i.e. kurtosis < 3). Both variables, exchange rate and inflation, have data that is positively skewed as depicted by their skewness values being greater than zero and positive (0.3455 and 0.4970). The non-normality of the variables is also evidenced by the probability of the JB statistic, which is lower than 5 per cent. Furthermore, the higher standard deviation for inflation implies that it is more volatile than the exchange rate. In lag length selection, the two different tests indicate that the GARCH (1,1) model is to be used in the estimations.
<table>
<thead>
<tr>
<th></th>
<th>EXCH_RATE</th>
<th>ACT_INFL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>6.619327</td>
<td>7.956731</td>
</tr>
<tr>
<td>Median</td>
<td>6.785600</td>
<td>7.450000</td>
</tr>
<tr>
<td>Maximum</td>
<td>14.93750</td>
<td>15.50000</td>
</tr>
<tr>
<td>Minimum</td>
<td>2.524600</td>
<td>2.600000</td>
</tr>
<tr>
<td>Std. Dev.</td>
<td>2.686089</td>
<td>3.035368</td>
</tr>
<tr>
<td>Skewness</td>
<td>0.345511</td>
<td>0.496998</td>
</tr>
<tr>
<td>Kurtosis</td>
<td>2.640611</td>
<td>2.244268</td>
</tr>
<tr>
<td>Jarque-Bera</td>
<td>7.886736</td>
<td>20.26908</td>
</tr>
<tr>
<td>Probability</td>
<td>0.019383</td>
<td>0.000040</td>
</tr>
<tr>
<td>Sum</td>
<td>2065.230</td>
<td>2482.500</td>
</tr>
<tr>
<td>Sum Sq. Dev.</td>
<td>2243.888</td>
<td>2865.386</td>
</tr>
<tr>
<td>Observations</td>
<td>312</td>
<td>312</td>
</tr>
</tbody>
</table>

**4.1.1 Exchange rate and inflation volatility**

The GARCH (1, 1) model approach is used to assess the presence of volatilities in the nominal exchange rate and inflation. Results are presented in the appendices A and B. The DW statistic is close to the rule of thumb (close to 2) in both estimations, which shows evidence of no serial correlation.

From the estimations, the variables of interest are the sums of the coefficients of the ARCH (RESID (-1)^2) and the GARCH (GARCH(-1)). These coefficients are statistically significant and their sum is close to one. This implies that volatility of both the exchange rate and inflation is persistent, meaning that the volatility today is close to the volatility in the period before. The volatility clustering is obvious from the Figure 5. Similar to most financial and economic time series variables, the exchange rate exhibits significant periods of high volatility followed by relatively more tranquil periods of low volatility.

**Figure 4: Exchange Rate Volatility**

From Figure 5, evidence of volatility is observed in the periods around 1998, 2002 and 2008. Unsurprisingly, these periods correspond with 1998 Asian crisis, 2002 dot com bubble and terrorism crisis in the United States, and the 2008 world financial crisis. Furthermore, most volatility was observed from 2001 when South Africa introduced inflation targeting regime, which is associated with currency volatility. The volatility of inflation also follows that of exchange rate, high in times of financial turbulences, and otherwise calm as shown in figure 6.
otherwise calm as shown in figure 6.

times of financial turbulences, and follows that of exchange rate, high in volatility. The volatility of inflation also which is associated with currency observed from 2001 when South Africa today is close to the volatility in the 2008 world financial crisis.

period before. The volatility clustering is obvious from the Figure 5. Similar to periods around 1998, observed in the periods before 1998 Asian 2002 and 2008. Unsurprisingly, these periods correspond with 1998, 2002 and 2008.

From Figure 5, evidence of volatility is 0.000 0.014 0.005

\[ C = \begin{bmatrix} 1.460^* & -1.298^* \\ 0.000 & 0.001 \end{bmatrix}, \quad A = \begin{bmatrix} 0.560^* & 0.157^* \\ 0.403^* & 0.276^* \end{bmatrix}, \]

\[ B = \begin{bmatrix} 0.216^* & 0.257^* \\ 0.225^* & 0.756^* \end{bmatrix} \]

\[ B: ^*, **, *** Denotes significance at the 1%, 5% or 10% level respectively \]

To check the stability and stationarity of the models, the roots of the estimated BEKK and the eigenvalues for the variance equation should be less than unity in modulus indicating convergence of the model and that the estimated \( H_t \) is covariance stationary. The eigenvalues were found to be [0.869502, 0.3459516, 0.01410605, 0.005895599], and are all less than unity in absolute values.

The models are also identified as observed by the upper diagonal coefficients of matrices A12 and B12, which are strictly positive. The positive definiteness of the variance-covariance matrix is therefore verified. Apart from the non-normality indicated before, the models are adequately specified. The diagonal elements in matrix A show the extent of the correlation of the conditional variances of the exchange rate and inflation rate with past squared residuals, while the off-diagonal elements show the contemporaneous impact on the conditional variance of one of the variables originated by

Figure 5: Inflation and Exchange Rates

Volatility

4.2 Spill over effects of exchange rate volatility on inflation

The above analysis has shown that both exchange rate and inflation volatilities are quite persistent in Swaziland. It is imperative to find out how the volatility of one variable affects the other variable. As previously stated that Swaziland is a member of the CMA, there cannot be observable, if any, spill-over from inflation to exchange rate. However, direct and indirect spill-overs can be observed from exchange rate to inflation. The multivariate GARCH is the most appropriate model to capture direct and spill over effects of exchange rate volatility to inflation.

4.2.1 Full BEKK MGARCH

Since we are interested in volatility spill-over, we use multivariate GARCH models to estimate simultaneously the means and variances of the variables to analyse volatility and its transmission. Specifically, we use the multivariate full BEKK model, which does not impose the restriction of constant conditional correlations across the commodity shocks. This procedure allows an examination of covariance spill-overs across commodities. Therefore, in our case the BEKK model is more advantageous than other models which estimates correlations but are unable to address spill-overs. The following matrices display the parameters of the estimated full BEKK model.
past squared shocks on the other. Similarly, the diagonal elements of B indicate the association of current conditional volatility with own past conditional variances, while the off-diagonal elements show the volatility spill-overs. The parameters from the estimated matrices are then substituted to the BEKK equations to obtain Table 2 below.

Table 2: Full BEKK MGARCH Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>Exchange Rate ($\sigma_{i,t}^2$)</th>
<th>Inflation ($\sigma_{2,t}^2$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$u_{1,t-1}$</td>
<td>0.560*</td>
<td>0.157**</td>
</tr>
<tr>
<td>$u_{1,t-1}u_{2,t-1}$</td>
<td>0.451*</td>
<td>0.607*</td>
</tr>
<tr>
<td>$u_{2,t-1}$</td>
<td>0.162</td>
<td>0.076*</td>
</tr>
<tr>
<td>$\sigma_{1,t-1}$</td>
<td>0.047**</td>
<td>0.066*</td>
</tr>
<tr>
<td>$\sigma_{12,t-1}$</td>
<td>0.24</td>
<td>0.389**</td>
</tr>
<tr>
<td>$\sigma_{2,t-1}$</td>
<td>0.097</td>
<td>0.572*</td>
</tr>
</tbody>
</table>

NB: *, **, *** Denotes significance at the 1%, 5% or 10% level respectively

From the table above we can deduce evidence of own-market effects on ARCH and GARCH terms for both variables. As previously stated, in the ARCH component (previous shocks); direct effects are captured by the coefficient of $u_{i,t-1}$, while spill-over effects are captured by the coefficient of $u_{1,t-1}u_{2,t-1}$. In the GARCH component.

(a) The Exchange Equation

From the ARCH elements of the exchange rate equation, the coefficient of $u_{i,t-1}^2$ is significantly and positively affected by news (unexpected shocks) from its own innovations, without being affected either directly or by volatility spill-overs from inflation. That is evidenced by the insignificant coefficients of the direct and spill-over effects in the exchange rate equation. On the volatility effects (GARCH), the results show that there are significant effects on own past volatility than from inflation in the exchange rate. That is in line with the spirit of the currency peg, as the country’s inflation has practically no effect on the exchange rate volatility.

(b) The Inflation Equation

On the inflation equation all the variables were found to be significant. There is evidence of direct effect from exchange rate volatility on inflation, as well as evidence of high spill-over effect from exchange rate to inflation. That could be explained by the currency peg with the CMA as most imports come from South Africa, hence the direct effect could be to the South African inflation, and hence to Swaziland. On the volatility effects (GARCH), the results show that there are significant effects on own innovation volatility as well as direct and spill-over effects from the exchange rate. That means the past volatilities of inflation have both direct and spill-over effects on the current exchange rate in Swaziland.

4.3 Diagonal BEKK MGARCH

The Diagonal BEKK parameterization of the multivariate GARCH (1,1) model was adopted to capture the time varying correlation where it exists. The major difference of the diagonal BEKK from the full BEKK is that it has zero’s in the off-diagonal estimate, rendering it unable to capture spill-over effects, furthermore there are seven parameters to estimate compared to
eleven in the full BEKK. The following are the matrices from the results of the diagonal BEKK:

\[ C = \begin{bmatrix} 0.082^* & 0 \\ 0 & 0.443^* \end{bmatrix}, \quad A = \begin{bmatrix} 0.990^* & 0 \\ 0 & 0.968^* \end{bmatrix}, \]

\[ B = \begin{bmatrix} 0.10 & 0 \\ 0 & 0.174^{**} \end{bmatrix}. \]

**NB:** *, **, *** Denotes significance at the 1%, 5% or 10% level respectively

All of the parameters, save for \( \beta_{11} \) are significant. From these results, since the coefficients of \( u_{it-1} \) are significant and positively affected by news (unexpected shocks) from its own innovations (ARCH term). However, it is only inflation which is affected by its own volatility innovation (GARCH term). Generally, since the sums of the ARCH and GARCH parameters are close to unity, which shows that volatility is persistent for both variables. To determine whether the model estimates are covariance stationary or not, the condition presented in the theoretical description of the BEKK model is used. Let the Kronecker product \( (K) \) of A and B be;

\[ K = \begin{bmatrix} 0.990^* & 0 \\ 0 & 0.968^* \end{bmatrix} \otimes \begin{bmatrix} 0.990^* & 0 \\ 0 & 0.968^* \end{bmatrix} + \]

\[ \begin{bmatrix} 0.10 & 0 \\ 0 & 0.174^{**} \end{bmatrix} \otimes \begin{bmatrix} 0.10 & 0 \\ 0 & 0.174^{**} \end{bmatrix} \]

and by setting , eigenvalues obtained show that the condition of covariance stationarity is fulfilled for the estimated model since all the calculated absolute eigenvalues are less than one. Having established the stability of the model, we examine the conditional covariance between the exchange rate and inflation from the diagonal BEKK model.

**Figure 7** shows the movement in the conditional covariance.

**Figure 6: Conditional Covariance from the Diagonal BEKK Model**

The conditional covariance has been volatile over the years, particularly prior to 2000, when South Africa introduced inflation targeting. However, in the years of financial turbulences, a significant jump is observed. Worth noting is that the conditional variance became stable at an average of around zero from 1996 onwards, save for the crisis years. **Figure 8** shows the individual conditional variances for the two variables.

**Figure 7: Conditional Variance for individual series the Diagonal BEKK Model**

Generally, the figure shows higher conditional variances for inflation compared to the exchange rate. The jump in the conditional covariance around 1996 from the previous
graph was a result of the pronounced jump in the conditional variance for inflation, which is generally more volatile than the exchange rate, particularly in times of financial turbulences, and this gap widens at the end of the sample. Turning to conditional correlation, the next graph (Figure 9) visualizes the estimated conditional correlation between the two variables.

Figure 8: Conditional Correlation from the Diagonal BEKK Model

From Figure 9, the correlation looks to be time varying, which is a general characteristic of this model. It is clear that there was a very pronounced apparent structural change in the correlation process. The conditional correlation was stable and negative prior to 1996, and became highly volatile in the years after that, however the correlation averaged zero in the years. The general increase and the volatility of the correlation after 1996 implies higher linkages between the exchange rate and inflation in the later years, as South Africa adopted the inflation targeting regime.

