The Relationship between Interest Rate and Exchange Rate in Namibia

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Abstract

This paper investigates the relationship between the exchange rate and the interest rate for Namibia. Time series techniques such as unit root tests, cointegration test, impulse response and variance decomposition. The study used quarterly data for the period 1993:Q1 to 2012:Q4. The results for cointegration show that there is no cointegration among the variables. The empirical results of this study have been unable to detect a clear systematic relationship between interest rates and exchange rates. However, the variance decomposition further revealed that the errors in the forecast of both the exchange rate and interest rate are dominated by itself and an insignificant percentage is also attributed to other variables.

Keywords: Inflation, Interest rate, Exchange rate, vector autoregression., Namibia
JEL Classification: E43
1. Introduction

After independence Namibia adopted a fixed exchange rate regime which dictates its monetary policy conduct. One of the many goals of an effective monetary policy in any economy is to establish price stability. According to Mundell-Fleming model, an increase in interest rate is necessary to stabilize the exchange rate depreciation and to curb the inflationary pressure and thereby helps to avoid many adverse economic consequences. The high interest rate policy is considered important for several reasons. Firstly, it provides the information to the market about the authorities’ resolve not to allow the sharp exchange rate movement that the market expects given the state of the economy and thereby reduce the inflationary expectations and prevent the vicious cycle of inflation and exchange rate depreciation. Secondly, it raises the attractiveness of domestic financial assets as a result of which capital inflow takes place and thereby limiting the exchange rate depreciation. Thirdly, it not only reduces the level of domestic aggregate demand but also improves the balance of payment position by reducing the level of imports (Dash, undated).

The benchmark interest rate in Namibia was last recorded at 5.50 percent. Interest Rate in Namibia is reported by the Bank of Namibia. Historically, from 2007 until 2013, Namibia Interest Rate averaged 7.8 Percent reaching an all-time high of 10.5 Percent in December of 2008 and a record low of 5.5 Percent in August of 2012. In Namibia, interest rates decisions are taken by the Executive Committee of the Bank of Namibia. The official interest rate is the Repo Rate.

Figure 1: Historical data for Namibia’s Interest Rate


As said earlier economic theory dictates that, there is a negative relationship between interest rates and exchange rates. Therefore, this study examines whether this holds for Namibia and whether interest rate policy does really lead to exchange rate stability.
examines whether the interest rate and exchange rate might be affecting each other. Theoretical and empirical literature is cardinal in helping us realize how interest policy can be used to achieve exchange rate stability.

Namibia’s fixed exchange rate regime dictates that its monetary policy should be in unison with the country it has pegged its currency to in our case the South African Rand. Such an arrangement therefore constrains monetary expansion. Interest rates are an important tool that can be used to affect prices and output in an economy through monetary expansion and monetary tightening. However, in the context of this study, theory dictates that the higher the interest rates the stable the exchange rates. This study examines whether this preposition holds. The article is organized 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 relationship between interest rates and exchange rates has long been a key focus of international economics. Most standard theoretical models of exchange rates predict that exchange rates are determined by economic fundamentals, one of which is the interest rate differential between home and abroad. However, a consistent result in the empirical literature is that a random-walk exchange rate forecasting model usually outperforms fundamental-based forecasting models. In other words, most models don’t explain exchange rates movements.

According to Dash (undated) before discussing the economic literature on the relationship between interest rate and exchange rate elaborately, it would be useful to discuss briefly some of the important theories of exchange rate determination. There are many theories such as Purchasing Power Parity theory (PPP), Flexible Price Monetary Model (FPM), the Sticky Price Monetary Model (SPM), the Real Interest Rate Differential Model (RIRD), and the Portfolio Balance Theory (PBT) of exchange rate determination. The PPP maintains the equality between domestic and foreign prices measured in domestic currency term via commodity arbitrage. If the equilibrium condition is violated, the same commodity after adjusting exchange rate will be sold at different prices in different countries. As a result, commodity arbitrage or simultaneous buying of a commodity in the lower price country and selling it in the higher price country will bring back the exchange rate to its equilibrium level.

