The effects of monetary policy on unemployment in Namibia

By Tafirenyika SUNDE [†]

Abstract. The main purpose of the article was to establish the effects of monetary policy on unemployment in Namibia. The article used the structural VAR methodology in a macroeconometric setting to achieve this. The results show that monetary policy affects unemployment in Namibia in the short run and in the long run, it is ineffective. These results differ from the results by Alexius & Holmlund (2007) and Jacobs *et al.* (2003) who found that monetary policy has a significant role to play in explaining unemployment in both the short run and the long run. This means that there is still need to investigate the other explanations of long run unemployment in Namibia such as the demand and supply related variables so that appropriate policies are propounded to address it effectively.
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JEL. E52, J64.

1. Introduction

This article analyses the effects of monetary policy on unemployment in Namibia using the structural VAR model for the period 1980 to 2013. Specifically, the study investigates how much of the fluctuations in unemployment are caused by monetary policy shocks and how persistent these effects are. Answers to these questions are derived from the structural VAR model. Impulse response functions contain information about the magnitude and duration of the effects of a specific structural shock and variance decompositions show which shocks have caused movements in a variable during the sample period. It should be noted that the reaction of unemployment to monetary policy shocks is poorly documented in both the developed and developing countries. The majority of the studies have looked at the demand and supply factors that affect unemployment and they are silent about the effect of monetary policy on unemployment.

Even though the effects of monetary policy on unemployment have not been investigated that much, there exist a few studies that are relevant. For example, Ravn & Simonelli (2006) estimated a twelve-variable VAR on United States data to analyse the effects of four structural shocks that include monetary policy and labour market variables. The study established that the labour market variables increase after positive shocks to monetary policy and that approximately 20 percent of the fluctuations in unemployment are

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caused by monetary policy shocks. In addition, Alexius & Holmlund (2007) investigated the relationship between monetary policy and unemployment fluctuations in Sweden using a structural VAR approach. They found that around 30 percent of the fluctuations in unemployment are caused by shocks to monetary policy; and that these effects are quite persistent.

However, the sources of fluctuations in unemployment were analysed using variance decompositions by several researchers who include Jacobson *et al.* (1997), Dolado & Jimeno (1997), Carstensen & Hansen (2000) among others. Dolado & Jimeno (1997) studied the Spanish unemployment and established that the main sources of unemployment variability in Spain are productivity shocks followed by labour supply and demand shocks, respectively. Maidorn (2003), established that demand shocks explain the greater part of fluctuations in Australian unemployment, while Gambetti & Pistoresi (2004) found long lasting effects of demand shocks on the Italian economy. Christoffel & Linzert (2005) and Karannassou & Sala (2010) found long lasting effects on European unemployment rates using other approaches instead of the VAR models. Additionally, Carstensen & Hansen (2000) and Fabiani *et al*. (2001) found that technology and labour supply shocks account for the greater portion of long-run fluctuations in German and Italian unemployment, respectively, and also that the goods market shocks are significant in the short run. Algan (2002) found that the standard model works well for the United States, but performs poorly in capturing the rise of unemployment in France. In addition, Amisano & Serati (2003) also found that unemployment rates in several European countries are affected permanently by the demand shocks. A study by Jacobson *et al.* (1997) found that transitory labour demand shocks negligibly affected unemployment in the Scandinavian nations. In addition, a study by Jacobs *et al*. (2003) established that monetary policy has permanent effects on Swedish unemployment. They obtained this result because they modelled the rate of unemployment as an I(1) process which implies that all shocks would automatically have long lasting effects.

The only study on the factors that affect unemployment in Namibia was carried out by Eita & Ashipala (2010) for the period 1970 to 2007 using the Engle-Granger two-step econometric procedure. The study found that unemployment in Namibia is affected by actual output, inflation, investment and aggregate demand. Their findings support the original Phillips curve relationship between unemployment and inflation, which suggests that there is a negative relationship between these variables. However, this study did not consider monetary policy as a factor that affects unemployment in Namibia. This fact alone makes the current study very important as it contributes literature on the relationship between monetary policy and unemployment in Namibia.

It is against this background that the current article develops a small macroeconometric model to investigate the effect of monetary policy on unemployment in Namibia. The model is developed using three modular experiments. The first stage is the specification of the basic model using productivity, real wage, unemployment and the interest rate. In the second stage, the demand, labour market and exchange rate channels of the economy are used to establish if there is additional information in these channels, which explains the monetary transmission process in Namibia. The third stage uses the first two modular experiments to develop the small macroeconometric model, which will be used to explain if monetary policy affects unemployment in Namibia.

The article unfolds as follows. Section 2 explains the SVAR methodology. Section 3 discusses the data, estimation and analysis of the results, while Section 4 escribes the robustness of the models estimated. Section 5 presents the summary of the results and the conclusions from the findings.