4.4 The CCC MGARCH Model

The results of the estimated CCC-MGARCH (1,1) model for the relation between the exchange rate and inflation are presented in the matrices below. From the results, the estimated parameters of the conditional variance matrices of the CCC-MGARCH (1,1) model are all statistically significant except the GARCH coefficient for inflation.

\[
C = \begin{bmatrix} 7.49 \\ 52.37 \end{bmatrix}, \quad A = \begin{bmatrix} 0.72^* \\ 0 \\ 1.02^* \end{bmatrix}, \\
B = \begin{bmatrix} 0.21^* \\ 0 \\ -0.12 \end{bmatrix}, \quad \rho = 0.998^*
\]

NB: *, **, *** Denotes significance at the 1%, 5% or 10% level respectively

That means the past volatility in inflation does not explain the current levels, but only previous shocks. In the case of the exchange rate, both the ARCH and GARCH are significant, which means both the past shocks and past volatilities explain the current exchange rate volatilities. These results differ from those of the diagonal BEKK which found the GARCH term for inflation significant while that of the exchange rate was insignificant. Since the CCC-MGARCH (1,1) model does not allow for cross-sectional dynamics across series, the co-movement between the variables is captured by conditional correlations \( \rho \), which is very high and statistically significant. That confirms the co-movement of the two variables. As the name states, the conditional correlation graph is a straight line in the CCC MGARCH model as shown by the blue line below.
5.0 CONCLUSIONS AND RECOMMENDATIONS

The aim of this paper was to distil both direct and spill-over effects on inflation due to exchange rate volatility using multivariate GARCH Models. The paper began by assessing the volatility of the exchange rate and inflation using the GARCH (1,1) model and both volatilities of the variables were found to be persistent. The full BEKK MGARCH was then used to ascertain the existence of direct and spill-over effects of the exchange rate volatility to inflation. The results show that there is evidence of both direct and spill-over effects running from the exchange rate to inflation, but not vice versa. That is true for a pegged exchange rate as local inflation has no impact on the nominal exchange rate.

The diagonal BEKK MGARCH was also estimated and the results show that each variable is significantly and positively affected by news from its own innovations. However, it is only inflation which is affected by its own volatility innovation. The conditional covariance from the diagonal BEKK, was found to be volatile over the years, particularly prior to 2000, when South Africa introduced inflation targeting. However, in the years of financial turbulences, a significant jump is observed. Inflation was found to be the driver of the volatility of the conditional covariance, particularly in times of financial turbulences. The conditional correlation was stable and negative prior to 1996, and became highly volatile in the years after that, however the correlation averaged zero in the years. The general increase and the volatility of the correlation after 1996 implies higher linkages between the exchange rate and inflation in the later years, as South Africa adopted the inflation targeting regime.

In terms of the conditional covariances, it is more volatile compared with those obtained from the diagonal BEKK, and is highly pronounced during times of economic turbulences. As can be seen from the figure below, the volatility of inflation is the driver of the volatility in the conditional variance.

Figure 9: Conditional Covariance and Correlation from the CCC MGARCH Model

Figure 10: Conditional Variance for individual series the CCC MGARCH Model
The CCC MGARCH model was also estimated and the results differ from those of the diagonal BEKK which found that the GARCH term for inflation is significant while that of the exchange rate was insignificant. Since the CCC-MGARCH (1,1) model does not allow for cross-sectional dynamics across series, the co-movement between the variables is captured by conditional correlations $\rho$, which is very high and statistically significant, which confirms the co-movement of the two variables.

The findings of this study may not only serve as an eye opener for policy makers in developing macroeconomic policies that could serve as a hedge against external shocks on inflation, but also as a basis for further research. However, irrespective of the effects of exchange rate volatility on inflation, this study recommends that the country strive to retain the peg with the rand as the benefits outweigh the costs.

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A Review of Swaziland NEER and REER

Bongani Dlamini

Abstract

The purpose of this paper was to evaluate the methodology, especially the weighting system which the Central Bank of Swaziland currently uses for calculating the Real Effective Exchange Rate (REER) and Nominal Effective Exchange Rates (NEER), and provide some possible suggestions on improvements. The current weights are based on 1995 as the base year, and the trading partners are South Africa, United Kingdom, EURO, Korea, Thailand, United States, and Zambia. However, there has been a number of new economic developments over this period, particularly in the direction of our exports, and source of our imports. The results revealed that weights for trading partners have changed over the years and new trading partners have also emerged, hence the study proposes 2010 as the new base year, with South Africa, EURO, Mozambique, United States, Nigeria, United Kingdom, Kenya, Angola, and China being our new export based trading partners. The study calculates the NEER and REER indices using both arithmetic and geometric averaging techniques; however, emphasis was placed on the geometric method because of its statistical properties. The results revealed that both arithmetically and geometrically calculated indices move...
broadly together. All three weighting methods (exports, imports and trade based weights) can be used to evaluate the country’s currency competitiveness and would give similar results; however, the export based indices fairly captures trade distribution than the others in terms of weights. The study recommends that the Bank should continue using the export weighted indices but should revise the weights to a new base after every five years in order to be more relevant.

Key words: Nominal effective exchange rate, Real effective exchange rate, Swaziland.

1.0 Introduction

The concept of nominal and real exchange rate is extremely useful in the context of open economy macroeconomics in the sense that exchange rate measures competitiveness of a country’s products in the international market as well as its debt servicing liability. Both the bilateral and the multilateral exchange rate can be expressed in nominal and real terms. The nominal effective exchange rate (NEER) expresses the price of the domestic currency relative to the currencies of its major trading partners while the inflation adjusted real effective exchange rate (REER) provides an indication of changes in competitive position between countries.

However, one cannot solely rely on the REER indicator to gauge the variations in competitiveness, as it does not adequately capture the impact of a host of other factors such as changes in macro-economic policies, changes in the trade and exchange system, including changes in the regulatory and institutional environment and productivity changes. In addition, there could be data deficiencies, particularly in the price indicators. Nevertheless, effective exchange rate indicators are widely used to assess competitiveness. The main focus of the NEER and the REER is on the trade balance, particularly the exchange rate induced changes in trade flows. A trend appreciation of the real effective exchange rate is considered unfavourable for the growth of export and import competing industries.

The Central Bank of Swaziland still uses 1995 as the base year for calculating the real effective exchange rate (REER) and economic variables, including trade flows change over time. It is possible that trade flows have considerably changed over the years together with the performance of the economy at large and hence the need to review the methodology for calculating the country’s REER. The purpose of this paper therefore is to evaluate the methodology, especially the weighting system which the Central Bank of Swaziland currently uses for REER calculations with the aim of providing some possible suggestions for improvement. The paper is structured as follows; section 2 presents the methodology for the construction of NEER and REER indices for Swaziland whiles the results and the analysis are presented in section. Section 4 presents the conclusion together with recommendations.
2.0 Methodology for construction of NEER and REER indices for Swaziland

There are three key elements in the calculation of the effective exchange rate (EER) index: the number of bilateral exchange rates included, i.e., currency basket, their weights, and price indices used; the methodology (arithmetic or geometric mean method), and the weights used to calculate the effective exchange rate indices have a great effect on their values.

2.1 Construction of weights

Usually the major trading partners as well as currency basket are selected depending on the value of exports or imports or total trade (exports plus imports) of the domestic country with each trading partner (Chinn, 2006 and Ellis, 2001). The weights are measured by calculating the proportion of home country’s trade with each trading partner to total trading partners. The trade weights used in calculating the effective exchange rate may either be fixed or variable. Usually, the fixed trade weights are calculated by using the value of exports and imports in the base period. The variable trade weights are calculated by revising the trade weight in each time period. This paper follows the fixed trade weight option.

The trading partner’s weights are defined as follows, and all sum up to unity:

For exports:

\[ x_{it} = \frac{X_{it}}{\sum_{j=1}^{k} X_{jt}} \]

For imports:

\[ m_{it} = \frac{M_{it}}{\sum_{j=1}^{k} M_{jt}} \]

For total trade:

\[ t = \frac{X_{it} + M_{it}}{\sum_{j=1}^{k}(X_{it} + M_{jt})} \]

Where \( X_{it}, M_{it}, \) and \( (X_{it} + M_{jt}) \), represent exports to trading partner \( i \) by the domestic country, imports from trading partner \( i \) by the domestic country and total trade between trading partner \( i \) and domestic country respectively. The subscript \( t \) represents the time period in all definitions.

Bilateral trade weights of the type previously used in the CBS do not necessarily capture the changes in the home country’s competitiveness relative to alternative suppliers of its exports. That is, there may be countries with which the home country trades little, but with which it competes intensely for export markets. In contrast to a standard bilateral trade-weighted or export-weighted index, third-country export-weighted exchange rate indices tend to weight more highly than countries with export compositions similar to that of the home country. For example, a third-country export-weighted index for Swaziland weights countries such as Brazil more highly as they compete with it in the sugar markets. Like multilateral trade weights, however, calculating third-country trade weights could potentially be hampered by the difficulty in obtaining comparable timely data. This is because the calculation then relies on trade statistics published in other countries, whereas bilateral trade weights
can be calculated from the home country’s trade statistics. Hence, third-country weights are not included in this paper.

2.2 Selection of Base Year and Trading Partners

2.2.1 Selection of Base Year

The choice of the base year in assessing developments in nominal and real effective exchange rates is necessarily arbitrary and should not be seen as implying that exchange rates prevailing in that reference period were in equilibrium. For an example, the IMF uses Year 2000 as a base year in analysing all macroeconomic variables including NEER and REER indices for developed countries. An appropriate base period should preferably be fairly recent, characterised by relative stability in the country’s economy and low volatility in the domestic market for foreign exchange. At the same time, the base period should take into account the underlying “sustainable” direction of trade as well as any other changes that could exercise a significant impact on the future structure of the country’s trade performance. However, the base year can be selected considering normal situations both in social and economic arena. Considering this situation, this paper suggests the use of 2010 as the base year in calculating the effective exchange rate index, and a revision after every five years.

2.2.2 Selection of Trading Partners

As mentioned above, selection of major trading partners may depend on (i) the value of exports or (ii) the value of imports or (iii) the value of total trade (exports plus imports) of home country with trading partners. In the current REER calculations, based on the 1995 base year, the countries which were observed as major trading partners are listed in Table 1. It is worth mentioning that weights were only based on exports; given that most imports came from South Africa.

The choice of the countries and of the relative weights is of utmost importance for the actual level of the REER. Theoretically, it is better that all the countries that engage in trade with the country for which one wishes to determine the competitiveness are taken into consideration. However, for reasons that are related to the availability of the time series and the time at which the series are published, the number of countries taken into account is smaller, so that we do not take into account those countries with relatively small weights, which influence only in a marginal way the resulting REER.

Table 1: Countries and weights for Current REER calculations (100 = 1995)

<table>
<thead>
<tr>
<th>Country</th>
<th>Value of Exports (E' billions)</th>
<th>Weight (% of total exports)</th>
</tr>
</thead>
<tbody>
<tr>
<td>South Africa</td>
<td>1 768 232.30</td>
<td>68.6</td>
</tr>
<tr>
<td>United Kingdom</td>
<td>187 881.00</td>
<td>7.31</td>
</tr>
<tr>
<td>France*</td>
<td>122 815.20</td>
<td>4.78</td>
</tr>
<tr>
<td>Portugal*</td>
<td>110 413.30</td>
<td>4.30</td>
</tr>
<tr>
<td>Korea</td>
<td>102 328.70</td>
<td>3.98</td>
</tr>
<tr>
<td>Thailand</td>
<td>88 837.50</td>
<td>3.46</td>
</tr>
<tr>
<td>United States</td>
<td>76 616.50</td>
<td>2.98</td>
</tr>
<tr>
<td>Zambia</td>
<td>61 512.30</td>
<td>2.39</td>
</tr>
<tr>
<td>Belgium*</td>
<td>50 921.40</td>
<td>1.98</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>2 569 558.20</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

Source: Central Bank of Swaziland, *Euro Zone.
Looking at the countries in Table 1, it is quite possible that some of these countries are no longer major trading partners for Swaziland, although exact data on the type of products which were destined to these countries is not readily available, save for some. For example, Thailand and Belgium were major destination for pulp, which is no longer the case as the country no longer exports pulp.