The FPM, SPM, and RIRD are known as the monetarists’ model of exchange rate determination. The demand for and supply of money are the key determinants of exchange rates. They also assume that the domestic and foreign bonds are equally risky so that their expected returns would equalize, i.e., uncovered interest parity would prevail. Assuming wages in the labour market and commodity prices in the goods market to be perfectly flexible,
PPP theory to hold continuously, and expected returns between the domestic and foreign bonds with similar risk and maturity are same, the FPM argues that the relative money supplies, inflationary expectations, and economic growth as the major determinants of exchange rate in an economy. The SPM, which was first developed by Dornbusch (1976), argues that in the short-run prices and wages tend to be rigid, therefore, the desire of investors to equalize the expected returns across the countries is viewed as the major determinant of the short-run exchange rates, whereas goods market arbitrage is viewed as relevant to exchange rate determination in the medium and long-run. Frankel (1979) developed a model of exchange rate, which is known as ‘real interest rate differential’ model, which incorporates the role of inflationary expectations of the FPM and the sticky prices of the Dornbusch’s model of exchange rate determination (Dash, undated).

But the spot exchange rate might be affected positively by the high interest rate policy when the expected exchange rate becomes an increasing function of the domestic interest rates. According to Sargent and Wallace (1981) a high interest rate policy may lead to a reduction in demand for money and increase in price level because an increase in interest rate implies an increase in government debt which, in turn, would be financed by seignorage. As a result there will be exchange rate depreciation. Similarly an increase in interest rate may adversely affect the future export performance which would reduce the future flow of foreign exchange reserves and thereby, leads to depreciation of currency (Furman and Stiglitz, 1998).

Furman and Stiglitz (1998) argue that there are two important channels through which exchange rates are likely to be affected by the increase in interest rates. One of them is the risk of default and another one is the risk premium. Since the uncovered interest parity theory assumes no role for both these channels, the interest rate represents the promised return on domestic assets, i.e., actual interest receipts is equal to promised interest receipts. But in a post crisis situation, high interest rate policy may decrease the probability of repayment and increase the risk premium on domestic assets because of its adverse effect on domestic economic activity by reducing the profitability of domestic firms and increasing the borrowing costs. Therefore an increase in interest rate may lead to exchange rate depreciation. This could be stronger when the financial position of firms and banks is fragile.

Hacker, Kim, and Månsson (2010) noted that exchange rate determination models in the flexible-price monetary tradition tend to indicate there should be a positive relationship between the interest rate differential and the exchange rate or the change in that exchange rate. He explains two ways by which this positive relationship can come about. First, an exogenous increase in the home country’s interest rate (not due to money supply reduction), all else equal will drive down money demand in that country and drive up its aggregate demand, resulting in higher prices in that country, and through relative purchasing power
parity the exchange rate will rise (the home country’s currency depreciates against the foreign country’s currency). “Relative purchasing power parity” refers to having a constant real exchange rate, i.e. EP*/P, where E is the exchange rate (the price of foreign currency in terms of domestic currency), P* is the foreign price level, and P is the home country’s price level. Relative purchasing power parity is equivalently defined as having the rate of change in the exchange rate equal to the home country’s price inflation minus the foreign country’s price inflation.

Second, assuming perfect foresight (so expected inflation and actual inflation are equivalent) an increase in the inflation in the home country all else equal tends to lead to both (1) a rise in the exchange rate due to relative purchasing power parity and (2) a rise in the nominal interest rate via the Fisher (1930) hypothesis, which asserts that any increases in expected inflation of country should, all else equal, be matched by an increase in that country’s nominal interest rate. There exist a short-run negative relationship between the interest rate differential and the exchange rate. However, in the true long run for the Dornbusch model, monetary shocks have no effect on the interest rate differential so they cannot induce any long-run relationship between the interest rate differential and the exchange rate at that time scale.

There is voluminous empirical literature on the relationship between interest rate and exchange rate. Goldfajn and Baig (1998) studied the linkage between real interest rate and real exchange rate for the Asian countries during July 1997 to July 1998 by using Vector Autoregression (VAR) based on the impulse response function from the daily interest rates and exchange rates. They have not found any strong conclusion regarding the relationship between interest rate and exchange rate.

Furman and Stiglitz (1998) have examined the effect of an increase in interest rate, inflation, and many non-monetary factors on exchange rate for 9 developing countries during 1992-98. Using probit they found that the high interest rate was associated with a subsequent depreciation of nominal exchange rate but the effect was more pronounced in low inflation country than in high inflation country.