2. The SVAR Methodology

This section attempts to develop the SVAR framework for the Namibian small macro-econometric model. The section employs short run restrictions in an attempt to provide a brief review of SVAR identification scheme. The scheme follows from (Blanchard & Quah, 1989) for systems without cointegration and it was later used by Gali (1999). In their evaluation of the VAR procedure twenty years after Sims (1980)'s original article, Stock & Watson (2001) conclude that VARs effectively capture the rich interdependent dynamics of data, and that the structural implications are only as sound as their identification schemes.

Suppose the labour market model for Namibia is given by the dynamic system whose structural equation is given by:

$$AX_t = \Omega + \Phi_1 X_{y-1} + \Phi_2 X_{t-2} + \cdots + \Phi_p X_{t-p} + B\mu_t \qquad (1)$$

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 $X_t = (X_{1t}, X_{2t}, \dots X_{nt})$; Ω is a vector of constants; Φ_i is an $(n \times n)$ matrix of coefficients of lagged endogenous variables $\forall_i = 1,2,3, I, p$; B is an $(n \times n)$ matrix whose non-zero off-diagonal elements allow for direct effects of some shocks on more than one endogenous variable in the system; and μ_t are uncorrelated or orthogonal white-noise structural disturbances.

The SVAR presented in the primitive system of equation [1] cannot be estimated directly due to the feedback inherent in a VAR process (Enders, 2004). Nonetheless, the information in the system can be recovered by estimating a reduced form VAR implicit in the two equations. Pre-multiplying equation [1] by A^{-1} yields a reduced form VAR of order p, which in standard matrix form is written as:

$$X_t = \Psi_0 + \sum_{i=1}^{p} \Psi_i X_{t-i} + \varepsilon_t \qquad (2)$$

where $\Psi_0 = A^{-1}\Omega$; $\Psi_i = A^{-1}\Phi_i$ and $\varepsilon_t = A^{-1}B\mu_t$. The term ε_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. Given the estimates of the reduced form VAR in equation [2], 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 [3]:

$$A\varepsilon_t = B\mu_t \qquad (3)$$

which derives from equation [2]. 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 A and B as presented in equation [4]:

$$A\Sigma A' = BB' \tag{4}$$

Since matrices A and B are both $(n \times n)$, a total of $2n^2$ unknown elements can be identified upon which $n(n + 1)/2$ restrictions are imposed by equation (4). To identify A and B, therefore, at least $2n^2 - n(n + 1)/2$ or $n(3n - 1)/2$ additional restrictions are required. These restrictions can be imposed in a number of ways. One approach is to use Sims (1980) recursive factorisation based on Cholesky decomposition of matrix A. The implication of this relationship is that identification of the structural shocks is dependent on the ordering of variables, with the most endogenous variable ordered last (Favero, 2001). Furthermore in this framework, the system is just (exactly) identified.

Christiano *et al*. (1999) contend that while there are numerous models consistent with the recursiveness assumption, the approach is controversial. The assumptions justifying the ordering of series are frequently dissimilar in various studies utilising the same series, and since estimation results, in a VAR identified by Cholesky factorisation vary with the ordering of variables. These studies tend to be incomparable. Note that changing the order of the series changes the VAR equations, coefficients and residuals; and that there are $n!$ recursive VARs representing all potential orderings (Stock & Watson, 2001). The validity of Cholesky factorisation is also questioned when a simultaneity problem exists between macroeconomic variables. Following the apparent shortfalls in the approach, many authors have adopted alternative approaches to the identification of structural shocks (see, for example, Bernanke, 1986; Sims, 1986; Bernanke & Mihov, 1998; Eichenbaum & Evans, 1995; Sims & Zha 2006; Basher *et al.* 2010). However, Christiano *et al.* (2005) argue that short-run SVARs perform remarkably by way of the relatively strong sampling properties of the IRFs they produce.

Restrictions can also be employed contingent on assumptions about what information is available to agents at the time of a shock (see Sims, 1986). Opinions regarding short-run restrictions are mixed. Faust & Leeper (1997) assert that there are frequently an insufficient number of tenable contemporaneous restrictions to achieve identification. Recent literature used structural factorisation, an approach that uses relevant economic theory to impose restrictions on the elements of matrices A and B (Bernanke, 1986; Sims, 1986; Bernanke & Mihov, 1998; Sims & Zha, 2006). This current article adopts a similar approach. The underlying structural model is identified by assuming orthogonality of the structural disturbances, μ_t (Favero, 2001:166).

