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MONEY CHANNEL OF MONETARY POLICY TRANSMISSION IN NAMIBIA

Abstract

There is an argument that being in an exchange rate pegging arrangement limits the scope of using interest rate to control money supply to affect output or inflation but here is a point of contention in the case of Namibia. This is due to the fact that the major concern in an exchange rate pegging arrangement is that it obliges the central bank (BoN) to limit money creation to levels comparable to those of the anchor country (South Africa), to which the Namibia dollar is pegged. This is because the process of money creation is associated with increase in domestic inflation pressures. This study includes four variables: real output; consumer price level; aggregate money supply; and repo rate, in the structural vector error correction (SVECM) model, to analyse the money channel for monetary policy transmission in Namibia. The model estimated utilised quarterly time-series data covering the period 2000:Q1 to 2016:Q4. The results show that money supply contains information on the monetary policy transmission process, but, there are more factors involved in the responses of output to the repo rate shocks than consumer prices alone.

Keywords: Structural Vector Error Correction, Exchange Rate Pegging, Money, Monetary Policy, Namibia
JEL Classification: E5, E52

Riassunto

Il canale di trasmissione della politica monetaria in Namibia

Il tasso di cambio fisso è talvolta considerato una limitazione al metodo di controllo della domanda di moneta al fine di influenzare la produzione o l'inflazione, ma nel caso della Namibia non è così. Ciò perché il problema principale in un paniere di tassi di cambio è che la banca centrale della Namibia è obbligata a limitare l'emissione di valuta a livelli comparabili a quelli del paese (in questo caso il Sud Africa) al quale il dollaro della Namibia è agganciato. Questo perchè il processo di emissione di moneta è associato all'aumento delle pressioni inflazionistiche interne. In questo articolo sono incluse 4 variabili: produzione reale, prezzi al consumo, domanda aggregata di moneta e tasso repo. Il modello applicato è quello a correzione vettoriale strutturale dell'errore (SVECM) al fine di analizzare il canale di trasmissione della politica monetaria in Namibia. I dati utilizzati sono trimestrali e time series per il periodo primo trimestre 2000-quarto trimestre 2016. I risultati mostrano che la domanda di moneta può dare indicazioni sui processi di trasmissione della politica monetaria, ma altri fattori sono da ricercare nella risposta della produzione agli shock del tasso di cambio piuttosto che dei prezzi al consumo.

1. Introduction

After independence, Namibia's monetary policy conduct involved the practice of adopting a fixed exchange rate, under which exchange rate becomes the main policy instrument used to control inflation in order to maintain financial stability (BON, 2008). This has been the practice since 1990, at the time of independence, when Namibia was confronted with a situation of choosing between different monetary policy options and exchange rate regimes. The two options that were available to Namibia were (1) to leave the Common Monetary Area (CMA[1]) to pursue an independent monetary policy, such as the use of interest rate by the central bank on money supply to influence the economy, or (2) to remain in the CMA. The country chose the second option. In the process the country's exchange rate was pegged to that of South Africa, particularly, the Namibian dollar was then pegged to the South African rand on a one-to-one basis in line with the requirement to satisfy the backing rules (Kalenga, 2001). The South African rand remained legal tender in Namibia.

Namibia uses interest rate as a monetary policy tool (Kalenga, 2001). However, there is an argument that being in an exchange rate pegging arrangement limits the scope of using interest rate to control money supply to affect output or inflation. For example, in the case of Namibia's exchange rate pegging arrangement, the Bank of Namibia is compelled to limit money creation to excessive levels. This is because the process of money creation is attributed to increased domestic inflationary pressures (Mishkin, 2001). However, the money effect model is viewed as

[1] The CMA was formerly known as the Rand Monetary Area, which consisted of Botswana, Lesotho, Swaziland and South Africa. Botswana moved out in 1976 and Namibia joined in 1990 after attaining independence. The CMA is now comprised of the following members: Lesotho, Swaziland, Namibia and South Africa.

an alternative channel of monetary policy transmission by the monetarist school of thought. In particular, this channel downplays the role of interest rates and liquid asset adjustment in the transmission mechanism. Thus, it reduces the process of a direct link between changes in aggregate money supply and absorption (Bolnick, 1991). Accordingly, there is a response of prices and output to monetary impulses because of inaccurate predictions of past and future anticipated actions by households and businesses (Meltzer, 1995). The study draws its motivation from that viewpoint to determine whether or not the Namibian authorities applied corrective measures by maintaining the peg through the control of monetary growth.

The paper is organised as follows: the next section presents a literature review. Section 3 discusses the methodology. The empirical analysis and results are presented in section 4. Section 5 concludes the study.