In this regard, we observe the value of exports, imports, and total trade with different trading partners of Swaziland for the period from the year 2004 to 2016 and select at most ten countries as major trading partners that capture at least more than one per cent of Swaziland’s trade. The countries included were chosen according to the amount of trade between them and Swaziland. Top 20 countries were listed and all those under the Euro, among the top 20, were grouped together and referred to as Euro countries. From the remaining countries, top ten countries were selected, based on the total amount of exports, imports, and total trade that a particular country traded with Swaziland in the period from year 2000 to 2011. The Euro countries were treated as one country.

2.3 Price Indices

According to Edwards (1989), the CPI is amongst the most commonly used indices for constructing the real effective exchange rate. The main advantage of the CPI over other price indices is that it is available monthly in most developing countries. However, it has several disadvantages. It includes a broad group of goods and services, and, thus, it is arguable whether it is a good index for constructing the real effective exchange rate, since it includes non-tradable goods. Therefore, if prices of tradable and non-tradable goods will diverge over time, the CPI could be a very misleading indicator. The same problem occurs with the wholesale price index (WPI) and the GDP deflator. CPI may be distorted by price controls and excise taxes, and, thus, diverges from the underlying costs of production. In addition, the CPI may not accurately reflect the prices of the intermediate goods.

These differences limit the usefulness of real effective exchange rate for comparing standards of living. Despite these disadvantages, the Consumer Price Index (CPI) is the most commonly used weighting scheme. CPIs have the advantage of being relatively accurate, frequently published and are based on a basket of commodities that is broadly comparable across boundaries. Therefore, the CPI is the most preferred price index for the REER calculations in this paper.

2.4 Arithmetic vs. geometric average approach

Arithmetically averaged indices are seldom used since such indices possess undesirable characteristics. For instance, changes in the index will differ in percentage terms, depending upon whether the exchange rates are expressed in units of foreign currency per domestic, or vice versa. It is common practice to use geometric averages rather than arithmetic averages for calculating effective exchange rates. Exchange rate indices based on geometric averaging have
the convenient feature that the logarithm of the index is equal to the arithmetic average of the logarithms of the underlying bilateral rates. As Brodsky (1982) notes, a percentage change in the geometrically averaged effective exchange rate between two periods is independent of the base period. However, when an arithmetic average is applied, it is affected by all movements since the base period. Moreover, for geometrically averaged EERs, proportionally equivalent currency appreciations and depreciations have the same effect (with opposing signs) on the overall index, whereas there is an upward bias in arithmetically averaged indices. However, for comparison purposes, this paper presents indices constructed in both arithmetic and geometric methods.

2.5 Constructing the Nominal Effective Exchange Rates (NEER)

The nominal effective exchange rate index is the weighted average of bilateral nominal exchange rate indices (NERI). The NEER denotes the nominal effective exchange rate for the home country with respect to each partner i. This is defined as an index reflecting movements in the nominal exchange rate between a home country and trading partners adjusted for by the respective weights of the trading partners. The NEER is also a measure of the multilateral nominal exchange rates. To construct the NEER, we first construct the nominal exchange rate index as follows:

\[ NERI_t^i = \frac{NER_t^i}{NER_b^i} \times 100 \]

Where, \( NER_t^i \) is the bilateral nominal exchange rate index of Lilangeni with partner i’s currency at period t; \( NER^i_t \) are units of country i’s currency per unit of taka at period t; \( NER_b^i \) are units of country i’s currency per unit of Lilangeni at base period.

After constructing the NERI, multiplying it with the corresponding weight of each trading partner, and averaging gives the NEER. Whenever we use arithmetic mean, the formula for NEER indices will be:

\[ NEER_t = \sum_{i=1}^{n} W_i^i NER_t^i \]

And for geometric mean the formula turns out to be:

\[ NEER_t = \prod_{i=1}^{n} \left( NER_t^i \right)^{W_i} \]

Where, \( NEER_t \) is the nominal effective exchange rate index for Swaziland at period t, n is the number of trading partners, and \( W_i \) is the trade weight for Swaziland with country i.

2.6 Constructing the Real Effective Exchange Rates (REER)

Acknowledging the existence of different methods for constructing the REER index in literature, we define REER as the weighted average of the product of the bilateral real exchange rate index (RERI) and the weight of each trading partner. Bilateral real exchange rate is calculated by adjusting the bilateral nominal exchange rate with the ratio of CPI. But the consumer price indices for different countries for the period 2004:01 to 2016:12 are not available at a single base period. Therefore, it is necessary to convert the prevailing CPI’s into single base (2010 = 100) before using them in the formula. Now the
bilateral real exchange rates are calculated by using formula:

\[ RER_i^t = \frac{NER_i^t \cdot CPI_t}{CPI_i^t} \]

Where, \( RER_i^t \) is the real exchange rate of Lilangeni with partner i’s currency at period t; \( NER_i^t \) is the nominal exchange rate of Lilangeni with i’s currency at period t; \( CPI_t \) is the consumer price index for Swaziland at period t; \( CPI_i^t \) is the consumer price index of partner i at period t.

After constructing the RERI, multiplying it with the corresponding weight of each trading partner, and averaging gives the REER. Whenever we use arithmetic mean, the formula for REER indices will be;

\[ REER_t = \sum_{i=1}^{n} W_i RER_i^t \]

And for geometric mean the formula turns out to be;

\[ REER_T = \prod_{i}^{n} (RER_i^t)^{w_i} \]

Where, \( REER_t \) is the real effective exchange rate index for Swaziland at period t, \( n \) is the number of trading partners, and \( W_i \) is the trade weight for Swaziland with country \( i \).

3.0 Results and Analysis

3.1 Introduction

This paper presents three different ways of measuring trade weights, namely; exports, imports and total trade weights. It further uses fixed weights as compared to variable weights, with 2010 as the base year. Using both arithmetic and geometric mean technique for averaging, the paper constructs six types of NEER indices using data spanning from 2004M01 to 2016M12. An increase in the index reflects an appreciation while a decrease reflects a depreciation.

3.2 Selection of Trading Partners and Trade weights

Analysis of the available data revealed that there is no major bi-directional trade with Swaziland in most of the countries, with the exception of South Africa, China, the Euro, United States, United Kingdom, and Mozambique. There was also lack of relevant data for some countries and were hence dropped from the final preferred list, resulting in unequal number of countries in each category. For example, Australia is available in the list of top ten export destinations, but was dropped as she reports her CPI quarterly, whereas monthly data is required for this exercise. The preferred list of trading partners for total trade, exports, and imports together with their weights are presented below in Table 2, Table 3 and Table 4, respectively.

In all three categories, the weight for South Africa is very high with 88.2 per cent, 72.0 per cent and 95.4 per cent for total trade, export and imports, respectively. This is
because South Africa is Swaziland’s major trading partner in terms of both imports and exports. Other countries which have considerable weights in terms of exports are EU (5.1 per cent), Mozambique (4.1 per cent), US (4.0 per cent), Nigeria (3.8 per cent) and the United Kingdom (3.8 per cent).

### Table 2: Countries and weights for total trade (100 = 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Value of Total Trade</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZA: South Africa</td>
<td>21 719 223 210.53</td>
<td>88.2</td>
</tr>
<tr>
<td>EURO</td>
<td>756 648 702.95</td>
<td>3.1</td>
</tr>
<tr>
<td>US: United States</td>
<td>557 819 446.61</td>
<td>2.3</td>
</tr>
<tr>
<td>CN: China</td>
<td>544 262 265.21</td>
<td>2.2</td>
</tr>
<tr>
<td>MZ: Mozambique</td>
<td>521 045 323.85</td>
<td>2.1</td>
</tr>
<tr>
<td>GB: United Kingdom</td>
<td>518 366 154.29</td>
<td>2.1</td>
</tr>
<tr>
<td>TOTAL</td>
<td>24 617 365 103.44</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Own calculations from the Swaziland Revenue Authority Data

### Table 3: Countries and weights for exports (100 = 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Value of Exports</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZA: Republic of South Africa</td>
<td>8 170 831 306.82</td>
<td>72.0</td>
</tr>
<tr>
<td>EURO</td>
<td>583 121 219.34</td>
<td>5.1</td>
</tr>
<tr>
<td>MZ: Mozambique</td>
<td>462 739 178.16</td>
<td>4.1</td>
</tr>
<tr>
<td>US: United States</td>
<td>458 767 062.40</td>
<td>4.0</td>
</tr>
<tr>
<td>NG: Nigeria</td>
<td>432 597 573.73</td>
<td>3.8</td>
</tr>
<tr>
<td>GB: United Kingdom</td>
<td>427 221 371.94</td>
<td>3.8</td>
</tr>
<tr>
<td>KE: Kenya</td>
<td>391 776 539.51</td>
<td>3.4</td>
</tr>
<tr>
<td>AO: Angola</td>
<td>256 803 597.74</td>
<td>2.3</td>
</tr>
<tr>
<td>CN: China</td>
<td>172 017 716.04</td>
<td>1.5</td>
</tr>
<tr>
<td>TOTAL</td>
<td>11 355 875 565.68</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Own calculations from the Swaziland Revenue Authority Data

### Table 4: Countries and weights for imports (100 = 2010)

<table>
<thead>
<tr>
<th>Country</th>
<th>Value of Imports</th>
<th>Weight (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZA: South Africa</td>
<td>13 548 391 903.71</td>
<td>95.4</td>
</tr>
<tr>
<td>CN: China</td>
<td>372 244 549.17</td>
<td>2.6</td>
</tr>
<tr>
<td>EURO</td>
<td>173 527 483.61</td>
<td>1.2</td>
</tr>
<tr>
<td>US: United States</td>
<td>99 052 384.21</td>
<td>0.7</td>
</tr>
<tr>
<td>GB: United Kingdom</td>
<td>91 144 782.35</td>
<td>0.6</td>
</tr>
<tr>
<td>MZ: Mozambique</td>
<td>58 306 145.69</td>
<td>0.4</td>
</tr>
<tr>
<td>TOTAL</td>
<td>14 342 667 248.74</td>
<td>100</td>
</tr>
</tbody>
</table>

Source: Own calculations from the Swaziland Revenue Authority Data

### 3.3 Effective Exchange Rate Indices

#### 3.3.1 NEER Indices

Figure 1 indicates that indices averaged geometrically broadly move together with those arithmetically averaged. All indices broadly move together, but with different volatility.

#### 3.3.2 REER Indices

The study also constructed six types of REER indices for Swaziland by using the previously stated formulae and the results are presented in Figure 2, below. As observed in the graph, the indices broadly move together and show an appreciation trend between 2004 and 2012 which is followed by a depreciation trend until November 2015. An appreciation trend is also observed thereafter up to December 2016. An appreciation trend means that the local currency was competitive in the years between 2004 and 2012, then depreciated until towards the end of 2015, after which it appreciated again until the end of the review period.

Figure 2: REER Indices for Swaziland

Notes: M is for imports, T for total trade, and X for exports. GM is for geometric mean while AM is for arithmetic mean.
3.3.2 REER Indices

The study also constructed six types of REER indices for Swaziland by using the previously stated formulae and the results are presented in Figure 2, below. As observed in the graph, the indices broadly move together and show an appreciation trend between 2004 and 2012 which is followed by a depreciation trend until November 2015. An appreciation trend is also observed thereafter up to December 2016. An appreciation trend means that the local currency was competitive in the years between 2004 and 2012, then depreciated until towards the end of 2015, after which it appreciated again until the end of the review period.