The seven variables included in small macroeconomic model SVAR are real wages $(RWG_t) = (NWG_t - (PCE_t))$, productivity (PRD_t), unemployment (UEM_t), import prices (MPP_t), exchange rates (NEX_t), bank credit to the private sector (CDT_t) and lending rates (LER_t) based on Figure 1. Real wages, productivity and unemployment are included in the SVAR as labour market variables; import prices as demand a variable, exchange rates and bank lending rates as monetary variables. From equation [3], the following equations using matrix notation are obtained:

$$
\begin{pmatrix}
1 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 & 0 & 0 \\
a_{41} & 0 & a_{43} & 1 & 0 & 0 & 0 \\
a_{51} & 0 & a_{53} & a_{54} & 1 & 0 & 0 \\
a_{61} & 0 & a_{63} & a_{64} & a_{65} & 1 & 0 \\
a_{71} & 0 & a_{73} & a_{74} & a_{75} & a_{76} & 1
\end{pmatrix}
\begin{pmatrix}
\varepsilon_t^{PRD} \\
\varepsilon_t^{RWG} \\
\varepsilon_t^{UEM} \\
\varepsilon_t^{MPP} \\
\varepsilon_t^{NEX} \\
\varepsilon_t^{CDT} \\
\varepsilon_t^{LER}
\end{pmatrix}
=
$$

$$
\begin{pmatrix}
b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & b_{77}
\end{pmatrix}
\begin{pmatrix}
\mu_t^{PRD} \\
\mu_t^{RWG} \\
\mu_t^{UEM} \\
\mu_t^{MPP} \\
\mu_t^{NEX} \\
\mu_t^{CDT} \\
\mu_t^{LER}
\end{pmatrix}
\qquad (5)
$$

Equation [5] shows that the non-zero coefficients a_{ij} and b_{ij} in matrices A and B, respectively indicate that any residual j in matrices ε_t and μ_t, has an instantaneous effect on variable i. The current section also discusses the SVAR model identifying assumptions and the estimation procedure. The article identifies seven structural shocks: technology shock, real wage shock, labour supply shock, import price shock, bank credit shock, exchange rate shock and monetary policy shock. To achieve identification, the article uses structural factorisation assumption and short run restrictions.

The first equation in the small macroeconometric model assumes that productivity is the most exogenous variable in the model; and that it is not contemporaneously affected by shocks to all the other variables in the model. The second equation implies that real wages are not contemporaneously affected by all the other shocks to the other variables included in the system (see similar placement in Dolado *et al.* (1997) and Maidorn, (2003)). The third equation indicates that unemployment is not contemporaneously affected by all shocks to the variables included in the model.

The fourth equation indicates that import prices are contemporaneously affected by shocks to productivity and unemployment and not by shocks to real wages, nominal exchange rates, bank credit and lending rates. Additionally, the fifth equation indicates that nominal exchange rates are contemporaneously affected by shocks to productivity, unemployment and import prices and not by shocks to real wage, bank credit and lending rates. It should be noted that in all short run models, the treatment of contemporaneous responses of exchange rates to other variables in an SVAR is comparatively standard in the majority of the studies. Kim & Roubini (2000) contend that most studies assume that all variables have contemporaneous effects on the exchange rate since it is a forward-looking asset price. The exchange rate variable and the foreign related variables closely relate to one another. However, given the large dimensionality problem and the small size of the study period, the article avoids the temptation to add more variables to the SVAR to capture external factors. The complete SVAR analysed in this article has seven variables, which is already large by SVAR standards and increasing the number of variables without proper justification would only decrease the power of the model without making meaningful additions to the output. In addition, the current article is not concerned with immediate responses of the exchange rate to shocks in other variables since it is making use of annual data and not

monthly or quarterly data. This means that the article can treat the exchange rate variable in the same way the other variables are treated.

The sixth equation indicates that shocks to productivity, unemployment, import prices and nominal exchange rates, contemporaneously affect commercial bank lending rates and that real wage, lending rates do not. Lastly, the seventh equation shows that lending rates are contemporaneously affected by shocks to all the other variables except real wages. The ordering suggested above is in line with theory in that nominal variables have no effects on real variables but the real variables affect the nominal variables.

Despite the fact that researchers regard the SVAR methodology as superior to the complicated traditional simultaneous equation methodologies, particularly in their forecasting power, the approach has its own weaknesses. The first weakness is that individual coefficients in SVARs are a lot difficult to interpret. For this reason, the majority of studies do not analyse SVAR results beyond impulse response functions and variance decomposition. The second weakness is that researchers do not agree on a uniform approach for the determination of the appropriate lag length. Consequently, different studies justify their choice of lag lengths in a different ways, making the known standard criteria like Akaike, Hannan-Quinn and Schwartz Information Criteria non-standard. The third weakness as stated earlier is that there is still serious disagreement on whether the appropriate method to be used (whether to estimate SVARs in first differences or in levels). Our analysis shows that the literature is largely in favour of estimation in levels. Note that this debate is still far from being over. The fourth weakness is that unlike simultaneous equation models, SVARs are not very much dependent on theory, which renders them a-theoretic for the reason that they do not use prior information (Gujarati, 2003). In addition, inclusion or exclusion of a particular series plays an essential part in the identification of simultaneous equation models (Gujarati, 2003).