Kwan and Kim (2004) study investigated the empirical relationship between the exchange rate and the interest rate for four Asian crisis countries – Indonesia, Korea, Philippines and Thailand. Using a bivariate VAR-GARCH model they examined the empirical relationship between exchange rates and interest rates, and investigated how the dynamics between them have changed following the post-Asia crisis. Their findings suggested these countries did not use interest rate policy more actively to stabilize exchange rates after the crisis, and provided evidence that their domestic currencies exhibited greater sensitivity to competitors’ exchange rates post-crisis. Further, the results indicate that increased exchange rate flexibility did not
lead to greater stability in interest rates in these economies. They further argue that as for the interaction between exchange rate and interest rate volatility, there is no strong evidence that an increase in exchange rate variability is associated with an increase in interest rate volatility in any of the four countries.

Sanchez (2005) states that there has been a special interest in the link between exchange rates and interest rates in both advanced and developing countries. The study consisted of the experience of some Asian EMEs at the time of the Asian crisis (1997-1998) and a couple of periods of financial turmoil in Brazil (1999 and 2002-2003). It makes use of the identified vector autoregressions (IVAR), given the important role these variables play in determining developments in the nominal and real sides of the economy. Further, his findings showed that, in response to an adverse risk premium shock, exchange rates and interest rates exhibit a negative correlation when depreciations are expansionary, and a positive correlation when they are contractionary.

Shambaugh (2004) used panel data of more than 100 countries during the period from 1973 to 2000 and finds that domestic interest rates in countries under a pegged exchange rate regime follow the interest rate movements in the country to which the currency is pegged.

Chinn and Meridith (2004, 2005) presented empirical estimates of how the change in the log exchange rate is linearly related to the interest rate differential using short-maturity bond data, and more innovatively, long-maturity bond data. They found that a positive relationship between these variables (consistent with uncovered interest parity along with rational expectations) was observable when using long-maturity data but the opposite occurred when using short-maturity data. Their estimated positive relationship using long-maturity bond data is consistent with similar findings by Flood and Taylor (1996) using medium-maturity bond data, whereas their estimated negative relationship using short-maturity bond data is a common finding.

Hacker et al (2010) examined the relationship between spot exchange rate and nominal interest rate differential. Using wavelet analysis to investigate the relationship between the spot exchange rate and the interest rate differential for seven pairs of countries, with a small country, Sweden, included in each of the cases. Their key empirical results showed that there tends to be a negative relationship between the spot exchange rate (domestic-currency price of foreign currency) and the nominal interest rate differential (approximately the domestic interest rate minus the foreign interest rate) at the shortest time scales, while a positive relationship is shown at the longest time scales. This indicates that among models of exchange rate determination using the asset approach, the sticky-price models are supported in the short-run while in the long-run the flexible-price models appear to better explain the
sign of the relationship. The results when using the two different data frequencies – monthly and quarterly – are consistent with each other in this finding.

The theoretical and empirical literature proves that there exists a relationship between interest rates and exchange rates. This conclusion is not definite because of the mixed finding for instance some studies found that there exists a negative relationship in the short-run and positive relationship in the long-run but economic theory postulates a negative relationship between these variables, this gap forms the basis for this study.

3. Methodology

3.1 Econometric Framework and Model Specification

This paper adopts the model specification used by Hacker et al (2010) but modified so as to suit the study objectives and follows a vector autoregressive (VAR) approach. The VAR is a general dynamic specification because each variable is a function of lagged values of all the variables. Each equation has many lags of each variable, the set of variables must not be too large. A vector autoregressive (VAR) approach which can be represented as follows:

$$Ay_t = \beta_0 + \beta_1 y_{t-1} + \beta_2 y_{t-2}^+ + \ldots + \beta_p y_{t-p} + \varphi \mu_t$$

Where $A$ is an invertible matrix (n*n) describing contemporaneous relations among the variables; $y_t$ is an (n * 1) vector of endogenous variables such that $y_t = (y_1, y_2, \ldots, y_n)$; $\beta_0$ is a vector of constants; $\beta_i$ is an (n*n) matrix of coefficients of lagged endogenous variables; $\varphi$ is an (n*n) matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on more than one endogenous variable in the system; and $\mu_t$ are uncorrelated or orthogonal white-noise structural disturbances i.e. the covariance matrix of $\mu_t$ is an identity matrix $E = (\mu_t \mu_t') = 1$.