2. LITERATURE REVIEW

The money effect channel challenges the role of interest rates and liquidity adjustment in the transmission mechanism (Bolnick, 1991). In this regard, the response of prices and output to monetary impulses is triggered by the failure of households and businesses to anticipate all the future implications of past and current actions (Meltzer, 1995). Ngalawa (2009) put it well by arguing that the cause of this is the time lag between observing the impulses and differentiating between permanent and transitory impulses, as well as real and nominal shocks. A monetary shock drives a wedge between money supply and money demand, allowing for portfolio adjustments, which in turn also alters spending decisions.

For small open economies the transmission mechanism in a Currency-Board Framework also requires particular attention as it plays a significant role in the transmission mechanism. According to Uanguta and Ikhide (2002) the monetary rule requires an adjustment in the monetary base to have a corresponding change in foreign reserves at a fixed exchange rate. Therefore, there is a need to undertake some form of convertibility for the currency board to convert local currency into foreign reserves at a fixed exchange rate. Hence, the settlement of transactions arising should be effected through the monetary base to allow for automatic adjustment mechanism that ensures exchange rate stability. Moreover, the currency board is required and expected to hold an adequate amount of foreign reserves to meet the expected reduction in the monetary base in stressful conditions. In view of the above, the monetary rule is more focused on the flow rather than the stock of the monetary base.

The obvious question would be, what is the money supply process in the currency-board arrangement? Uanguta and Ikhide (2002) answered this question as follows:

"Apropos [to] (sic.) the stability of the fixed exchange rate arrangement (sic.) [there] is the agile functioning of the transmission mechanism inherent in the money supply process in the arrangement".

Monetary base constitutes the notes and coins issued by the Currency board together with the deposits held by commercial banks at the currency board. Therefore, strictly speaking, a currency board does not have the liberty to determine the monetary base in the presence of a fixed exchange rate arrangement with the reserve currency and a fixed reserve ratio of 100 per cent foreign reserves. Typically central banks have discretion to increase the monetary base by lending to commercial banks, which enables them to create reserves even when faced with a decline in foreign reserves (Uanguta and Ikhide, 2002). On the other hand, a currency board is limited in affecting the relationship between the monetary base and the money supply because of its inability to create reserves for commercial banks (in an inflationary manner) as it is done by a conventional central bank. It follows that in a currency-board system money supply is fully determined by the balance of payments (BoP) and it is responsive to changes in demand (Uanguta and Ikhide, 2002). The authors further state that, in a currency-board framework, foreign reserves can be expanded by running a current account surplus. Hence, the monetary process in this system is automatic, as it is self-adjusting provided the various actors in the system do not tamper with the transmission process. However, it is well documented that there will always be some tampering with the transmission process and that warrants an investigation of this channel and there is voluminous empirical literature on this channel of monetary policy transmission mechanism. Bernanke (1986) conducted a study relating to the situation in the USA using quarterly data for the period 1953:Q1 to 1984:Q4. The analysis was undertaken by utilising a structural reduced-form vector auto-regression (SVAR) model for six variables namely: real gross national product; gross national product price deflator; real defense spending; money stock; credit variables; and nominal interest rate. The study revealed that credit shocks affect output and are thus, important for output. However, money and credit are approximately equally important for monetary transmission mechanism in USA. On the situation in the same country, Friedman (1988) also conducted a study but using quarterly data for the period 1953:Q1 to 1978:Q4. This study estimated two separate vector auto-regression (VAR) models, one with three variables while the other with four variables. The findings for the study are that both money and credit equally affect prices. Similar to Bernanke's findings, this suggests a two-target monetary policy framework based on both money and credit. Similarly, Bernanke and Blinder (1988) employed instrumental variables of logarithmic partial adjustment model on quarterly data for the period 1974:Q1 to 1985:Q4 on USA. The results showed that money demand shocks are more important than credit-demand shocks. However there is no strong evidence to reject the role of credit-demand, and thus warrant a symmetric treatment of money and credit.

Saxena (2008) examined the pattern of excess liquidity in Sub-Saharan Africa and its consequences for the effectiveness of monetary policy using a non-linear structural or threshold vector auto-regressive (SVAR) model. The model that was applied, employs quarterly data for the period 1990 to 2004 for countries such as the Central African Economic and Monetary Community (CEMAC) region, Nigeria, and Uganda. The results showed that money supply shock has weaker impact on real output and inflation, particularly, when bank liquidity is high in Nigeria and Uganda with no effect in the CEMAC. This suggests that excess liquidity undermines and/or weakens the monetary policy transmission mechanism.