2.1. Analysis technique

To analyse the SVAR the article uses three modular experiments. First, the article estimates a basic model comprising the country's real wage, productivity, unemployment and interest rates relationship derived from Figure 1 below. The essence of the basic model that incorporates interest rates to the key variables of the study is to establish if unemployment is affected by monetary policy. At the second level of analysis, the article separately appends demand and exchange rate channel variables to the basic model and estimate the resultant model. If the shocks to the appended variables are important in explaining variables in the basic model, they are incorporated in the small macroeconometric model. Additionally, two sets of impulse responses are estimated in each case: one with variable of interest calculated endogenously, while the other calculates the variable of interest exogenously (Disyatat & Vongsinsirikul, 2003; Morsink & Bayoumi, 2001; Ngalawa & Viegi, 2011). The latter procedure generates an SVAR comparable to the former even though it blocks off any responses within the SVAR that pass through the variable of interest (Disyatat & Vongsinsirikul, 2003). The next stage in the modular experiment is to compare the two sets of impulse responses. Therefore, the size difference in the impulse responses is an indicator of the level of additional information contained in the series of interest, which explains a particular transmission channel. Large differences indicate that there is more information in the variable of interest and suggest that the related transmission channel is of great importance. In particular, the current article investigates the level of additional information

contained in the individual series of interest, which explain the monetary policy transmission process that feeds into unemployment.

At the third and final level of analysis, pool all variables found to have important additional information in explaining the country's monetary transmission process and append them to the basic model to create a composite SVAR, which the article refers to as the small macroeconometric model. The ultimate aim of the article is to find out if monetary policy has a role to play in influencing labour market variables, particularly unemployment. There is, therefore, little value in extending the article of the macroeconometric monetary transmission process to cover the long run since economists generally agree that monetary policy affects only the price level in the long-run and not the other variables (Disyatat & Vongsinsirikul, 2003).
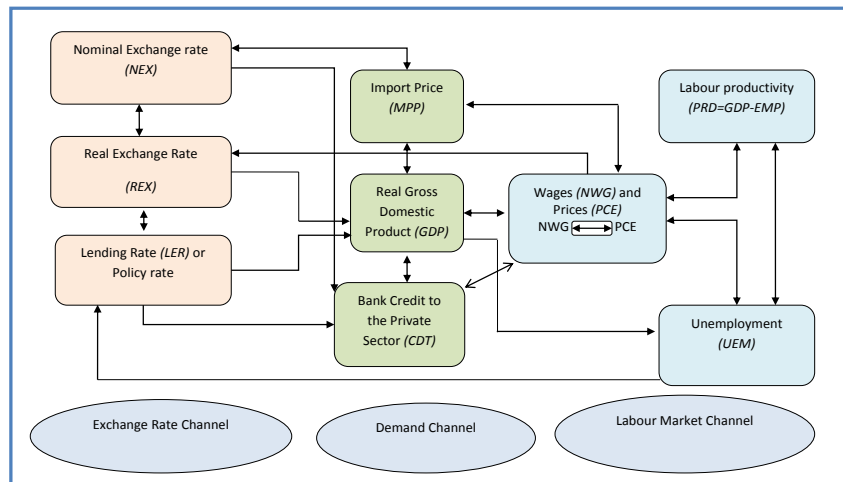
Graph 1. A stylised illustration of the complete macroeconomic model
Adaptation from McHugh (2004)

2.2. Properties of the Variables

For this type of article, it is convenient to use monthly or quarterly data, and most of the studies summarised in the introduction made use quarterly data. However, in the case of Namibia quarterly data is unavailable. This is the reason why the current article utilises annual data for the period 1980 to 2013. The variables are subjected to stationarity tests which reveal that they are all integrated of order one [I(1)][1]. The article proceeds to estimate the SVAR in levels, and this is what is consistent with standard practice based on the canonical article by Sims *et al.* (1990). In addition, the Sims *et al.* (1990) study reveals that the common practice of trying to transform models to stationary form by difference or cointegration operators whenever data appears cointegrated is unnecessary because statistics of interest frequently have distributions that are not affected by non-stationarity, which implies that hypotheses can be tested without first transforming regressors to stationarity. According to this study, the issue is not whether the data are integrated, but instead whether the test statistics or estimated coefficients of interest have distributions, which are nonstandard if the regressors are

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[1] Due to the size of the article information about the data sources, properties, stationarity tests, autocorrelation test, stability tests, etc. has been explained but not included in the article. The information is readily available if needed.

integrated. The SVAR literature has generally accepted and adopted the Sims *et al.* (1990) findings.