Unrestricted versions of the VAR model (and the error-correction model) are estimated by ordinary least squares (OLS) because Zellner (1962) proved that OLS estimates of such a system are consistent and efficient if each equation has precisely the same set of explanatory variables. If the underlying structural model provides a set of over-identifying restrictions on the reduced form, however, OLS is no longer optimal.” The simultaneous equations system in a contemporaneous structural VAR, however, generally does not impose restrictions on the reduced form.

The standard, linear, simultaneous equations model is a useful starting point for understanding the structural VAR approach. A simultaneous equations system models the dynamic relationship between endogenous and exogenous variables. If some shocks have temporary effects while others have permanent effects, the empirical model must account for this. Sims, Stock and Watson (1990) show that this reduced form is consistently estimated by...
OLS, but hypothesis tests may have non-standard distributions because the series have unit roots, their existence is controversial.

This study will ascertain the existence of such a relationship by implementing the following three-steps procedure:

(1) Testing for unit root and determine the order of integration for two variables by employing tests devised by Augmented Dickey - Fuller (ADF), Philips and Peron (PP) and Kwiatkowski-Phillips-Schmidt-Shin (KPSS).

(2) Testing for cointegration and if there is cointegration relationship among the variables. The Johansen cointegration can be applied in this respect.

(3) Impulse response function and variance decomposition derived from the estimated vector autoregressive model.

3.2 Unit Roots Tests

Testing for the presence of unit root in the series is a primary step before attempting to estimating economic relationships. Furthermore, the test also helps in finding the order of integration at which the variables become stationary. These tests are necessary to avoid spurious regression (Gujarati, 2004). Hence, the whole idea for unit root test is to search for data generating process (DGP) namely:

(a) Pure random walk meaning no intercept and no time trend items:

\[ \Delta y_t = \delta y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta y_{i-1} + \epsilon_t \]  

…2

(b) Random walk with drift meaning intercept and no time trend item:

\[ \Delta y_t = \alpha + \delta y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta y_{i-1} + \epsilon_t \]  

…3

(c) Random walk with drift and time trend meaning intercept and time trend item:

\[ \Delta y_t = \alpha + \gamma t + \delta y_{t-1} + \sum_{i=1}^{n} \alpha_i \Delta y_{i-1} + \epsilon_t \]  

…4

There are various methods for testing unit roots such as Augmented-Dickey Test (ADF), extension to the dickey fuller test for example Pantula tests, Phillips Peron tests, Kwiatkowski-Phillips-Schmidt-shin (KPS), Elliot-Rothenberg-stock point optimal (ERS) as Ng-Perron tests. This study will use ADF, PP and KPSS test for unit root.

3.3 Cointegration Tests

Cointegration gives an indication as to whether the variables will converge in the long run to some sort of equilibrium. To ascertain whether such a relationship exist, this study employs the Johansen cointegration test in order to determine if there are any cointegrated equations. Since this will be done in the vector autoregressive (VAR) framework, the first step uses first difference as shown below:
\[ Y_t = A_1 Y_{t-1} + A_2 Y_{t-2} + \ldots + A_p Y_{t-p} + \varepsilon_t \]  

whereas \( Y_t \) is lag length \( n \) \((p \times 1)\) vector endogenous variable, then first difference changes below:

\[ \Delta Y_t = \sum_{j=1}^{\infty} \pi_j \Delta Y_{t-j} + \pi Y_{t-n} + \varepsilon_t \]

whereas \( \pi_j \) is a short term adjusting coefficient to explain short-term relationship, \( \pi \) is long term shock vector that includes long term information that tipoff on the existence long term equilibrium relationship. Moreover rank of \( \pi \) decides the number of cointegrated vector. \( \pi \) has three hybrids:

(a) \( \text{rank}(\pi) = n \), then \( \pi \) is full rank, meaning all the variables are stationary series in the regression \( (Y_t) \)

(b) \( \text{rank}(\pi) = 0 \), then \( \pi \) is null rank, meaning variables do not exhibit cointegrated relationship.