Figure 2: REER Indices for Swaziland

As stated in section 2.4 above, the arithmetic average is probably more familiar, but there are strong theoretical and statistical reasons to prefer the geometric average. For example, percentage movements in an arithmetic index will differ in magnitude depending on whether the bilateral rates are expressed as units of home currency per foreign currency unit, or the other way around. Furthermore, exchange rate indices based on arithmetic averages can also be distorted when the base period is changed. Because geometrically averaged indices treat movements in exchange rates symmetrically, they do not have these undesirable properties. In addition, the logarithm of a geometric average is the arithmetic average of the logs of the bilateral rates. Hence we drop the arithmetically averaged indices and present the geometrically weighted indices in the following section.

3.3.3 Geometrically Weighted NEER Indices

Figure 3: Geometrically Weighted NEER Indices

As noted before, Figure 3 indicates that the indices broadly move together. The nominal
The effective exchange rate allows defining the extent by which the exchange rate of the national currency changed relatively to exchange rates of the trading countries compared to a base year. However, the change in the nominal effective exchange rate does not reflect changes in the purchasing power of the currency, nor the competitiveness of goods produced in the country and showing how an export potential changed during a specific period of time and hence the need to develop geometrically weighted REER.

3.3.4 Geometrically Weighted REER Indices

The REER indicates the extent by which the purchasing power of the currency changed over a period of time and the geometrically weighted REER indices are presented in Figure 4, below. The results indicate that the REER has been trending up until the year 2012 after which it marginally trended down until November 2015. The local currency was therefore competitive between the year 2004 and 2012.

Figure 4: Geometrically Weighted REER Indices

Notes: M is for imports, T for total trade, and X for exports. GM is for geometric mean while AM is for arithmetic mean.

The results from Figures 1 to 4 indicate that the indices have moved broadly together and are highly correlated. It is evident from the results that analysing competitiveness of the country can lead to the same conclusions whether using total trade, export, or import based indices. However, for the purpose of this paper, a conclusion needed to be reached on which index best captures the country’s competitiveness. In this regard, export based indices fairly captures trade distribution and hence they are the recommended indices. The weights for imports and total trade are biased to South Africa as they are 95.4 per cent and 88.2 per cent, respectively, which is not favourable as we share a common currency with South Africa.

3.4 Comparison of the Results from Other CMA Countries

This part of the paper compares the Swaziland indices with those from South Africa and Namibia. The objective here was to compare the indices with all the CMA member countries, unfortunately there was no monthly data for Lesotho; hence the comparison is between Swaziland, Namibia, and South Africa, whose data is available in their central banks websites. South Africa and Swaziland use 2010 as the base year whiles Namibia uses 2004.
3.4.1 NEER Indices for Namibia, South Africa and Swaziland

Figure 5 indicates that the NEER indices for Namibia, South Africa and Swaziland have broadly moved together over the period under review. This trend is widely explained by the pegging of the Lilangeni and the Namibian Dollar to the Rand.

Figure 5: NEER Indices for Namibia, South Africa and Swaziland (Right axis)

Source: SARB, The Bank of Namibia and Own calculation (Swaziland)

3.4.2 REER Indices for Namibia, South Africa and Swaziland

Again it can be observed from Figure 6 that the REER indices broadly move together as explained by the pegging of the other currencies to the Rand. From Figures 5 and 6, it can be deduced that the indices for Swaziland are at par with those of the region and can be used in future analysis for competitiveness.

Figure 6: REER Indices for Namibia, South Africa and Swaziland (Right axis)

Source: SARB, Bank of Namibia and Own calculations (Swaziland)

3.5 Comparison of the new and the old indices

Table 5 (Appendix E) summarizes the differences between old and new weights. There are generally few differences in the construction of the new and old weight. They are basically the base year, averaging, weights, and trading partners.

From Table it is evident that there are major changes in the trading partners and weights, with South Africa’s weight increasing from 68.8 per cent in the old weights to 72 per cent in the new weights. This is due to the gradual change in the direction of our exports to focus in South Africa. Furthermore, countries which used to be our markets for pulp like Thailand and Korea are no longer in the new weights as the country seized to export pulp due to the closure of SAPPI. Over the years, Mozambique has become a major trading partner with Swaziland, hence its inclusion in the weights. Nigeria, Kenya and Angola have also become our major trading partners due to our sugar and sugar concentrates exports. One of the causes of
this shift is the closure of the coca cola plant in Nigeria in 2010.

Figure 6 indicates that the 1995 and the 2010 based NEER indices mainly move together but in different directions. That is explained by the fact that an appreciation in the 2010 indices is depreciation in the 1995 indices.

Figure 7: 1995 and 2010 based NEER Indices Swaziland (Right axis 2010)

Source: Central Bank of Swaziland (1995 REER) and own calculations (2010 REER)

The 1995 and 2010 REER indices for Swaziland presented in Figure 8 generally move together but in direction just like the NEER indices. That is also explained by the fact that an appreciation in the 2010 indices is depreciation in the 1995 indices.

Figure 8: 1995 and 2010 based REER Indices Swaziland (Right axis 2010)

Source: Central Bank of Swaziland (1995 REER) and own calculations (2010 REER)

4.0 Conclusion and Recommendations

4.1 Conclusion

The paper sought to review the measure of the real effective exchange rate (REER) and nominal effective exchange (NEER) rate for Swaziland, using various measures (export weighted, import weighted and total trade weighted). The major objective was to determine the best measure for the indices as the current measure has a base year of close to twenty years ago, hence the need to review. The study started by identifying the major trading partners and their weights in the basket. It further continued to identify the appropriate formulas for calculating both the NEER and REER using both arithmetic and geometric averaging technique, as well as the price index to use which is the consumer price index.

The paper presented twelve indices (both arithmetic and geometric) for NEER and REER from 2004M01 to 2016M12, which were total trade based, export based, and import based. The results showed that all the indices move broadly together. However, due to the superiority of the geometrically averaged indices to their arithmetically averaged counterparts in economic theory, the latter were dropped. An empirical analysis was then applied to the geometrically weighted indices to see which is superior among them in terms of export, import, or total trade based. The results showed that all of them can be used in economic analysis and the same conclusion can be reached; however, export based indices fairly captures trade
distribution than the others in terms of weights. The weights for imports and total trade are biased to South Africa as they are 95.4 per cent and 88.2 per cent, respectively, which is not favourable as we share a common currency with South Africa. The export based indices were then compared to those of South Africa and Namibia, and were found to follow the same trend as these countries share a common currency under the Common Monetary Area (CMA).

4.2 Recommendations

The results from this study shows that all the indices can be used; however, for ease of computation and data availability, the Bank can continue using the export based indices as in the current practice, but using the new weights. The weights should be revised to a new base after every five years in order to remain relevant.

Furthermore, the weights for imports and total trade tends to bias South Africa as they are 95.4 per cent and 88.2 respectively, which is not favourable as we share a common currency with South Africa. The export based indices were further compared to the current practise and were found to move together but in opposite directions, due to definition of appreciating and depreciation in each index.

REFERENCES


1. Background

Drought is a recurrent climatic phenomena experienced across the world. It affects humanity in a number of ways such as causing loss of life, crop failures, food shortages which may lead to famine in many regions, malnutrition, health issues and mass migration. It also causes huge damage to the environment and is regarded as a major cause of land degradation and desertification. The impacts of droughts are witnessed at a range of geographical scales. For instance, individual families or communities may lose their livelihoods and source of water, subject to acute food shortages and health issues and the country’s economy may be severely impacted (EM-DAT, 2009).

The Southern Africa region was hit by one of the worst El Nino weather phenomena in 2015. According to UN Food and Agricultural Organisation (FAO 2016) the intense drought which worsened during 2015-16 planting season, would have devastating impacts on harvest and food security in Southern Africa. The World Food Programme (WFP 2016) estimated a food deficit of 7.9 million tonnes for the region in the 2015/16 marketing season. This shortfall was partly due to poor harvest in 2014/15 season and would be worsened by the significant shortfall in 2015/16 harvest due to the El Nino phenomenon. The WFP further estimates that 40 million rural people and 9 million poor urban people who live in drought-affected...
areas could be exposed and an estimated 14 million people in the region were already food insecure in February 2016.

Severe drought conditions were last experienced by the entire Southern African region in the 1991/92 agricultural season, whereby the region was under-going an ‘Él Nino event’. In 1991/92, the drought that struck Southern Africa had a devastating impact on agricultural production and placed an estimated sixteen million people at risk of poverty and starvation (Chimhete, 1997). The country’s main economic sectors were adversely affected which led to the downward trends in growth and development. The agricultural sector which is a key component of a majority of local livelihoods was severely drained, especially maize cultivation. According to (Chimhete, 1997), the El Nino-induced drought in 1992 also had a negative impact on the region’s food prices. The Southern African region imported 11.6 million metric tonnes (MT) of food.

Swaziland, a small landlocked country in the Southern African region, is always vulnerable to negative effects of drought experienced in the region particularly due to low domestic food production and high dependence on imports. In 1991/92, the severe drought caused irreversible crop damage in the country which drastically reduced grain production leading to urgent need for food relief requirements during this era. In the same manner, livestock production was drastically reduced by 20 per cent, which was a severe blow to farmers whose livelihood largely depended on the livestock and the resultant flow of milk products, kraal manure and draught power (GOS, 2001).

The worst El Nino event (Appendix F) in more than half a century experienced in the 2015/16 season is expected to have more pronounced negative effects than the one experienced in 1991/92. Due to the drought, rains decreased drastically in 2015/16 season to reach their lowest level in more than ten years. In 2015, the country received a total rainfall of 5 935 mm a drop from 9 342 mm a drop received in 2014 (Figure 1). The drought is expected to intensify as official weather forecast of the country’s weather show that little rainfall is expected in the remainder of the rain season of 2015/16.

**Figure 1: Total Rainfall Received**

![Total Rainfall Received (mm)]

Source: Swaziland Meteorological Services
2. Implications for Swaziland

2.1 Outcomes on Output

2.1.1 Agricultural Production

Maize Production

With agricultural production directly dependent on the total levels of rainfall received amongst other inputs, 2015 has proven to be a difficult year for local farmers and the country as a whole. Despite the drought conditions which prevailed for the most part of the 2014/15 crop season, the total area planted for maize slightly increased to 87.2 thousand hectares from 86.8 thousand hectares planted in the 2013/14 planting season. This increase was mainly driven by the promising rains experienced in the beginning of the 2014/15 season, easy access to agricultural inputs through the disbursement of the Indian loan and government subsidies in agricultural inputs. However, the utilization of the agricultural inputs was lower in 2014/15 season as farmers learnt late about the logistics involved in accessing these inputs.

In preparation of the 2015/16 season, farmers paid early for subsidized farm inputs offered through the Indian loan. However, at the commencement of planting season there was no rain. The drought manifested through poor rain distribution and prolonged dry-spells. According to the country’s Drought Assessment Report (2016), area planted fell by more than 44 per cent in 2015/16. On the other hand, total maize production is estimated to drop by 64 per cent from 93,653 in 2014/15 to 33,460 tonnes in 2015/16 season. The significant decrease in maize production as shown in Figure 2 is the worst output recorded in more than 10 years.

According to the Vulnerability Assessment & Analysis (VAC) Report of 2015, the observed decrease in local maize production coupled with the increase in the country’s consumption requirement necessitated the country to continue its dependence on imports to cover the shortfall. The country’s consumption requirement was estimated at 131,220 metric tonnes in the 2015/16 season, as a result commercial maize imports from the Republic of South Africa by the National Maize Corporation (NMC) increased by 104 per cent to 30, 446 metric tons in the 2015/16 season (highest level since 2009/10 season). Furthermore, in view of the reported maize shortages in South Africa, where Swaziland imports 22 per cent of local consumption needs, the situation is projected to worsen and low supply will eventually result in food price increasing in the country.