Bernanke & Mihov (1998) explained that the levels specification of the SVAR produces estimates that are consistent irrespective of whether cointegration exists or not. However, a differences specification is unreliable when some of the variables are cointegrated. The other studies that used this method of estimating SVARs in levels even when the variables are I(1) include Berkelmans (2005), Dungey & Pagan (2000), Dungey & Pagan (2009), Brischetto & Voss (1999), Bernanke & Mihov (1998), Ngalawa & Viegi (2011), Baffoe-Bonnie & Gyapong (2012), among others. Kim & Roubini (2000) and Becklemans (2005), explained that what partly explains preference of SVARs is an unwillingness to impose conceivably wrong restrictions on the model. Kim & Roubini (2000) argued that the imposition of wrong restrictions result in inferences that are wrong. Other studies opt to convert non-stationary information before estimating SVARs. In addition, a large number of studies concentrate on dominant relationships in the series of interest in the long run.

Note that debate regarding whether to transform models to stationary form by difference or cointegration operators or not, when dealing with I(1) variables seem to heavily lean towards the Sims *et al.* (1990) conclusion. In addition, Amisano & Giannini (1997) and Enders (2004) argue that some authors support the traditional method of converting the data to stationary regressors before estimation, irrespective of whether their studies focus on the long run or short run relationships. The current article is not going to experiment with this method. However, previous studies did not find significant differences between the variables in levels and the differenced variables on cointegrated relationships (Ngalawa & Viegi, 2010).

3. Estimation and analysis of results

3.1. The basic model

The specification of the small macroeconometric model commences with a simple four variable basic model explained in the introduction. Equation below gives a vector of endogenous variables in the basic model:

$$X_t^{'} = [PRD_t, RWG_t, UEM_t, LER_t] \tag{6}$$

Using the identification scheme in the system of equations [5] the equations separating structural shocks from the reduced form residuals for the basic model is presented as:

$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ a_{41} & 0 & a_{43} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{PRD} \\ \varepsilon_t^{RWG} \\ \varepsilon_t^{UEM} \\ \varepsilon_t^{LER} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33} & 0 \\ 0 & 0 & 0 & b_{44} \end{pmatrix} \begin{pmatrix} \mu_t^{PRD} \\ \mu_t^{RWG} \\ \mu_t^{UEM} \\ \mu_t^{LER} \end{pmatrix} \tag{7}$$

Figure 1, indicates that there is a relationship between unemployment and labour productivity, gross domestic product, real wages and lending rates. This is what led to specification of equation [7]. To select optimal lag length the article uses established criteria, which include the Akaike, Hannan-Quinn and Schwatz Information Criteria. These criteria chose a lag length of two, which result in inverse roots of characteristic autoregressive (AR) polynomial with a modulus of less than one (lying inside the unit circle), depicting that the estimated VAR is stable. All the models estimated in this

article apply the same lag length techniques and all their lag lengths are equal to two[2].

The article confirms the reliability of the structural innovations by analysing the efficiency of the structural coefficients estimated in the SVAR. All the structural estimates in matrices A and B of the basic model have standard errors that are smaller than one, and this implies that the coefficients are efficient. This further implies that structural shocks determined are reliable and, therefore, a true reflection of reality. This analysis also allows the researcher to carry out the impulse response and the variance decomposition analyses, which give reasonable results.

3.1.1.Impulse response functions to monetary policy shocks in the basic model

Figure 1 indicates that productivity declines when there is a positive interest rate shock in the economy of Namibia. A shock that increases the cost of money, negatively affects the entire economy in that less people and businesses are prepared to borrow and this leads to a fall in production and hence the gross domestic product. However, note that the response of productivity to interest rate shocks in Namibia is insignificant as it falls from 0 percent to almost negative 0.03 percent. Second, a positive shock to interest rates leads to a decline in real wages in the first year after which it becomes positive up to the sixth year. The positive response of real wages to a positive interest rate shock is not surprising because sometimes the economy grows together with real wages and loans. Third, unemployment responds positively to a sudden increase in interest rate and it reaches its optimum of approximately 3 percent after three years. A positive shock to interest rates, leads to a decrease in gross domestic product and an increase in unemployment. Lastly, as expected, the lending rates respond positively to a positive interest rate shock. As demonstrated, real wage, unemployment and lending rates respond significantly to lending rate shocks and only productivity responds insignificantly, but in the correct direction. The results clearly indicate that both lending rates and unemployment shocks are important in the basic model specified and estimated. Besides, these results favourably compare with those obtained by Linzert (2001), Watzka (2006) and Marques (2008) and Robalo Marques *et al.* (2010) even though only Watzka (2006) incorporated interest rates in his model.