Dabla-Norris and Floerkemeier (2006) analysed monetary policy transmission in Armenia. The study employed VAR on monthly data for the period 2000: 5 to 2005: 12. Furthermore, the study also applied a multivariate and bivariate block-wise Granger causality tests to examine the causal relationships between monetary policy and economic outcomes. The findings showed a joint significance of all three policy variables on both output and prices. The bivariate model showed that monetary aggregates have a significant Granger-cause effect on output but not on prices. On the contrary, the repo rate affects prices, but not output. Similarly, Samkharadze (2008) analysed monetary policy transmission in Georgia. In this study a VAR approach with Cholesky ordering was employed on monthly data for the period 2002: 6 to 2007: 5. The empirical findings revealed significant effects of monetary aggregates on inflation and real GDP.

Jayaraman and Choong (2008) analysed monetary policy transmission mechanism in Fiji. A VAR modelling approach was used on quarterly data for the period 1990: Q1 to 2006: Q4. The findings revealed that the money channel is the most important amongst the four channels investigated.

The study by Elias and Kulish (2010) examined the direct effects of money on aggregate demand in Australia, Japan, United Kingdom and United States. The study employed a structural model on quarterly data for the period 1961:Q1 to 2009:Q4, though there was some variation in terms of period analysis. The paper revealed that produce positive and statistically significant coefficients on real money growth, similar to those often found when using actual data.

Sheefeni (2013) investigated the role of monetary policy in Namibia for the period 1993 to 2011. The study specifically analysed the relative importance of the different channels of monetary policy transmission using a SVAR and SVECM on quarterly data. Furthermore, the study also examined the exchange rate pass-through from exchange rate to domestic prices using both SVAR/SVECM and the single equation error correction model (ECM). Estimation results based on the different channels of monetary policy transmission mechanism, showed that the interest rate channel and the credit channel are effective in transmitting monetary policy actions. The exchange rate channel is also operative but not effective. The money effect model confirms that inflation in Namibia is not a monetary phenomenon. The results of the pass-through relationship showed that there is an incomplete but high exchange rate pass-through from exchange rate to domestic prices.

Funda (2014) examined the effectiveness of the interest rate channel of monetary policy transmission in Zambia. The study employed a VAR model, specifically looking at the reduced-form relationships between money supply, inflation, real interest rate and real output. The analysis utilised annual data for the period 1980 to 2011. The main findings from the basic VAR model suggest that a decrease in money supply leads to a fall in output but with lags, though it is small but statistically significant. On the contrary, an increase in money supply results in a rise in inflation with lags too and the magnitude is small but statistically significant. When real interest rate variable is incorporated into the model, money supply still affects output, inflation and the real interest rate but the magnitudes are small and statistically insignificant. Therefore, though the money supply affects output and inflation, the interest rate channel is not effective in Zambia.

The lessons from literature are that, there are more studies on developed countries with regard to the money channel of monetary policy transmission. On the other hand, there are few studies from developing countries on this channel. It follows that, there are mixed results where some find that the money channel is effective while other studies find the opposite. However, there are also variations in the statistical significance of the effectiveness. Secondly, there are also variations in econometric techniques employed in analysing the interrelationship between the variables.

In Namibia, the only study that has touched on the issue of money channel is that of Uanguta and Ikhide (2002). However, this study only looked at interest rate and the credit channel, leaving a gap by not examining the money channel. Furthermore, Sheefeni's (2013) comprehensive model of analysing the interest rate, credit, exchange rate and money channels only ended in 2011, leaving a gap of five years. A lot of changes might have taken place during that time and could reveal new information about the money channel. Therefore, this calls for a renewed study on the money channel to fill this gap.

3. METHODOLOGY

3.1 Empirical Framework

This study estimates a structural vector auto-regression model to analyse the money channel mechanism of monetary policy transmission in Namibia as it was used by Sheefeni (2013). It builds on Sim's approach, but according to Bwire *et al.* (2013), this approach is appropriate as it allows for the identification of the impulse responses by imposing *a priori* restrictions on the covariance matrix of the structural errors and/or on long-run impulse responses themselves. Furthermore, the SVAR permits contemporaneous relationships between the elements of a vector of endogenous variables. This in turn, allows the modelling of dynamic and contemporaneous endogenous factors between variables.