Figure 2: Maize Production

Source: Ministry of Agriculture and Cooperatives
Cotton Production

Cotton is the only cash crop that is 100 per cent reliant on rainfall in Swaziland. Erratic weather conditions mainly characterised by lower-than-expected rains and a mid-season drought resulted in cotton production falling by 27 and 52 per cent in 2013/14 and 2014/15 season respectively. The severe drought of 2015/16 affected negatively cotton production with output estimated to have declined to 100 tons i.e. by nearly 90 per cent (Figure 3). This is expected to affect farmers’ incomes in the Lowveld where cotton is predominantly grown, a development that will lead to job losses particularly in the cotton ginnery which was already operating below 10 per cent of its capacity.

Figure 3: Cotton Production

Source: Swaziland Cotton Board

Sugar Cane Production

The country’s sugar cane plantations have also been severely affected by the occurring drought. The drought has led to severe water shortage which has resulted in reservoirs nearly drying up. Also ground water levels have drastically declined in several areas including the Lowveld where a large swathe of both small and large scale cane farmers are situated (Times of Swaziland, 2016). According to the Swaziland Sugar Association (SSA), as the cane harvesting period looms, cane growers are anticipating a 10 per cent decline on yields due to the prevailing drought which is expected to result in a financial loss of €120 million. However, the association further highlighted that effects of the drought will be felt fully next year during the cane harvesting period which commences from April 2016 and ends in November 2016, with some crops completely dry. The drought also increased costs of production for local cane farmers, which, in turn, minimises returns. Absence of adequate rains compels farmers to use a lot of electricity for irrigation as well as additional labour force and incur additional transport costs, which in turn increases the costs of production in significant proportions (SSA Annual Report, 2015). Prolonged prevalence of the drought will affect sugar cane production and the effects will be carried on to the next three years resulting in job losses and subdued economic growth.

Livestock Production

Figure 4: Cattle Births and Mortalities

Source: MOAC Veterinary Department
The drought that has hit the country has also had a negative impact on Livestock production, as local dams and rivers dried up and the land completely patched with no grazing land for livestock (World Vision, 2015). The stock of cattle was eroded from two fronts; the total number of calve births decreased by 6 per cent whilst cattle mortalities rose by 49 per cent in 2015. This would have a negative impact on livestock production and beef exports in the medium-term. According to the Ministry of Agriculture Veterinary services data, Lubombo and Shiselweni regions were the hardest hit in terms of cattle mortalities.

**Figure 5: Cattle Mortalities by Region**

According to Swaziland Economic Justice Network (SENJUN, 2015), farmers in the most affected areas were forced to sell their cattle for as little as E1,500 and not more than E4,000, despite the amounts of money spent on medicines, food supplements and also the time spent to raise the cattle.

Although the Ministry of Agriculture has been providing water for livestock in the hardest hit constituencies since July/August 2015, livestock continued to die. About 65 per cent of total mortalities occurred in the second half of the year.

### 2.1.2 Manufacturing Sector

As much as the climate change effects were severely felt in the agriculture sector as crops suffered harsh weather conditions, production was also affected in 2015. Economic impacts of drought are influenced by a country’s stage of economic development. Swaziland, being a developing country is most vulnerable to drought as it has a high dependency on the agricultural sector (food crops).

**Sugar Production**

Sugar production is currently under a strain due to factors relating to world sugar prices and the drought. Sugar production is expected to fall due to the negative effects of the drought, following decline in sugar cane volumes and sucrose level. Poor quality of cane delivered at the mill especially during the harvesting season of 2016/17 will also affect sucrose and sugar yields retrieved from harvested cane. Revenue from this product is also expected to drop in line with falling global sugar prices.

Figure 6 shows that in 2016/17 there will be a huge fall in sugar production. Sugar production is projected to fall by 25 per cent to 520,000 metric tonnes from a record high of 695,000 tonnes in 2015/16.
Figure 6: Sugar Production

Source: Swaziland Sugar Association

Meat Production

The meat industry performed well in 2015 in terms of volumes of cattle slaughtered in commercial abattoirs (Figure 7). This was mainly because cattle owners, upon realizing effects of the drought, heeded the advice to sell their cattle to commercial abattoirs especially the export abattoir. Due to the effect of the drought, most of the cattle sold to the abattoir were of low quality and therefore fetched a low price. For 2016 and the medium-term negative growth is expected due to the erosion of cattle stock experienced during the drought.

Figure 7: Beef Production

Source: MOAC Veterinary Services Department

Other Manufacturing

The drought affected water supply especially in areas around Mbabane. Clean treated water is generally essential in most industries particularly those dealing with food manufacturing. For example, in the production of milk and milk products, about 132,000 litres of clean water per day is required while meat production needs over 350,000 litres of clean water every day. Exporting companies require treated water that is supplied by the Swaziland Water Services Corporation in order to meet health standards set by the market. However, due to the drought, water shortage only affected Mbabane residential and commercial clients as well as government offices while the Matsapha industrial area was, at the time of compiling this paper, spared by the water shortage. Should it be affected, a significant drop in production can be expected as some factories may be forced to shut down operations.

2.1.3 Electricity and Water Supply

Electricity

Electricity is largely hydro-generated, with the Swaziland Electricity Company (SEC) being the major producer. The company has four hydro-power generation stations namely Ezulwini, Maguga, Maguduza and Dwaleni. Production in these power stations rely heavily on the river in-flows which, in turn, determine the water levels of the dams. The river in-flow for Luphohlo dam that services the Edwaleni power station, reached its lowest level in 2015 compared to the levels of the past five years. The largest producer is Maguga power station, situated
in the Hhohho region, which generates about 38 per cent of the total production by SEC. According to the Swaziland Meteorology Services, the rainfall received in 2015 was the lowest in the past ten years at 5 935.5 mm. Electricity production fell by 24 per cent to 231 GWh in the 2014/15 season and further dropped by 47 per cent to 123.3 GWh in 2015/16 due to suspension of power generation in most power stations controlled by SEC from October 2015. If the drought conditions persist, local hydro-power generation production is expected to fall further and reach a low of 60 GWh in 2016/17 as shown in Figure 8.

When studying the monthly generation trends depicted in Figure 9, it is evident that towards the end of 2015 and opening 2 months of 2016 hydro-power generation fell significantly below its long-term average trend of about 20GWh).

**Water**

The production and distribution of treated water at national level is done by the Swaziland Water Services Corporation (SWSC). Just like electricity production, the production of treated water relies on the river in-flows and dam water levels. The drought experienced in 2015/16 affected the supply of water particularly in the last quarter of 2015. Though treated water sales are generally lower in the last quarter of the past years, water shortage was also a contributing factor to the lower sales in the quarter ended December 2015 (Figure 10).

**Figure 8: Domestic Hydro-Power Generation**

![Figure 8: Domestic Hydro-Power Generation](image)

*Source: Swaziland Electricity Company*

**Figure 9: Monthly Electricity Generation (in GWh)**

![Figure 9: Monthly Electricity Generation (in GWh)](image)

*Source: Swaziland Electricity Company*

**Figure 10: Water Sales (In million kilolitres) M³**

![Figure 10: Water Sales (In million kilolitres) M³](image)

*Source: Swaziland Water Services Corporation*

The shortage of treated water due to the drought, affected distribution only in the North-West region mainly Mbabane. Hawane
...normal rainfall, while the Lubombo Plateau was likely to receive normal with a bias of above-normal rainfall in the January-March 2016 quarter. These forecasts show that due to the drought, treated water production would be under pressure, especially in the North-West region.

2.2 Financial Sector

The financial sector, which extends credit to all sectors of the economy, provides information that indicates the level of economic activity in the country. Credit to the private sector (by the banking sector) fell by 6.1 per cent in nominal terms in 2015 which is higher than inflation (which averaged 5.0 per cent) reflecting a negative real growth of 1.1 per cent. While credit extension decreased for most sectors, the decrease was bigger in sectors heavily affected by the drought as water production in those areas remained somewhat consistent.

Figure 11: Hawane Dam Water Level October 2015 to February 2016

![Graph](image)

Source: Swaziland Water Services Corporation

**Dam Capacity Level** = 2750 x10³ m³  **Full Water Height** = 15.8 metres

Official short-term rainfall forecasts by the Meteorology Department indicated a chance of below, with a bias to normal rainfall during the first quarter of 2016 in the Highveld. Forecasts for the Middle-veld and Lowveld indicated a normal, with a bias of below normal rainfall, while the Lubombo Plateau was likely to receive normal with a bias of above-normal rainfall in the January-March 2016 quarter. These forecasts show that due to the drought, treated water production would be under pressure, especially in the North-West region.

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An analysis of non-performing loans in Figure 13 shows that these loans have been stable over the past 2 years (2014 and 2015) averaging 7.1 per cent of total loans. Thus the fall in credit to the agricultural sector indicates a decrease in agricultural activity due to the negative effects of the drought and the risk aversion towards this sector which is prone to external supply shocks.

The expected negative performance of the sugar industry, due to the effects of the drought, will be felt by the banking sector which has traditionally supported and earned interest income for this sector.

**Figure 13: Non-performing Loans (NPL) in the Banking Sector**

From a revenue generation standpoint, there is a significant potential revenue loss due to poor performance of some sectors particularly the agricultural sector and other sectors linked to its performance. Figure 14 summarises the main sectors (that may be affected directly or indirectly by the drought) as a per cent of total domestic tax revenue. Crop, animal production and food manufacturing which are hard hit by drought account for more than 15 per cent of total revenue.

**Figure 14: Sectorial Contribution to Government Tax revenue**

From a revenue generation standpoint, there is a significant potential revenue loss due to poor performance of some sectors particularly the agricultural sector and other sectors linked to its performance. Figure 14 summarises the main sectors (that may be affected directly or indirectly by the drought) as a per cent of total domestic tax revenue. Crop, animal production and food manufacturing which are hard hit by drought account for more than 15 per cent of total revenue.

**2.3 The Fiscal sector**

The effects of the drought put pressure on both the government expenditure and revenue generation. From a government expenditure standpoint, the government is expected to provide relief measures financially as mitigating measures for the drought effects. More financing for drought relief will be required. According to the 2016/17 budget an amount of E105 million was allocated for drought through a supplementary budget in 2015/16 and for fiscal year 2016/17 an extra E200 million was allocated for drought mitigation. According to the Budget Speech (2016) these funds will be used for food distribution, water distribution to affected areas, drilling boreholes, dredging Hawane dam, provision of supplementary feed for livestock and importation of power from South Africa.

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**2.4 Food Prices**

The ‘food and non-alcoholic beverages’ component has the largest weight in the
country’s Consumer Price Index (CPI) basket. Weighing 29.22 per cent followed closely by the ‘housing and utilities’ component at 29.15 per cent, any changes in the ‘food and non-alcoholic beverages’ index determines the magnitude and direction of the country’s overall inflation rate. In detail, the ‘food’ component carries the weight of 28.27 per cent in the consumer basket with ‘bread and cereals’ dominating with a weight of 11.13 per cent followed by ‘meat’ at 6.62 per cent, ‘vegetables’ at 3.52 per cent and the remainder is accounted by other food items. One thing common about the production of the highlighted food components is their sensitivity to weather conditions.

The price of ‘bread and cereals’ is a reflection of maize prices which is mainly influenced by maize production. The existence of drought implies low production in agricultural goods such as crops (maize and vegetables) and livestock (meat). With the 2015/16 planting season, already the indication is that the harvest will be one of the lowest in many years both in county and the region, largely as a result of the persistent drought (El Nino) during the planting season. In normal seasons, domestic maize production falls way below the demand for maize in the country and the shortfall is covered by imports from South Africa, the country’s major trading partner. In 2015 maize production dropped by an estimated 31 per cent and is expected to drop further in the 2016 harvest. Figure 15 shows that South Africa recorded a fall of more than 30 per cent for two successive years leading to shortages in maize supply throughout the Southern Africa region. Outside Southern Africa, white maize is grown in significant quantities only in Mexico and the United States of America. Due to GM certification, imports of white maize from the US are not feasible, leaving Mexico as the only option for white maize imports. According to the Bureau for Food and Agricultural Policy (BFAP, 2016) buying and transporting maize to the Durban port would cost a minimum of R4,400 (i.e. excluding inland transportation). A Rand depreciation would make these imports even more expensive.