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[2] The results described here can be made available on demand. Same applies to the results of structural coefficients of the A and B matrices.
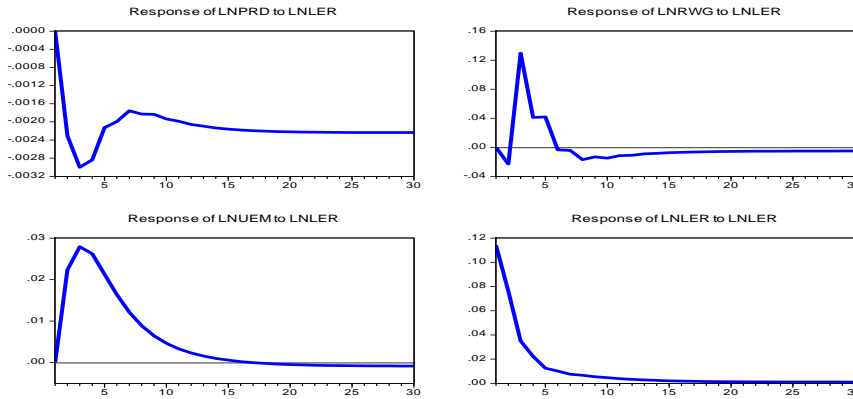
Graph 2. Effects of monetary policy in the basic model

3.1.2. Variance decomposition of unemployment in the basic model

The variance decomposition analysis shows shocks that have caused movements in a variable during the sample period (see Fonseca, 2008). The variance decomposition of unemployment indicates that the unemployment shocks are the most important shocks in explaining movements in unemployment throughout the thirty-year period studied. As an illustration, labour supply shocks explain 94 percent of the variation in unemployment in the first year and approximately 84 percent in the thirtieth year. On the other hand, productivity, real wage and interest rate shocks explain 4, 2, and 0 percent of the variation in unemployment in the first year and 12, 1, and 4 percent of the same variation in the thirtieth year. Furthermore, the results illustrate that unemployment shocks become increasingly less important in explaining unemployment variation with time, whereas productivity, real wage and interest rate shocks become increasingly more important. As a final point, the variation in unemployment is largely explained by unemployment and the monetary policy variable appears to be insignificant.

Table 1. *Variance decomposition of unemployment*

Variance Decomposition of LNUEM					
Period	S.E.	LNPRD	LNRWG	LNUEM	LNLER
1	0.122274	4.248074	1.765660	93.98627	0.000000
5	0.265233	7.445695	0.404659	88.71075	3.438895
10	0.282072	8.943683	0.367169	86.94666	3.742486
15	0.284038	9.800301	0.405843	86.07794	3.715918
20	0.285184	10.44429	0.465931	85.40307	3.686706
30	0.287461	11.56246	0.596454	84.20560	3.635485

3.2. Channels of monetary transmission in the macroeconometric model

This section, analyses the specific monetary transmission channels that relate to unemployment. The article determines the strength of each channel by first appending to the basic model the variable that captures the particular channel of interest and calculating two sets of impulse responses: one with the variable of interest treated as endogenous in the SVAR and another where it is treated as exogenous. Comparison of impulse response functions of these two models provides a measure of the importance of that particular channel in acting as a conduit for monetary policy to the real economy (Disyatat & Vongsinsirikul, 2003). The article investigates two channels, which influence unemployment, that is, the demand channel and the

exchange rate channel. As we identify these transmission channels for Namibia, the article establishes the significance of each channel in the monetary transmission process by looking at its significance in influencing unemployment. If the channel shock is significant in influencing unemployment, it is considered as a candidate to be included in the small macroeconometric model.
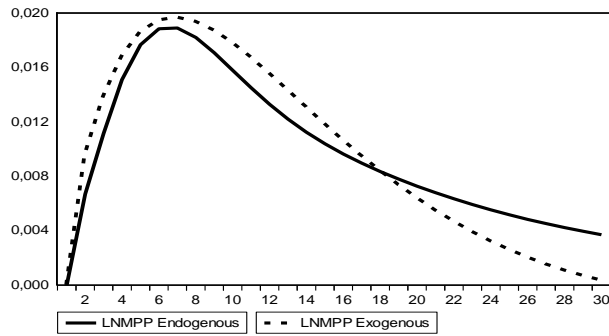
3.2.1. The demand channel model using import prices

The article experimented with output, bank lending to the private sector and import prices in the demand channel, but output was found insignificant in the model and was therefore dropped. The Namibian economy is highly dependent on imports of both consumer and capital goods from both developed and developing countries. In this context, one can interpret the import price shock as a shock to the terms of trade. A change in the terms of trade could emanate from a rise in the price of exports or a fall in the price of imports and vice versa. In addition, emphasis in Namibia is placed on import price changes for the latter reason. Appending import prices to equation [7] transforms the basic model and the corresponding vector of endogenous variables becomes:

$$X_t^{'} = [PRD_t, RWG_t, UEM_t, \ MPP_t, LER_t] \tag{8}$$

Using the identification scheme in the system of equations [5] the equations separating structural shocks from the reduced form residuals for the basic model is presented as:

$$
\begin{pmatrix}
1 & 0 & 0 & 0 & 0 \\
0 & 1 & 0 & 0 & 0 \\
0 & 0 & 1 & 0 & 0 \\
a_{41} & 0 & 0 & 1 & 0 \\
a_{51} & 0 & a_{53} & a_{54} & 1
\end{pmatrix}
\begin{pmatrix}
\varepsilon_t^{PRD} \\
\varepsilon_t^{RWG} \\
\varepsilon_t^{UEM} \\
\varepsilon_t^{MPP} \\
\varepsilon_t^{LER}
\end{pmatrix}
=
\begin{pmatrix}
b_{11} & 0 & 0 & 0 & 0 \\
0 & b_{22} & 0 & 0 & 0 \\
0 & 0 & b_{33} & 0 & 0 \\
0 & 0 & 0 & b_{44} & 0 \\
0 & 0 & 0 & 0 & b_{55}
\end{pmatrix}
\begin{pmatrix}
\mu_t^{PRD} \\
\mu_t^{RWG} \\
\mu_t^{UEM} \\
\mu_t^{MPP} \\
\mu_t^{LER}
\end{pmatrix}
\tag{9}
$$

To establish the importance of the demand channel to the monetary transmission process in Namibia, impulse responses of unemployment is plotted under two scenarios in each case: endogenous and exogenous import prices. In this case, exogenous import prices block responses that pass through interest rates while the case of endogenous import prices allows interest rates to transmit monetary policy shocks. Figure 4 indicates that there is significant difference in the magnitude of impulse responses when import price is endogenous and when it is exogenous from the first year onwards. Essentially, this provides evidence that import prices contain important additional information that relate to the country's monetary transmission process. A positive monetary policy shock means that the Central Bank is tightening monetary policy and this limits activity in the loans market. In addition, unemployment increases after a tight monetary policy shock to reach a maximum of 1.8 percent, and this is applicable to both endogenous and exogenous cases.

Graph 3. Impulse response of unemployment to a monetary policy shock with endogenous and exogenous import prices

3.2.2. The demand channel using the bank credit to the private sector

The bank credit lending is the other variable from the demand channel, which is appended to the basic model. As explained above, the first thing done here is to estimate equation [11] using SVAR and then determine how all the variables in the basic VAR respond to bank credit shocks[3]. The next stage is to determine responses of variables in the basic model when bank credit is endogenous and exogenous.

The model estimated here is:

$$X_t^{'} = [PRD_t, RWG_t, UEM_t, \ CDT_t, LER_t].\tag{10}$$

Using the identification scheme in the system of equations [5] the equations separating structural shocks from the reduced form residuals for the basic model is presented as:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ a_{41} & 0 & 0 & 1 & 0 \\ a_{51} & 0 & a_{53} & a_{54} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{PRD} \\ \varepsilon_t^{RWG} \\ \varepsilon_t^{UEM} \\ \varepsilon_t^{CDT} \\ \varepsilon_t^{LER} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{pmatrix} \begin{pmatrix} \mu_t^{PRD} \\ \mu_t^{RWG} \\ \mu_t^{UEM} \\ \mu_t^{CDT} \\ \mu_t^{LER} \end{pmatrix} \tag{11}$$

To determine the significance of the bank credit to the private sector to the monetary transmission process, Figure 6 presents impulse responses of unemployment to sudden tightening of monetary policy using two scenarios: endogenous and exogenous bank credit. Unemployment increases after a tight monetary policy shock for both cases where bank credit is endogenous and exogenous to reach a maximum of approximately 1.1 percent. The two responses commence to diverge from each other after the third year and this confirms that bank credit contains important additional information in the monetary transmission process, which appears pronounced in the response of unemployment.

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[3] Results not shown here, but are available on demand.
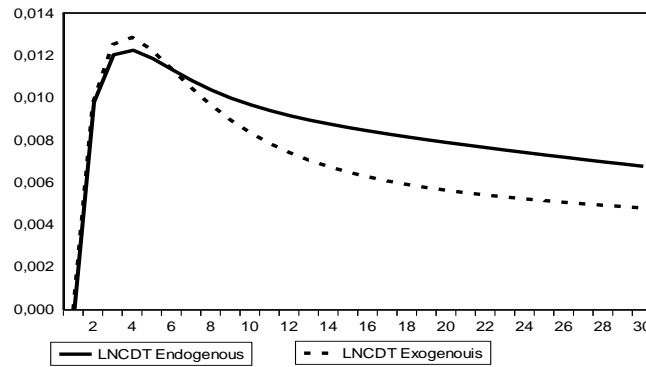
Graph 4. Impulse response of unemployment to a monetary policy shock with endogenous and exogenous bank credit

3.2.3. The exchange rate channel model

For a small open economy, a potentially important channel through which monetary policy may affect real economic activity is through its effects on exchange rate. Precisely, monetary easing combined with sticky prices, results in a depreciation of the exchange rate in the short run and higher net exports (see Fragetta, 2010; Fragetta & Melina, 2011; Ajilore & Ikhide, 2013). The strength of the exchange rate channel is dependent on the sensitivity of the exchange rate to monetary shocks, level of openness of the economy, and sensitivity of net exports to exchange rate variations. According to Disyatat & Vongsinsirikul (2003) substantial unanticipated exchange rate depreciation can reduce output when a significant share of debt in the economy is foreign currency denominated[4].