To draw up the SVAR mainframe, assume that Namibia's monetary transmission process is described by a dynamic system whose structural form equation is given by:

$$Ax_t = \Phi + \Psi_1 x_{t-1} + \Psi_2 x_{t-2} + \cdots + \Psi_p x_{t-p} + B\mu_t \tag{1}$$

where A is an invertible $(n \times n)$ matrix describing contemporaneous relations among the variables; x_t is an $(n \times 1)$ vector of endogenous variables such that: $y_t = (y_{1t}, y_{2t}, \dots, y_{nt})$; Φ is a vector of constants; Ψ_i is an $(n \times n)$ matrix of coefficients of lagged endogenous variables $(\forall_i = 1,2,3, \dots, p)$; B is an $(n \times n)$ matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on one or more endogenous variables in the system; and μ are uncorrelated or orthogonal white-noise structural disturbances i.e., the covariance matrix of μ_t is an identity matrix $(\mu_t, \mu_t' = 1)$. Equation (1) can be rewritten in compact form as:

$$Ax_t = \Phi + \Psi(\mathrm{L})x_{t-i} + B\mu_t \tag{2}$$

where $\Psi(\mathrm{L})$ is a $(n \times n)$ finite order matrix polynomial in the lag operator L.

Analysis of monetary transmission mechanism(s) using VAR models is really about monetary policy shocks and their dynamic behaviour in the system. Thus, monetary policy shocks are defined as unexpected deviations from the systematic behaviour of monetary policy. This definition, therefore, suggests a differentiation and/or isolation of autonomous disturbances emanating from monetary policy shocks from other types of shocks. This is exactly carried out in SVARs (Vonnák, 2005; Ngalawa, 2009). The SVAR model is a structural-form relationship deduced from the reduced-form VAR. Furthermore, SVAR is a standard VAR where the restrictions needed for identification of the underlying structural model are provided by economic theory. These restrictions can be either contemporaneous or long-run restrictions depending on whether economic theory suggests temporary or permanent shocks (McCoy, 1997).

The SVAR presented in the primitive system of equations (1) and (2) cannot be estimated directly (Enders, 2004). However, the information in the system can be recovered by estimating a reduced form of VAR implicit in (1) and (2). Therefore, pre-multiplying equation (1) by A^{-1} yields a reduced form VAR of order *p,* which in standard matrix form is written as:

$$x_t = \Omega_0 + \sum_{i=1}^{p} \Omega_i x_{t-i} + \varepsilon_t \tag{3}$$

where $\Omega_0 = A^{-1}\Phi$; $\Omega_1 = A^{-1}\Psi_i$; and $\varepsilon_t = A^{-1}\mathrm{B}\mu_t$ is an $(n \times 1)$ vector of error terms assumed to have zero means, constant variances and to be serially uncorrelated with all the right-hand side variables, as well as their own lagged values though they may be contemporaneously correlated across equations. The variance-covariance matrix of the regression residuals in equation (3) is defined as $\Sigma = E(\varepsilon_t, \varepsilon_t')$. Given the estimates of the reduced form VAR in equation (3), the structural economic shocks are separated from the estimated reduced form residuals by imposing restrictions on the parameters of matrices A and B in equation (4):

$$A\varepsilon_t = B\mu_t \tag{4}$$

which is derived from equation (3). The orthogonality assumption of the structural innovations i.e., $E(\mu_t, \mu_t') = 1$, and the constant variance-covariance matrix of the reduced-form equation residuals i.e., $\Sigma = E(\varepsilon_t, \varepsilon_t')$, impose identifying restrictions on matrices A and B as presented in equation (5):

$$A\Sigma A' = BB' \tag{5}$$

Matrices A and B are both $(n \times n)$, hence, a total of $2n^2$ unknown elements can be identified upon which $n(n+1)/2)$ restrictions are imposed by equation (4). To identify matrices A and B, at least $n^2 - n(n+1)/2$ other additional restrictions are required. This study follows recent literature that has used structural factorisation where relevant economic theory guides the imposing of restrictions on the elements of matrices A and B (Ngalawa, 2009; Sims & Zha, 1998; Bernanke & Mihov, 1995; Sims, 1986 and Bernanke, 1986). This structural model is identified by assuming orthogonality of the structural disturbance μ_t. This is simply to say that macroeconomic variables do not simultaneously react to monetary variables, but there is feedback in the reverse direction and an imposing of restrictions on the monetary block of the model reflecting the operational procedures implemented by the monetary policy-maker (Favero, 2001).