Figure 15: RSA White Maize Production

According to the SAFEX-JSE (Figure 14), white maize prices have escalated significantly from E1, 913 per metric tonne in January 2015 to E4, 935 per metric tonne in January 2016 and are projected to average E4, 870 in 2016.

Increases in yellow maize prices tend to affect prices for meat, eggs, milk and other dairy products. The international price for wheat, the major ingredient for bread, is also expected to increase due to its shortage. Wheat prices increased from E3, 841 per tonne in January 2015 to E4, 942 in January 2016 (Figure 16). Though set as an administered price in Swaziland, increases in wheat prices could form basis for an upward adjustment of the price for bread in the country. The same trend is noted with the April 2016 grain prices where the...
Shortages are also anticipated in yellow maize production which is used as a major ingredient in livestock feed. According to the SAFEX-JSE, yellow maize international prices increased from E1, 925 per tonne in January 2015 to E3, 950 per tonne in the same period in 2016 and are expected to average E3, 765 per tonne in 2016.

Figure 16: International Purchasing price for White Maize, Yellow Maize & Wheat

![Chart showing international purchasing price for white, yellow maize, and wheat](chart.png)

Source: SAFEX-JSE

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The increase in maize and wheat prices resulted in a notable rise in food prices in the country. This in turn, via the relatively high weight on food in the consumption basket, exerted upward pressure on headline inflation. Food inflation surged significantly in the opening months of 2016 to reach double digits in February 2016 for the first time in more than 36 months. This pushed overall inflation to a 3-year high of 8.5 per cent in April 2016 as shown in Figure 17 (Appendix F).

The persistent drought and the currency depreciation remain the main upside risk to inflation. A closer analysis at the food components show that ‘bread and cereals’, ‘oils and fats’ and ‘fruits and vegetables’ are the main drivers of the observed acceleration in food inflation. Bread and cereals prices reflect the effects of maize and wheat price increases. Meat price increases, on the other hand, have remained muted below 5 per cent with the prospect of increasing later due to lagged effects of increases in yellow maize prices which is an input cost to livestock production.
2.2 Effects on trade

Exports

The drought effects will weigh more heavily on sugar exports which is the second highest commodity in export earnings with an average contribution of 22 per cent. The 25 per cent decline in sugar production would undoubtedly lead to a significant fall in sales. Total sugar sales are projected to decline by 22 per cent in 2016/17 marketing season after recording a record high of 700,017 metric tonnes in 2015/16. While all markets will receive less, the drop in volume sales would be much higher for sales destined outside the SACU market than for the domestic market. SACU volume sales are expected to drop by 5 per cent whilst export sales outside the SACU market will drop by 45 per cent as shown in Figure 19. On the other hand, challenges on livestock sector will hamper beef exports primarily destined to the EU and Norwegian market. The huge fall in foreign currency denominated exports would trade balance.

Imports

The severity of the drought has negative effects on imports. Though being a net importer of goods and services, the effects of the drought are expected to cause an increase in imports in the country. The drop in domestic production of agricultural goods, predicted poor harvest and the significant decrease in domestic electricity generation are all an indication of a significant spike in food and electricity imports. The imports of maize from South Africa increased by 104 per cent in the 2015/16 season. Imports of other food items expected to increase include vegetables. The suspension of domestic electricity generation in the last quarter of 2015 increased the need of sourcing electricity from RSA. With the domestic electricity generation forecasted to be as low as 60GWh in 2016/17, against the country’s demand of 220MW, imports would have to be higher to meet domestic consumption.
2.6 Social Considerations

2.6.1 Food Insecurity

Almost 80 per cent of the Swazi population is rural-based with livelihoods predominantly dependent on subsistence farming and/or livestock rearing. Over the past years, multiple interrelated factors such as small fragmented land holdings and minimal access to agricultural inputs, reduced employment opportunities, market inefficiencies and high HIV/AIDS prevalence have contributed to chronic food insecurity and gradually weakening livelihoods (Osen and Masarirambi, 2011). Households’ vulnerability to food insecurity has increased given that the country’s agricultural system is largely dominated by a single crop, rain-fed maize, which has been reported (MOAC, 2015) to have been severely affected by the drought in terms of area planted and the projected decline in production during the 2014/15 planting season. According to the VAC report, the drought has had a negative impact on the total number of people in need of immediate assistance which was estimated at 44,622 in July 2015 and it is projected to increase to 200,897 as the drought persists.

The Swaziland Comprehensive National Drought Response Plan is targeting 320,000 destitute people affected by the drought which are mostly in the Lubombo and Shiselweni Regions (Times of Swaziland, 2016). The impact of the drought is estimated to affect a population of 83,573 on food security as a result of the crop damages in the selected ecological zones. According to the Crop and Food Security Assessment Mission (CFSAM) report, at least 23.7 per cent of the Swazi population are severely food insecure. The Lubombo region was the most affected with 11.3 per cent of households falling into the poor food consumption category and 28 per cent in the borderline food consumption. The Lubombo region was followed by the Shiselweni region at 5.4 per cent while the Hhohho and Manzini Regions were better off (CFSAM, 2015). The report further noted that poorly integrated food markets, the high price of agricultural inputs, food imports and the very low incomes of rural small holders, promote their exposure to climate shocks and magnified the role of climate as a driver of food insecurity.

It has been reported that there is a need for a Comprehensive Food Security and Vulnerability Analysis (CFSVA) in the affected areas to ascertain the severity and magnitude of the damage as well as come up with appropriate recommendations to advise on the appropriate assistance to reduce vulnerability and food insecurity (NEWU, 2015). According to the 2015/16 Drought Assessment report from the Deputy Prime Ministers office, about 550,744 people are projected to have livelihood deficit during the 2016/17 consumption year, of which 275,274 would be in food deficit, which will result in high levels of malnutrition and put strain on health facilities. A survey undertaken through the Rapid Assessment report revealed that food consumption patterns have already been altered for 68 per cent of households with coping strategies ranging from decreasing the number of meals per day to decreasing the types of foods consumed. Food insecurity has also
worsened for urban population as a result of drought mainly reinforced by significant increases in food prices.

3. Summary

The drought caused by El Nino was more severe in 2015/16 than the one in 1992/93. Rainfall received in the 2015/16 fell drastically with water in some dams and rivers drying up, reaching extremely low levels. Due to the lower-than-expected rainfall, major sectors of the economy such as agriculture, manufacturing, financial sector and government (fiscal) sector have been negatively affected; some of the effects will be seen in the short to medium-term.

In the agricultural sector, maize production in 2015/16 is estimated to have decreased by 64 per cent, cotton production by 90 per cent and sugar cane yields by 10 per cent. Livestock mortality grew by 49 per cent in 2015.

In the manufacturing sector, sugar production is projected to decrease by 25 per cent in 2016. Drought effects on meat production are expected to be seen in the short to medium-term as cattle population will be negatively affected by low birth rates and high mortality rate. Water and electricity production have also been affected by the severe drought. Due to the huge drop in water levels in dams and rivers, electricity generation was at its lowest, falling by 47 per cent in 2015/16 due to suspension of generation in major plants. Water sales were only affected in the North-West region, mainly Mbabane where water rationing was effected in residential areas due to drastic fall of water level at Hawane Dam. The financial sector was not spared from the drought effects as the major source of revenue for commercial banks, credit extension, especially to agriculture sector that fell by 39 per cent.

The effects of the drought were not observed only in the private sector but also in the Government sector where both revenue and expenditure were affected. The loss in revenue is associated with the poor performance of the business sector resulting in low taxes paid. With the severe drought effects taking their toll on citizens, especially in the Shiselweni and Lubombo regions, the government was forced intervene and implement relief measures that were not initially included in the county’s budget.

The effects of the severe drought have resulted in an increase in food prices, worsened vulnerability and food insecurity, job losses, loss of income, increase in cost of production, increase in imports, and decrease of exports. Overall, this indicates that there has been a loss in the country’s GDP, making the eradication of poverty in the country a difficult task. The drought conditions have also exposed the country’s vulnerability to severe weather conditions. The country’s policy makers need to come up with short-term and long-term plans to moderate its exposure to risks associated with severe weather conditions. The paper recommends to government to pursue drought sensitive farming programs with farmers, improve existing dams whilst at the same time constructing new ones.
REFERENCES


Swaziland Water Services and Corporation (2016). ‘Active Connections and Consumption tables


APPENDIX A
### Appendix A

#### Table 1: Unit Root Test Results at first difference

<table>
<thead>
<tr>
<th>Variable</th>
<th>Augmented Dickey-Fuller</th>
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<td>Trend and Intercept</td>
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<td>LogINV</td>
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Note: ***, **, * = significant at the 1%, 5%, 10% Level.

#### Table 2: Model 1 Pairwise Granger Causality Test

<table>
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<tr>
<th>Null Hypothesis:</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
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### Table 3: Model 2 Pairwise Granger Causality Tests

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### Table 4: Model 3 Pairwise Granger Causality Tests

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<td>LM2 does not Granger Cause RSVREQ</td>
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Table 6: Johansen Cointegration test results

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<th>Model 3</th>
<th>Model 4</th>
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<td>237.4448*</td>
<td>249.3029*</td>
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<tr>
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<td>At most 3</td>
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<td>0.209404*</td>
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<tr>
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<tr>
<td>At most 2</td>
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* denotes rejection of the hypothesis at the 0.05 level

Figure 7: Inverse roots of characteristic polynomials

Model 1

![Inverse Roots of AR Characteristic Polynomial](image1)

Model 2

![Inverse Roots of AR Characteristic Polynomial](image2)

Model 3

![Inverse Roots of AR Characteristic Polynomial](image3)
Figure 8: Impulse Response for model 1 (shock to the discount rate)

Table 7: Variance Decomposition of LRGDP

<table>
<thead>
<tr>
<th>Period</th>
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<th>LRGDP</th>
<th>LCPI</th>
<th>TBR</th>
<th>LM2</th>
<th>LBSCR</th>
<th>LHHCR</th>
<th>LSAV</th>
<th>LINV</th>
</tr>
</thead>
<tbody>
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<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
</tr>
<tr>
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<td>0.3532</td>
<td>0.5604</td>
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<td>0.1639</td>
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Table 8: Variance Decomposition of LCPI

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<th>LCPI</th>
<th>TBR</th>
<th>LM2</th>
<th>LBSCR</th>
<th>LHHCR</th>
<th>LSAV</th>
<th>LINV</th>
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<tbody>
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Figure 9: Impulse Response for model 2 (shock to the liquidity requirement)

Table 9: Variance Decomposition of LRGDP

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<th>LRGDP</th>
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<th>TBR</th>
<th>LM2</th>
<th>LBSCR</th>
<th>LHHCR</th>
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<th>LINV</th>
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Table 10: Variance Decomposition of LCPI

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<th>LCPI</th>
<th>TBR</th>
<th>LM2</th>
<th>LBSCR</th>
<th>LHHCR</th>
<th>LSAV</th>
<th>LINV</th>
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Figure 10: Impulse Response for model 3 (shock to the reserve requirement)

Table 11: Variance Decomposition of LRGDP

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<th>LRGDP</th>
<th>LCPI</th>
<th>TBR</th>
<th>LM2</th>
<th>LBSCR</th>
<th>LHHCR</th>
<th>LSAV</th>
<th>LINV</th>
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Table 12: Variance Decomposition of LCPI

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<th>LCPI</th>
<th>TBR</th>
<th>LM2</th>
<th>LBSCR</th>
<th>LHHCR</th>
<th>LSAV</th>
<th>LINV</th>
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<td>0.4642</td>
<td>0.8532</td>
<td>2.5454</td>
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</table>
APPENDIX B
Appendix B

Graph 1: Seigniorage Compensation, 1974-2018.