(c) \( 0 < \text{rank}(\pi) = r < n \), then some of variables exist \( r \) cointegrated vector.

The Johansen cointegration approach uses rank of \( \pi \) to distinguish the number of cointegrated vector and examine rank of vector in testing how many of non-zero of characteristic roots exist in the vector. There are two statistic processes for cointegration.

(i) Trace test:

\[ H_0 : \text{rank}(\pi) \leq r \text{ (at most } r \text{ integrated vector)} \]
\[ H_1 : \text{rank}(\pi) > r \text{ (at least } r+1 \text{ integrated vector)} \]

\[ \hat{\lambda}_{\text{trace}}(r) = -T \sum_{i=r+1}^{n} \ln(1-\hat{\lambda}_i) \]

\( T \) is sample size, \( \hat{\lambda}_i \) is estimated of characteristic root. If test statistic rejects \( H_0 \) that means variables exist at least \( r+1 \) long term cointegrated relationship.

(ii) Maximum eigenvalue test:

\[ H_0 : \text{rank}(\pi) \leq r \text{ (at most } r \text{ integrated vector)} \]
\[ H_1 : \text{rank}(\pi) > r \text{ (at least } r+1 \text{ integrated vector)} \]

\[ \hat{\lambda}_{\text{max}}(r, r+1) = -T \ln(1-\hat{\lambda}_{r+1}) \]

If test statistics accepts \( H_0 \) that means variables have \( r \) cointegrated vector. This method starts testing from variables that do not have any cointegrative relationship which is \( r=0 \). Then test has added the number of cointegrative item to a point of no rejecting \( H_0 \) that means variables have \( r \) cointegrated vector.

3.4 Impulse Response Function
Impulse responses trace out the response of current and future values of each of the variables to a unit increase in the current value of one of the VAR errors, assuming that this error returns to zero in subsequent periods and that all other errors are equal to zero. More generally, an impulse refers to the reaction of any dynamic system in response to some external changes. According to Hamilton (1994), a VAR can be written in vector moving average (MA) as follows:

$$Y_t = \beta_0 + \varepsilon_t + \alpha_1 \varepsilon_{t-1} + \alpha_2 \varepsilon_{t-2}$$

Thus, the matrix $\alpha_s$ has the interpretation $\partial Y_{t+s}/\partial \varepsilon_j = \alpha_s$ that is, the row i, column j element of $\alpha_s$ identifies the consequences of one unit increase in the $j^{th}$ variable’s innovation at the t (\(\varepsilon_{jt}\)) for the value of the $i^{th}$ variable at time $t + s$ ($Y_{i(t+s)}$), holding all the other innovations at all dates constant. A plot of $\partial Y_{i(t+s)}/\partial \varepsilon_{jt}$ as a function of $s$ is called the impulse response function. It describes the response of $Y_{i(t+s)}$ to a one-time impulse in $\varepsilon_{jt}$ with all other variables dated t or earlier held constant (Girma, 2012).

3.5 Forecast Error Decomposition

Forecast Error Decomposition indicates the amount of information each variable contributes to the other variables in the autoregression. It determines how much of the forecast error variance of each of the variable can be explained by exogenous shocks to the other variables. The forecast error decomposition is the percentage of the variance of the error made in forecasting a variable due to specific shock at a given horizon (Girma, 2012).

3.6 Data and Data Sources

This study used quarterly time-series data covering the period 1993:01-2012:04. Data is collected on the following variables; the CPI represented by the inflation rate, the interest rate represented by the repo rate, and the exchange rate represented by the nominal exchange rate between the US dollar and Namibian dollar. The data series is collected from various issues of Bank of Namibia’s Quarterly Bulletins and Annual Reports.

4. Empirical Analysis And Results

4.1 Unit Root Test

The Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests are applied. The PP test is necessitated by the fact that the ADF statistic has limitations of lower power and it tends to under-reject the null hypothesis of unit roots. The results of the unit root test in levels are presented in Table 1. The table show that the series were found to be non-stationary as the ADF values were found to be less than the critical values in level form with the exception of the interest rate whose results from the two-unit root tests are conflicting, however the
inflation rate is seen to be stationary in the two-unit root tests at level form. After differencing them, the entire test statistic shows that all the series became stationary.