This study includes four variables in the SVAR model namely output (Y_t), inflation rate (P_t), aggregate money supply (M_t) and repo rate (R_t). In practice, output and inflation rates enter the SVAR model as policy goals, monetary aggregates as an intermediate target while the repo rate as an operating target. The structural shocks in equation (4) are identified according to the following scheme:

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ a_{21} & 1 & 0 & 0 \\ a_{31} & a_{32} & 1 & a_{34} \\ 0 & 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^Y \\ \varepsilon_t^P \\ \varepsilon_t^M \\ \varepsilon_t^R \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{pmatrix} \begin{pmatrix} \mu_t^Y \\ \mu_t^P \\ \mu_t^M \\ \mu_t^R \end{pmatrix} \tag{6}$$

The first two equations suggest that output and inflation rate respond slowly to shocks in monetary variables. This is because most types of real economic activity respond with time-lags to monetary policy action due to planning delays. The third equation is a standard money demand function which postulates that money demand behaviour in the country makes aggregate money supply respond contemporaneously to changes in consumer prices, output and interest rates. The last equation is that of the monetary policy variable which is based on the assumption that delays in information, handicap the monetary authorities to react timeously to economic activity and price developments (Ngalawa, 2009).

Prior to the estimation of the SVAR model there are various steps that precede the estimation. The first step requires a test for non-stationary (unit root) of time series. That is, to establish the 'univariate' characteristics of data. In this regard, a formal test for testing 'non-stationarity' is essential to select appropriate estimation methodology. This study uses the Kwiatkowski-Phillips-Schmidt-Shin (KPSS) tests. The KPSS test the null hypothesis of 'stationarity' against the alternative hypothesis of 'non-stationarity' (Gujarati, 1995; Pindyck and Rubinfeld, 1991).

Thereafter, the next step is to determine the number of lags to be included in the VAR model. This can be determined by following the many criteria which include the Hannan-Quinn (HQ), Schwarz information criterion (SC), Akaike Information Criterion (AIC), Final prediction error (FPE) and Likelihood Ratio (LR). After determining the number of lags it is possible to estimate a VAR and test the stability of the model.

The following step was to conduct co-integration tests, i.e., if two or more series have long-run equilibrium. Since, the SVAR involves a multivariate system of equations, the Johansen approach to co-integration was found to be appropriate. This approach relies on two statistical tests to determine the number of co-integration vectors namely: the Trace test; and the Maximum Eigenvalue test. Trace statistics investigate the null hypothesis of r co-integrating relations against the alternative of n co-integrating relations, where n is the number of variables in the system for $r = 0,1,2 \dots n-1$. Its equation is computed according to the following formula:

$$LR_{tr}(r/n) = -T^* \sum_{i=r+1}^{n} \log(1-\hat{\lambda}_i) \tag{7}$$

The Maximum eigenvalue statistic tests the null hypothesis of r co-integrating relations against the alternative of $r+1$ co-integrating relations for $r = 0,1,2 \dots n-1$. This test statistics are computed as:

$$LR_{max}(r/n+1) = -T^* \log(1-\hat{\lambda}_i) \tag{8}$$

Where λ_i is the Maximum eigenvalue and T is the sample size.

In some instances, the Trace and Maximum Eigenvalue statistics may yield conflicting results. In such a case the results of the trace test should be followed as it appear to be the superior of the two (Alexander, 2001). In the event where co-integration is found among the variables, the adjustment of the short-run to the long-run equilibrium is obtained through the vector error correction model (SVECM). However, in the event where co-integration is not found, a vector auto-regression model should is estimated.

The main use of the SVAR is to derive the impulse response function which traces the response of the endogenous variables to one standard deviation shock or change to one of the disturbance terms in the system. A shock to a variable is transmitted to all of the endogenous variables through the dynamic structure of the SVAR. In general, the number of possible impulse responses for a structural SVAR with n variables and hence n equations and n shocks, is the number of different combinations of shocks and variables, namely n^2.

Variance decomposition is a complementary method to the impulse response functions for examining the effects of shocks to the dependent variables. This technique determines how much of the forecast error variance for the variables in a system, is explained by innovations to each explanatory variable, over a series of time horizons (Stock & Watson, 2001). Usually own series shocks explain most of the error variance, although the shock will also affect other variables in the system.