Source: Central Bank of Swaziland Quarterly Reviews

Graph 2: Growth in Seigniorage Compensation, 1974-2018

Source: Central Bank of Swaziland Quarterly

Graph 3. Growth in ZAR in Circulation in South Africa, 1974-2018

Source: Central Bank of Swaziland Quarterly

Source: Central Bank of Swaziland Quarterly


Source: Central Bank of Swaziland Quarterly

Source: Central Bank of Swaziland and South African Reserve Bank
Appendix C

Figure 1: Domestic Credit to the Private (percentage of GDP)

![Graph 1: Domestic Credit to the Private (percentage of GDP)](image)

Source: World Data Bank, 2016

Table 1: Unit Root Test Results

<table>
<thead>
<tr>
<th>Variable</th>
<th>ADF Intercept</th>
<th>ADF Trend and Intercept</th>
<th>Philips Perron Intercept</th>
<th>Philips Perron Trend and Intercept</th>
<th>None Intercept</th>
<th>None Trend and Intercept</th>
<th>Order I(d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>logVEH</td>
<td>-6.139***</td>
<td>-6.167***</td>
<td>-0.053***</td>
<td>-10.011***</td>
<td>-10.02***</td>
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<td></td>
</tr>
<tr>
<td>LogHH</td>
<td>-2.777*</td>
<td>-3.629</td>
<td>-2.176</td>
<td>-3.217*</td>
<td>3.073</td>
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<tr>
<td>logDT</td>
<td>-3.339**</td>
<td>0.169</td>
<td>-2.986**</td>
<td>-2.913**</td>
<td>0.236</td>
<td>I(0)</td>
<td></td>
</tr>
<tr>
<td>logTC</td>
<td>-2.859*</td>
<td>-0.234</td>
<td>-2.668*</td>
<td>4.777***</td>
<td>0.329</td>
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<td></td>
</tr>
<tr>
<td>Logman</td>
<td>-3.701***</td>
<td>0.098</td>
<td>-3.707***</td>
<td>-4.651***</td>
<td>0.381</td>
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<tr>
<td>logAGRF</td>
<td>-2.940*</td>
<td>-0.413</td>
<td>-2.940*</td>
<td>-3.198*</td>
<td>-0.550</td>
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</tr>
<tr>
<td>Disc rate</td>
<td>-9.856***</td>
<td>-9.835***</td>
<td>-10.605***</td>
<td>-10.585***</td>
<td>I(1)</td>
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<td></td>
</tr>
<tr>
<td>Liquidity rate</td>
<td>-10.863***</td>
<td>-10.817***</td>
<td>-10.863***</td>
<td>-10.82***</td>
<td>I(1)</td>
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<td></td>
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<tr>
<td>Reserve requirement</td>
<td>-10.863***</td>
<td>-10.817***</td>
<td>-10.863***</td>
<td>-10.818</td>
<td>I(1)</td>
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Note: ***, **, * = Significant at 1%, 5% and 10%, respectively.
Table 2: VAR Lag Order Selection Criteria

<table>
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<tr>
<th>Lag</th>
<th>LogL</th>
<th>LR</th>
<th>FPE</th>
<th>AIC</th>
<th>SC</th>
<th>HQ</th>
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<td>2.24e-11</td>
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<td>-1.625453</td>
<td>-1.740847</td>
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<td>1447.734</td>
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<td>-14.73244*</td>
<td>-12.98484*</td>
<td>-14.02339*</td>
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<tr>
<td>3</td>
<td>979.1120</td>
<td>46.42799</td>
<td>1.33e-16</td>
<td>-13.91271</td>
<td>-9.058252</td>
<td>-11.94310</td>
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<td>1.95e-16</td>
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<td>-11.01440</td>
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<td>5</td>
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<td>3.83e-16</td>
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<td>-9.849684</td>
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Notes: * Indicates lag order selected by the criterion

Table 3: Johansen Cointegration Test Results

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<th>Model 3</th>
<th>Model 4</th>
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<tbody>
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<td>No. of CE(s)</td>
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<td></td>
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<td>133.0432</td>
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<td>At most 2</td>
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<tr>
<td>At most 3</td>
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<td>57.12531</td>
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<tr>
<td>At most 4</td>
<td>40.31203</td>
<td>33.11875</td>
<td>47.59440</td>
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<tr>
<td>At most 5</td>
<td>20.67817</td>
<td>15.30607</td>
<td>26.60201</td>
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<table>
<thead>
<tr>
<th>Maximum Eigenvalue Statistic</th>
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<th>Model 3</th>
<th>Model 4</th>
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<td>At most 3</td>
<td>24.39045</td>
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<td>At most 4</td>
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<td>At most 5</td>
<td>11.44152</td>
<td>11.05010</td>
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</table>

Source: Authors own calculations *denotes rejection of the null hypothesis (0.05)
### Table 4: Model 1 Pairwise Granger Causality

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<th>Null Hypothesis:</th>
<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
</tr>
</thead>
<tbody>
<tr>
<td>LVEH does not Granger Cause DR</td>
<td>107</td>
<td>0.89265</td>
<td>0.5577</td>
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<tr>
<td>DR does not Granger Cause LVEH</td>
<td></td>
<td>0.62651</td>
<td>0.8139</td>
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<tr>
<td>LHH does not Granger Cause DR</td>
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<td>2.14601</td>
<td>0.0223</td>
</tr>
<tr>
<td>DR does not Granger Cause LHH</td>
<td></td>
<td>2.08695</td>
<td>0.0266</td>
</tr>
<tr>
<td>LDT does not Granger Cause DR</td>
<td>107</td>
<td>1.68196</td>
<td>0.0859</td>
</tr>
<tr>
<td>DR does not Granger Cause LDT</td>
<td></td>
<td>1.58103</td>
<td>0.1134</td>
</tr>
<tr>
<td>LTC does not Granger Cause DR</td>
<td>107</td>
<td>0.97854</td>
<td>0.4761</td>
</tr>
<tr>
<td>DR does not Granger Cause LTC</td>
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<td>0.53128</td>
<td>0.8884</td>
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<td>LCONS does not Granger Cause DR</td>
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<td>2.74128</td>
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<tr>
<td>DR does not Granger Cause LCONS</td>
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<td>LAGF does not Granger Cause DR</td>
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<td>DR does not Granger Cause LAGF</td>
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### Table 5: Model 2 Pairwise Granger Causality

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<th>F-Statistic</th>
<th>Prob.</th>
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Table 6: Model 3 Pairwise Granger Causality

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<th>Obs</th>
<th>F-Statistic</th>
<th>Prob.</th>
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<tbody>
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<td>LVEH does not Granger Cause LRQ</td>
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<td>1.90817</td>
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<td>LRQ does not Granger Cause LVEH</td>
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<td>LHH does not Granger Cause LRQ</td>
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<td>LRQ does not Granger Cause LHH</td>
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<td>1.67700</td>
<td>0.0941</td>
</tr>
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<td>LDT does not Granger Cause LRQ</td>
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<td>0.3983</td>
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<td>LRQ does not Granger Cause LDT</td>
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<td>LTC does not Granger Cause LRQ</td>
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<td>0.7980</td>
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<td>LRQ does not Granger Cause LAGF</td>
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<td>0.64290</td>
<td>0.7974</td>
</tr>
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</table>

Figure 4: Inverse roots of characteristic polynomials

![Inverse roots of characteristic polynomials](image)

Figure 5: Impulse Response for Model 1 (Discount Rate) polynomials

![Impulse Response for Model 1](image)
Table 7: The Impact of the Discount Rate Shocks on Credit Extension to the Private Sector

<table>
<thead>
<tr>
<th>Period</th>
<th>DR to LVEH</th>
<th>DR to LHH</th>
<th>DR to LDT</th>
<th>DR to LTC</th>
<th>DR to LCONS</th>
<th>DR to LMAN</th>
<th>DR to LAGF</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.06965</td>
<td>1.75562</td>
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<td>1.16074</td>
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Figure 6: Impulse Response for Model 2 (Reserve Requirement)
Table 8: The Impact of Reserve Requirement Shocks on Credit Extension to the Private Sector

<table>
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<tr>
<th>Period</th>
<th>DR to LVEH</th>
<th>DR to LHH</th>
<th>DR to LDT</th>
<th>DR to LTC</th>
<th>DR to LCONS</th>
<th>DR to LMAN</th>
<th>DR to LAGF</th>
</tr>
</thead>
<tbody>
<tr>
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<td>0.1797</td>
<td>2.0027</td>
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<td>1.8091</td>
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<tr>
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</table>

Figure 7: Impulse Response for Model 3 (Liquidity Requirement)
Table 9: The Impact of Liquidity Requirement Shocks on Credit Extension to the Private Sector

<table>
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<tr>
<th>Period</th>
<th>DR to LVEH</th>
<th>DR to LHH</th>
<th>DR to LDT</th>
<th>DR to LTC</th>
<th>DR to LCONS</th>
<th>DR to LMAN</th>
<th>DR to LAGF</th>
</tr>
</thead>
<tbody>
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<td>3.931188</td>
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<td>4.163640</td>
<td>2.822762</td>
<td>0.928551</td>
<td>2.787498</td>
<td>6.370000</td>
<td>4.117501</td>
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</table>
APPENDIX D
Appendix D

Table 1. Description of Variables.

<table>
<thead>
<tr>
<th>Variables</th>
<th>Description</th>
<th>Source</th>
</tr>
</thead>
<tbody>
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<td>External variables</td>
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<tr>
<td>International oil prices (OPEC)</td>
<td>Interoilprice</td>
<td>OPEC crude oil prices Statista The Statistics Portal</td>
</tr>
<tr>
<td>US inflation rate</td>
<td>Usainfla</td>
<td>Average annual inflation rate Inflation.eu</td>
</tr>
<tr>
<td>US discount rate</td>
<td>usaannudisco</td>
<td>Average annual discount Federal Reserve of St. Louis FED.</td>
</tr>
<tr>
<td>South Africa discount rate</td>
<td>saannudisco</td>
<td>Average annual discount rate South African Reserve Bank (SARB)</td>
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<tr>
<td>Domestic variables</td>
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<td></td>
</tr>
<tr>
<td>Swaziland Inflation rate</td>
<td>Sainfl</td>
<td>Average annual Inflation rate Statistics South Africa</td>
</tr>
<tr>
<td>Swaziland discount rate</td>
<td>Sdannudisco</td>
<td>Average annual discount rate Central Bank of Swaziland</td>
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</table>

Graph 1: SD, RSA, and USA Interest Rates and International Oil Prices

Source: CBS, SARB, Statista The Statistics Portal and Federal Reserve of St. Louis FED
Graph 2: Average Annual Inflation Rates; and oil Prices

Source: CBS, SARB, Statista The Statistics Portal and Federal Reserve of St. Louis FED

Table 2. Augmented Dicky-Fuller Statistics for Testing for Unit Root.

<table>
<thead>
<tr>
<th>Variables</th>
<th>t-adf</th>
<th>Lag-length selection</th>
<th>Lag</th>
<th>Additional regressors</th>
</tr>
</thead>
<tbody>
<tr>
<td>International price of oil</td>
<td>0.175537</td>
<td>&gt;11.6I</td>
<td>-2.423630 (6)</td>
<td>Constant + trend</td>
</tr>
<tr>
<td>US average annual inflation index</td>
<td>-0.17718</td>
<td>&gt;11.6I</td>
<td>-3.910708 (8)</td>
<td>Constant + trend</td>
</tr>
<tr>
<td>USA average annual Discount rate</td>
<td>-1.475008</td>
<td>&gt;11.6I</td>
<td>3.191512 (8)</td>
<td>Constant + trend</td>
</tr>
<tr>
<td>South Africa average annual Discount rate</td>
<td>-1.233859</td>
<td>&gt;11.6I</td>
<td>2.447321(8)</td>
<td>Constant + trend</td>
</tr>
<tr>
<td>South Africa average annual inflation index</td>
<td>-1.489042</td>
<td>&gt;11.6I</td>
<td>2.882756(8)</td>
<td>Constant + trend</td>
</tr>
<tr>
<td>Swaziland average annual inflation index</td>
<td>1.999509</td>
<td>&gt;11.6I</td>
<td>5.482217(8)</td>
<td>Constant + trend</td>
</tr>
<tr>
<td>Swaziland average annual Discount rate</td>
<td>-2.455695</td>
<td>&gt;11.6I</td>
<td>-3.421852(2)</td>
<td>Constant + trend</td>
</tr>
<tr>
<td>Exchange rate</td>
<td>-0.886512</td>
<td>&gt;11.6I</td>
<td>2.168239(8)</td>
<td>Constant + trend</td>
</tr>
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</table>

Source: Central Bank of Swaziland, Federal Reserve of St. Louis FED and Statista the Statistics Portal.
Table 2.1 First Difference Stationarity.