Table 1: Unit root tests: ADF and PP in levels and first differences

<table>
<thead>
<tr>
<th>Variable</th>
<th>Model Specification</th>
<th>ADF</th>
<th>PP</th>
<th>ADF</th>
<th>PP</th>
<th>Order of integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lnex</td>
<td>Intercept and trend</td>
<td>-1.69</td>
<td>-1.89</td>
<td>-7.26**</td>
<td>-7.24**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>-1.89</td>
<td>-1.90</td>
<td>-7.23**</td>
<td>-7.22**</td>
<td>1</td>
</tr>
<tr>
<td>Lnin</td>
<td>Intercept and trend</td>
<td>-3.47**</td>
<td>-2.48</td>
<td>-5.44**</td>
<td>-4.74**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>-1.09</td>
<td>-0.66</td>
<td>-5.45**</td>
<td>-4.76**</td>
<td>1</td>
</tr>
<tr>
<td>Lninfl</td>
<td>Intercept and trend</td>
<td>-2.94</td>
<td>-3.01</td>
<td>-9.06**</td>
<td>-9.06**</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Intercept</td>
<td>-2.82**</td>
<td>-2.86**</td>
<td>-9.12**</td>
<td>-9.11**</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: Compilation and values obtained from Eviews

Notes: (a) ** means the rejection of the null hypothesis at 5%

Reduced form VAR model is estimated based on the information criteria. The convergence lag length suggested is two. At the chosen lag length, all the inverse roots of the characteristic AR polynomial have a modulus of the less one and lie inside the unit circle, meaning the estimated VAR is stable or stability condition. The results for roots of characteristic polynomial are shown in table 2.

Table 2: Roots of Characteristic Polynomial

<table>
<thead>
<tr>
<th>Root</th>
<th>Modulus</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.962733</td>
<td>0.962733</td>
</tr>
<tr>
<td>0.831213</td>
<td>0.831213</td>
</tr>
<tr>
<td>0.728960</td>
<td>0.728960</td>
</tr>
<tr>
<td>0.576035</td>
<td>0.576035</td>
</tr>
<tr>
<td>0.291762</td>
<td>0.291762</td>
</tr>
<tr>
<td>0.001345</td>
<td>0.001345</td>
</tr>
</tbody>
</table>

Source: Authors compilation using Eviews.
Notes: No root lies outside the unit circle. VAR satisfies the stability condition.

4.2 Testing for Cointegration

Table 3: Johansen Cointegration Test Based on Trace and Maximum-Eigen Values of the Stochastic Matrix

<table>
<thead>
<tr>
<th>Maximum Eigen Test</th>
<th>Trace Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>H0: rank = r</td>
<td>H0: rank = r</td>
</tr>
<tr>
<td>95% Critical Value</td>
<td>95% Critical Value</td>
</tr>
<tr>
<td>r = 0</td>
<td>r = 1</td>
</tr>
<tr>
<td>r &lt;=1</td>
<td>r = 2</td>
</tr>
<tr>
<td>r &lt;=2</td>
<td>r = 3</td>
</tr>
</tbody>
</table>

Source: Author’s compilation using Eviews.
Note: Trace tests indicate no cointegrating equations at the 0.05 level, while the Max-eigen values also indicates no cointegrating. Sample period 1993:Q1 to 2012:Q4.

Table 3 presents the results for the Johansen cointegration test based on trace and maximum eigen values test statistics. The results for both the maximum eigen values and trace test statistic reveal that there are no cointegration equations, because the test statistics are less than the critical values hence, accepting the null hypothesis of no cointegrating variables. Both test shows that the hypothesis of no cointegrating variables could not be rejected at 5 per cent. The absence of cointegration among the variables implies that the long run relationship between inflation, interest rate and exchange rate is non existent.

4.3 Impulse Response Function

Figure 1: Impulse response of exchange rate, interest rate and inflation.