3.2 Data, Data Sources and Data Measurements

This study used quarterly time-series data covering the period 2000:Q1 to 2016:Q4. The variables include a policy indicator variable, a variable representing the potential channels of the monetary transmission mechanism and a set of variables representing the final objectives of the monetary policy. The major source of data is *Bank of Namibia's Quarterly and Annual Reports*. The models make use of the following variables:

The policy shock variable (R) in percentage is the repo rate defined as the rate at which the central bank provides short-term loans to commercial banks. The variable enters the SVAR as an instrument target of monetary policy. Money supply (M), aggregate (broad) money supply, measured in millions of N$, (for the money effect model). Aggregate money supply is measured by the sum of currency in circulation, demand deposits and time deposits. The variable also enters the SVAR as an intermediate target of monetary policy. The measure of the price level is the (P) consumer (aggregate) price level, in percentage. The CPI was published long ago and changes in it have been used as the official measure of inflation since then. Furthermore, it has commonly been used in empirical economic studies. Hence, it will be used for Namibia. The variable enters the SVAR as a monetary policy goal. Real gross domestic product at constant price (2010=100) enters the SVAR as a monetary policy goal. GDP data are used as a proxy for Namibia representing the final objectives for monetary policy. All variables are transformed into the log form.

4. EMPIRICAL FINDINGS AND ANALYSIS

4.1 Unit Root

TABLE 1 - *Unit Root Tests: KPSS in Levels and First Difference*

Variable	Model Specification	KPSS		Order of Integration
		Levels	First Difference	
LNY_t	Intercept	1.043**	0.102	1
	Intercept and Trend	0.107	0.102	0
LNM_t	Intercept	1.065**	0.177	1
	Intercept and Trend	0.149	0.105	0
LNP_t	Intercept	0.194	0.080	0
	Intercept and Trend	0.073	0.050	0
LNR_t	Intercept	0.718	0.095	0
	Intercept and Trend	0.067	0.064	0

Source: author's compilation and values obtained from Eviews.
Notes: (a) ***, ** and * means the variable is non-stationary at 1%, 5% and 10% respectively.

The results for the unit root show that consumer price level and the repo rate are an integration of order zero, meaning they are stationary in level form. However, the variables real output and money supply constitute a combination of both integration of order zero and one as reported in table 1.

4.2 Optimal Lag Length Selection and Stability Condition

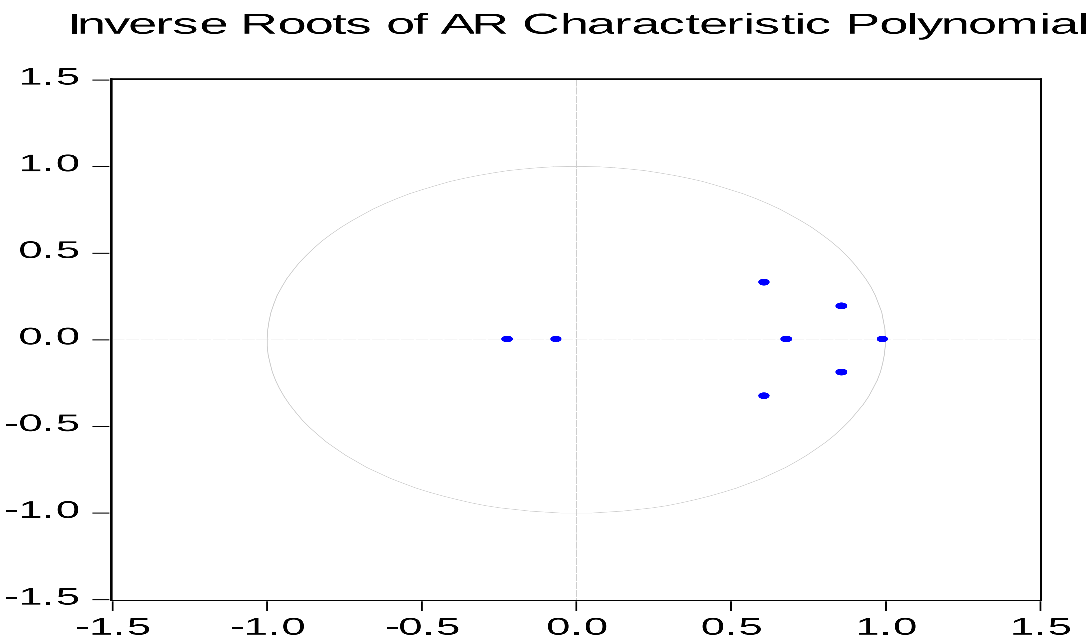
After establishing the 'univariate' characteristics of the variables, the reduced form VAR model is estimated. However, it is necessary to determine the number of lags, since this has a significant effect on the analysis. There are five criteria: the sequential likelihood ratio (LR); Akaike information criterion (AIC); Schwarz information criterion (SC); final prediction error (FPE); and the Hannan Quinn information criterion (HQ). The information criteria for the lag order selection for the VAR system is presented in table 2. These tests show the convergence on the lag length and that is the essence of the lag structure test. As suggested by the information criterion, at the chosen lag length of 1, all the inverse roots of the characteristic AR polynomial have a modulus of less than one and lie inside the unit circle, indicating that the estimated VAR is stable or satisfies the stability condition as shown in figure 1. Furthermore, there was cointegration among the variables as suggested by the Johansen co-integration test. Thus, a SVECM model was estimated from where the impulse responses are derived.