<table>
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<th>Additional regressors</th>
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</thead>
<tbody>
<tr>
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<td>-6.1707***</td>
<td>&gt;1.6I</td>
<td>6</td>
<td>Constant</td>
</tr>
<tr>
<td>US average annual inflation index</td>
<td>-4.72354***</td>
<td>&gt;1.6I</td>
<td>8</td>
<td>Constant</td>
</tr>
<tr>
<td>US average annual discount rate</td>
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<td>&gt;1.6I</td>
<td>8</td>
<td>Constant</td>
</tr>
<tr>
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<td>&gt;1.6I</td>
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</tr>
<tr>
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<td>Constant</td>
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<td>8</td>
<td>Constant</td>
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<td>&gt;1.6I</td>
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<tr>
<td>Exchange rate</td>
<td>-4.49516***</td>
<td>&gt;1.6I</td>
<td>8</td>
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Source: Central Bank of Swaziland, Federal Reserve of St. Louis FED and Statista the Statistics Portal.

Table 2.2 Inflation levels Stationarity Tests.

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<th>Additional regressors</th>
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<tr>
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<tr>
<td>2. SA Inflation</td>
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<td>10</td>
<td>Constant</td>
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<tr>
<td>3. SD Inflation</td>
<td>-3.652912**</td>
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<td>Constant</td>
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</table>

Source: Central Bank of Swaziland, Federal Reserve of St. Louis FED and Statista the Statistics Portal.

Table 3. Unrestricted Cointegration Rank Test (Trace).

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Trace Statistics</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>0.812786</td>
<td>162.2885</td>
<td>125.6154</td>
<td>0.0000</td>
</tr>
<tr>
<td>At most 1*</td>
<td>0.707888</td>
<td>110.3478</td>
<td>95.75366</td>
<td>0.0034</td>
</tr>
<tr>
<td>At most 2*</td>
<td>0.560258</td>
<td>72.19866</td>
<td>69.81889</td>
<td>0.0319</td>
</tr>
<tr>
<td>At most 3</td>
<td>0.444758</td>
<td>46.73008</td>
<td>47.85613</td>
<td>0.0635</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.372052</td>
<td>28.49120</td>
<td>29.79707</td>
<td>0.0701</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.358175</td>
<td>14.06699</td>
<td>15.49471</td>
<td>0.0811</td>
</tr>
<tr>
<td>At most 6</td>
<td>0.010281</td>
<td>0.320355</td>
<td>3.841466</td>
<td>0.5714</td>
</tr>
</tbody>
</table>
Table 3.1. Unrestricted Cointegrating Rank Test (Maximum Eigenvalue).

<table>
<thead>
<tr>
<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Max-Eigen Statistics</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
<tr>
<td>None*</td>
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<td>51.94066</td>
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<td>At most 1</td>
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<td>0.0811</td>
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<tr>
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<tr>
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<td>0.444758</td>
<td>18.23888</td>
<td>27.58434</td>
<td>0.4753</td>
</tr>
<tr>
<td>At most 4</td>
<td>0.372052</td>
<td>14.42421</td>
<td>21.13162</td>
<td>0.3312</td>
</tr>
<tr>
<td>At most 5</td>
<td>0.358175</td>
<td>13.74663</td>
<td>14.26460</td>
<td>0.0602</td>
</tr>
<tr>
<td>At most 6</td>
<td>0.010281</td>
<td>0.320355</td>
<td>3.841466</td>
<td>0.5714</td>
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</table>

Graphs 4. Residuals Graph.

Table 4. Unrestricted Cointegration Rank Test (Trace).

<table>
<thead>
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<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Trace Statistics</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
<tbody>
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<td>125.6154</td>
<td>0.0000</td>
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<tr>
<td>At most 1*</td>
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<td>95.75366</td>
<td>0.0031</td>
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<td>69.81889</td>
<td>0.0561</td>
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<td>At most 3</td>
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<td>At most 4</td>
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<td>19.20622</td>
<td>29.79707</td>
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<td>0.187371</td>
<td>7.589748</td>
<td>15.49471</td>
<td>0.5103</td>
</tr>
<tr>
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<td>0.044491</td>
<td>1.365321</td>
<td>3.841466</td>
<td>0.2426</td>
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</table>
Table 5. Unrestricted Cointegration Rank Test (Maximum Eigen value).

<table>
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<th>Hypothesized No. of CE(s)</th>
<th>Eigenvalue</th>
<th>Max-Eigen Statistics</th>
<th>0.05 Critical Value</th>
<th>Prob.**</th>
</tr>
</thead>
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<td>46.23142</td>
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</tr>
<tr>
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<td>0.749859</td>
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<tr>
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<td>0.2071</td>
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<tr>
<td>At most 3</td>
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<td>27.58434</td>
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<tr>
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<td>21.13162</td>
<td>0.5858</td>
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<td>14.26460</td>
<td>0.5846</td>
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<tr>
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<td>1.365321</td>
<td>3.841466</td>
<td>0.2426</td>
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</table>

Graph 8. Residuals

Graphs showing residuals for various series over the years from 1985 to 2010.
Graph 18. Swaziland Inflation Demonstrating Shocks.

Source: Central Bank of Swaziland

Graphs 26. Impact of External Shocks on Domestic Discount Rate.
Table 6. The Importance of External shocks on Inflation excluding Domestic Discount Rates.

<table>
<thead>
<tr>
<th></th>
<th>SD Inflation</th>
<th>SA Inflation</th>
<th>dlogZAR/USD</th>
<th>dlogSA Dr</th>
<th>dlogIntern. Price Oil</th>
<th>dlogUSA Dr</th>
<th>USA Inflation</th>
</tr>
</thead>
<tbody>
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<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
<td>0.0000</td>
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<td>5.4695</td>
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<td>6.1688</td>
<td>8.3655</td>
<td>7.3793</td>
<td>4.4626</td>
<td>18.2112</td>
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<tr>
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<td>49.752</td>
<td>6.1536</td>
<td>8.4119</td>
<td>7.5354</td>
<td>4.4197</td>
<td>18.4019</td>
<td>5.3251</td>
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</table>

Table 7. The Importance of External Shocks on Domestic Inflation Rate.

<table>
<thead>
<tr>
<th></th>
<th>SD Inflation</th>
<th>SD Disc. rate</th>
<th>SA Inflation</th>
<th>Exchange Rate(ZAR/USD)</th>
<th>SA Disc. rate</th>
<th>Intern. Price of Oil</th>
<th>USA Disc. rate</th>
<th>USA Inflation</th>
</tr>
</thead>
<tbody>
<tr>
<td>100.00</td>
<td>0.0000</td>
<td>0.00</td>
<td>0.00</td>
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<td>0.00</td>
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<td>0.00</td>
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</tr>
<tr>
<td>90.80</td>
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<td>0.83</td>
<td>1.71</td>
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<td>0.33</td>
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<tr>
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<td>9.51</td>
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<td>8.90</td>
<td>4.49</td>
<td>4.80</td>
<td>18.25</td>
<td>1.19</td>
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<td>1.18</td>
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<tr>
<td>48.56</td>
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<td>3.90</td>
<td>8.74</td>
<td>4.73</td>
<td>4.72</td>
<td>18.64</td>
<td>1.18</td>
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Appendix E

Table 8. Variance Decomposition of Domestic Discount Rate.

<table>
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<tr>
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<th>SD Inflation</th>
<th>SD Disc. Rate</th>
<th>SA Inflation</th>
<th>Exch. Rate ZAR/USD</th>
<th>SA Disc. Rate</th>
<th>Intern. Price of Oil</th>
<th>US Discount Rate</th>
<th>US Inflation</th>
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<td>1</td>
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<td>0.000</td>
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</tr>
<tr>
<td>2</td>
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<td>6.861</td>
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<tr>
<td>4</td>
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<tr>
<td>9</td>
<td>21.045</td>
<td>38.847</td>
<td>4.697</td>
<td>3.689</td>
<td>11.622</td>
<td>6.556</td>
<td>13.007</td>
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<tr>
<td>10</td>
<td>20.998</td>
<td>38.739</td>
<td>4.77</td>
<td>3.758</td>
<td>11.636</td>
<td>6.568</td>
<td>12.983</td>
<td>0.547</td>
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</table>

Appendix F

Table 5: Major differences between the old and new weights

<table>
<thead>
<tr>
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<th>OLD INDICES</th>
<th>NEW INDICES</th>
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<tbody>
<tr>
<td>Base year</td>
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<td>2010</td>
</tr>
<tr>
<td>Price indices</td>
<td>CPI</td>
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</tr>
<tr>
<td>Sloping (vice versa)</td>
<td>Increase - depreciation</td>
<td>Increase - appreciation</td>
</tr>
<tr>
<td>Weight determination</td>
<td>Exports</td>
<td>Exports</td>
</tr>
<tr>
<td>Averaging</td>
<td>Arithmetic</td>
<td>Geometric</td>
</tr>
<tr>
<td>Weights and trading partner</td>
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<td></td>
</tr>
<tr>
<td>RSA</td>
<td>68.8</td>
<td>RSA</td>
</tr>
<tr>
<td>UK</td>
<td>7.3</td>
<td>EURO</td>
</tr>
<tr>
<td>France*</td>
<td>4.8</td>
<td>Mozambique</td>
</tr>
<tr>
<td>Portugal*</td>
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<td>USA</td>
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<td>Nigeria</td>
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<td>Thailand</td>
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<td>UK</td>
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<td>USA</td>
<td>3.0</td>
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<td>Belgium*</td>
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<td>China</td>
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NB: *Countries were grouped to form the Euro
Appendix G

Figure 17: Inflation Developments

Source: Central Statistics Office (CSO)
Box 1: Background on El Niño Event

According to the US National Ocean service, the term El Niño refers to the large-scale ocean-atmosphere climate interaction linked to a periodic warming in sea surface temperatures across the central and east-central Equatorial Pacific which affects the atmospheric circulation worldwide. Scientists believe that the phenomenon has been around for thousands of years, but the droughts and floods they trigger may be becoming more intense as a result of climate change. According to Kennedy (2016), waters across the tropical Pacific Ocean continued to be much warmer than average in January 2016, suggesting that El Niño still had a grip on the basin. The Ocean Nino Index (ONI) is one of the primary indicators used to monitor El nino (and La’ Nina). The ONI is based on sea surface temperatures (SST) in east-central tropical Pacific Ocean. The ONI tracks the 3-month average of SST. El’nino conditions are deemed to be present when ONI is +0.5 or higher indicating that the east central tropical pacific is significantly warmer than usual.

Figure 1: Ocean Nino index (ONI)

According to the African Climate and Development Initiative (ACDI), during 2015 the Pacific became even warmer leading to one of the strongest El Niño events ever observed. Research shows that eight of the ten strongest droughts in southern Africa since 1900 occurred during the mature phase of El Niño. It has also been noted that El Niño events have led to a severe drought half of the time they occurred. The effect of El Niño on droughts has been exacerbated over the past 50 years. This has been because continental and oceanic temperatures have risen globally but not uniformly during due to the increase in carbon dioxide.

Given that El Niño does not result in a drought 100% of the time, it is important to establish what measures should be taken in the case of a risk of drought. This would enable countries to prepare for major disturbances which are increasing in frequency as a result of climate change. It is imperative for countries and individual citizens, to take preventive measures for what is now known to be a recurring pattern in southern Africa. This includes selling cattle, restricting water, fixing leaks, planting drought resistant crops and getting ready for a drought.