Figure 1 above, presents the responses of the exchange rate to changes in the level of interest rate. In contrast to theoretical expectations such as that by Hacker et al (2010), the response of LNEX to LNIN in the short-run is observed to be a stable increase in the exchange rate, the effects of the shock are seen to be brief and pass on only for about a year. Thereafter, there is convergence toward the steady state although slightly above the baseline. However, the effects remained permanent even after 24 quarters. The response of LNIN to LNEX is negative in the transitory period but die off in the 3-quarter followed by a permanent effect from the 12-quarter which is above the steady state. A transitory negative effect in the 1-quarter which is short-lived is observed in the response of LNEX to LNINFL, followed by a gradual positive effect in the 3-7 quarters succeeded by a permanent effect along the steady state through to the 24 quarter. However, in the response of LNIN to LNINFL, a shock on inflation results in positive temporary effect through to the 3-quarter which dies off as seen by
a negative drop in the interest rate until the 19-quarter at which it converges toward the steady state along the baseline.

### 4.4 Forecast Error Variance Decomposition

Table 4: Forecast Error Variance Decomposition

<table>
<thead>
<tr>
<th>Variance Decomposition for LNEX</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>S.E.</td>
<td>LNEX</td>
<td>LNIN</td>
<td>LNINFL</td>
</tr>
<tr>
<td>1</td>
<td>0.068322</td>
<td>100.0000</td>
<td>0.000000</td>
<td>0.000000</td>
</tr>
<tr>
<td>6</td>
<td>0.169629</td>
<td>97.78188</td>
<td>2.024152</td>
<td>0.193967</td>
</tr>
<tr>
<td>12</td>
<td>0.208099</td>
<td>94.76729</td>
<td>4.98017</td>
<td>0.252197</td>
</tr>
<tr>
<td>18</td>
<td>0.226630</td>
<td>92.78763</td>
<td>6.93414</td>
<td>0.278052</td>
</tr>
<tr>
<td>24</td>
<td>0.237097</td>
<td>91.58528</td>
<td>8.123104</td>
<td>0.291619</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variance Decomposition of LNIN</th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Period</td>
<td>S.E.</td>
<td>LNEX</td>
<td>LNIN</td>
<td>LNINFL</td>
</tr>
<tr>
<td>1</td>
<td>0.062493</td>
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Source: Author’s compilation using Eviews

Table 4 above presents forecast error variance decomposition for each variable in the model over a 24-quarter forecast restriction. The results show that errors in the forecast of the exchange rate are greatly attributed to other variables than is ascribed to the interest rate and inflation rate. In the first quarter error in the forecast of the exchange rate was fully dominated by itself. Interest rate accounted for a meager 8.1% in the 24-quarter. Fluctuations in exchange rate dominated the interest rate but not significantly, inflation rate was the most insignificant in the forecast of the interest rate throughout all quarters. In comparing the inflation it can be noted that the errors in its forecast is dominated by interest rate and the exchange rate. The magnitude of these two variables is not much different.

### 5. Conclusion
The study examined the relationship between inflation, interest rate and exchange rate. Economic theory postulates that there exists a negative relationship between interest rates and exchange rates. This therefore formed the basis for this study so as to examine whether this holds for Namibia and whether interest rate policy does really lead to exchange rate stability. The study employed considerable amount of secondary data from 1993-2012. It introduced the model specification and econometric procedures to be carried out which included the unit root test, cointegration test, impulse response functions and the forecast error decomposition.

The VAR procedure designates that both the interest rate and the exchange rate are affected by their respective previous lagged values. The variance decomposition further revealed that the errors in the forecast of both the exchange rate and interest rate are dominated by itself and an insignificant percentage is also attributed to other variables. In light of the above results, it can be recommended that policy makers consider the inflation rate for forecasting and policy planning. From the backdrop of economic theory it is well documented that interest rate does affect macroeconomic policy. This study showed that for Namibia, there is no relationship between interest rate and exchange rate, however, a unicausal relationship exists between the exchange rate and inflation rate. This does not necessarily imply that monetary authorities should not exercise restraint when regulating interest rate, but rather the interest rate should be monitored regardless of this result. Interest rate should be monitored and adjusted accordingly because it is a contributing factor in macroeconomic policy making. The interest rate is affected by many components such as economic stability, monetary policy etc, for which exchange rate is one of those macroeconomic variables. Future research should adopt a different methodological approach and possibly to add more additional variables in the estimations to determine whether similar results would be obtained. Quarterly frequencies maybe more appropriate due to the fact that sometime monthly rate remains constant over a period.

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