TABLE 2 - *Vector Auto-regression Lag Length Selection Criteria*

Lag	LogL	LR	FPE	AIC	SC	HQ
0	34.191	NA	4.371	-0.990	-0.852	-0.936
1	360.286	598.732	1.681	-11.157	**-10.465***	-10.886
2	385.792	**43.485***	**1.241***	**-11.469***	-10.223	**-10.980***
3	399.296	21.252	1.371	-11.387	-9.587	-10.682
4	409.604	14.871	1.711	-11.200	-8.847	-10.278
5	422.903	17.442	1.971	-11.112	-8.205	-9.972
6	440.143	20.349	2.071	-11.152	-7.692	-9.796

* indicates lag order selected by the criterion

FIGURE 1 - *VAR Stability Condition*



4.3 Impulse Response Functions

This study used the generalised impulse response functions in order to take care of the sensitivity of the results that is associated with the ordering of the variables when using other impulse definitions. These impulse response were derived from a SVECM model estimated. Figure 2 presents the impulse response functions of the repo rate to its own shocks as well as the response of real output, consumer price level and money supply. The results show that M2 contains information on monetary policy transmission process. In particular, real output responds negatively and immediately to shocks in the repo rate. This suggests that an increase in the repo rate results in a reduction in output via monetary aggregates.

In the same manner, the consumer price level also responds immediately to shocks in the repo rate though positively for some period before returning to the baseline. However, there are more pronouncements in the responses of output to the repo rate shocks than to consumer prices. These results are similar and comparable to those of Ngalawa (2009) in a study for Malawi.

FIGURE 2 - *Response to Shocks in Repo Rate (Monetary Policy)*

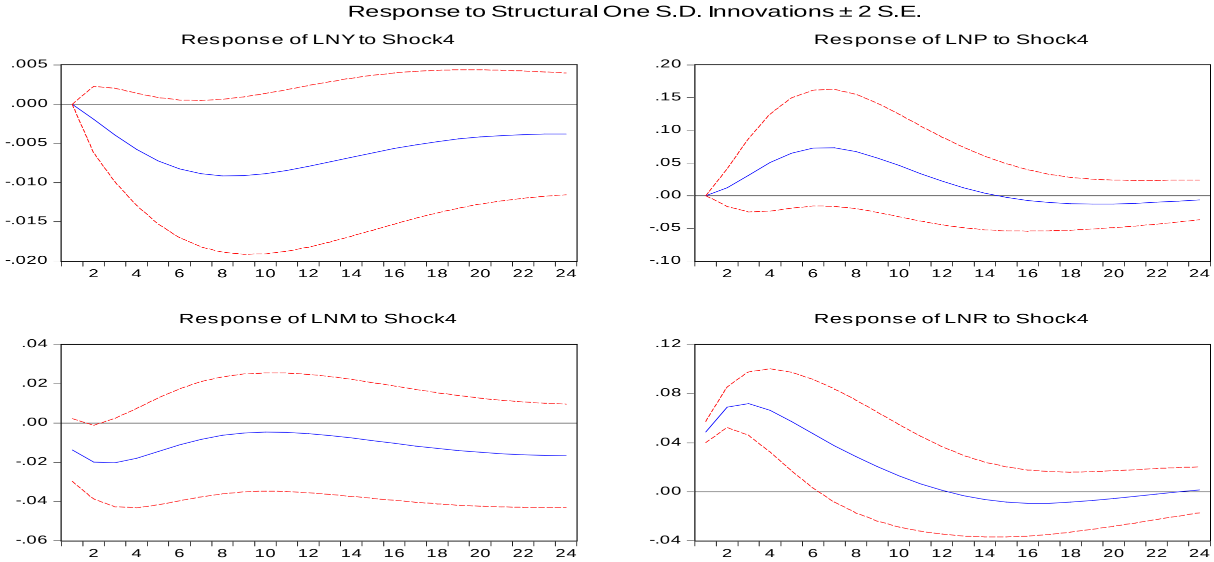


FIGURE 3 - *Response to Shocks in Money Supply*

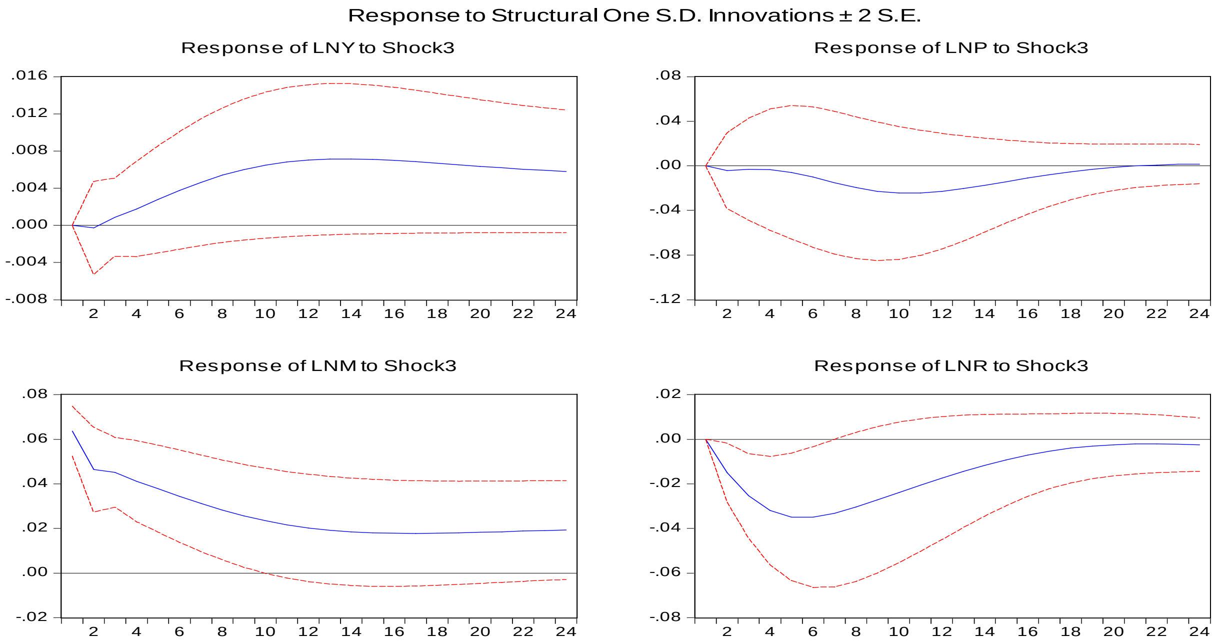


Figure 3 shows that both output and consumer prices respond to unexpected changes in M2. In this regard, an unanticipated increase in M2 is followed by a rise in output, which peaks at 4 per cent above baseline after 10 quarters and is significant up to 2 years. Consumer prices respond to the monetary expansion almost after 5 quarters with an initial price decrease.

TABLE 3 - *Forecast Error Variance Decomposition of Money Supply*

Period	S.E.	Shock1	Shock2	Shock3	Shock4
1	0.065334	0.331452	0.243613	95.03693	4.388002
6	0.127804	6.922069	6.095792	76.92367	10.05847
12	0.166039	23.45305	10.28946	59.55697	6.700516
18	0.194369	35.87798	8.961663	48.72388	6.436474
24	0.218399	41.64046	7.193202	42.98241	8.183931

The results for the forecast error variance decomposition of money supply are reported in table 3. Accordingly, the decomposition of the fluctuations in money supply is predominantly explained by itself, though real output also contributed to the variation in money supply from medium to long-term. The consumer price level and the repo rate also contributed to variations in money supply, though the magnitude is relatively small compared to that of real output.

5. CONCLUSION

This study estimates a Structural vector error correction (SVECM) model to analyse the money channel mechanism of monetary policy transmission in Namibia. This study includes four variables: real output; consumer price level; aggregate money supply; and repo rate in the money model estimated, utilising quarterly time-series data covering the period 2000:Q1 to 2016:Q4. The results for the unit root show that the consumer price level and the repo rate are integrated of order zero, meaning they are stationary in level form. However, the variables real output and money supply constitute a combination of both integration of order zero and one. The results of the impulse response revealed that real output responds negatively and immediately to shocks in the repo rate. This suggests that an increase in the repo rate results in a reduction in output via monetary aggregates. The results show that money supply contains information on the monetary policy transmission process. However, there are more pronouncements in the responses of output to the repo rate shocks than consumer prices. Moreover, when unanticipated shocks are induced into the money supply, it is followed by a rise in output. The decomposition of the fluctuations in money supply is explained predominantly by itself, though real output also greatly contributed to the variation in money supply from medium to long-term relative to consumer price and the repo rate. Thus, the money channel for monetary policy transmission cannot be ignored as it reveals important dynamics of monetary policy process even under the currency-board framework.

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