In Equation [12], nominal exchange rates are appended to the basic model and this gives the following vector of endogenous variables:

$$X_t' = [PRD_t, RWG_t, UEM_t, NEX_t, LER_t] \tag{12}$$

Using the identification scheme in the system of equations [6.5] the equations separating structural shocks from the reduced form residuals for the basic model is presented as:

$$
\begin{pmatrix} 1 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 \\ a_{51} & 0 & a_{53} & a_{54} & 1 \end{pmatrix}
\begin{pmatrix} \varepsilon_t^{PRD} \\ \varepsilon_t^{RWG} \\ \varepsilon_t^{UEM} \\ \varepsilon_t^{NEX} \\ \varepsilon_t^{LER} \end{pmatrix}
=
\begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 \\ 0 & 0 & 0 & 0 & b_{55} \end{pmatrix}
\begin{pmatrix} \mu_t^{PRD} \\ \mu_t^{RWG} \\ \mu_t^{UEM} \\ \mu_t^{NEX} \\ \mu_t^{LER} \end{pmatrix}
\tag{13}
$$

To determine the significance of nominal exchange rates in the monetary transmission process, Figure 8 presents impulse responses of unemployment to monetary policy shocks using two scenarios: endogenous and exogenous nominal exchange rates. The response of unemployment is all in line with the a priori expectations after a sudden positive exchange rate shock under cases where exchange rates are endogenous or exogenous. The response of unemployment to a tight monetary policy shock, in both cases, is positive. In other words, a sudden increase in interest rates increases unemployment to reach a maximum of about 2.4 percent in the 5th year. The figure, therefore, confirms that exchange rates contain important additional information in the monetary transmission process and this is illustrated by the diverging

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[4] This may not be relevant to Namibia because its foreign debt is still very small.

response of unemployment after the third year when nominal exchange rates are treated as endogenous and when they are treated as endogenous.
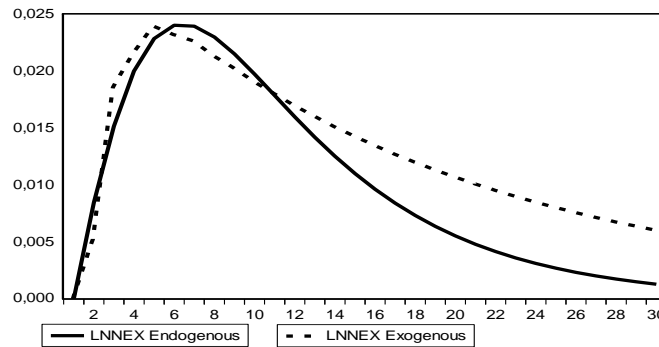
Graph 5. Impulse response of unemployment to a monetary policy shock with endogenous and exogenous exchange rate

Even though the study established that import prices, bank credit to the private sector and nominal exchange rates have important additional information, which explains the monetary transmission process in Namibia, the response of unemployment to a monetary policy shock under all endogenous and exogenous scenarios was rather subdued. The response of unemployment only attained a maximum of 2.4 percent when the nominal exchange rate scenarios where considered and this is not a strong response.

3.2.4. The small maroeconometric model for Namibia

The results from the preceding section indicate that variables in the basic model largely influence each other correctly and significantly [5]. This corroborates the findings by McHugh (2004) that real wage, productivity and unemployment can be estimated simultaneously to give meaningful results. Furthermore, preliminary indications from the previous section also suggest that the demand (import prices, bank lending to the private sector) and exchange rates (nominal exchange rates) channels contain important additional information for monetary transmission process in Namibia. Incorporating information from the basic model and the possible transmission channels discussed, result in a composite small macroeconometric model for Namibia with the following vector of endogenous variables:

$$X_t^{'} = [PRD_t, RWG_t, UEM_t, \ MPP_t, CDT_t, NEX_t, LER_t] \tag{14}$$

Equation [14] is identified in accordance with the system of equations in [5]. It should be noted that the article experimented with many possible variables and the ones whose results were discussed are the ones that gave significant and meaningful results.

3.2.5. Impulse response functions for the macroeconometric model

The impulse response functions of the small macroeconometric model over a thirty-year period are presented in Figure 9. The information contained in these figures corroborates the fact that that import prices, bank lending to the private sector and exchange rates are important channels of monetary transmission in Namibia, which influence unemployment.

[5] The full results are not shown but we only show the results that relate to the response of unemployment to the monetary policy shock. The full results can be made availble when needed.

Furthermore, most of the responses of the variables in the small macroeconometric model to shocks in these variables are significant in the short run. Unemployment generally responds positively to a positive import price shock even though it became negative between the 5th and the 8th year. The possible explanation for this is that sudden increases in import prices reduce production and the gross domestic product and this has the effect of decreasing unemployment in the economy.
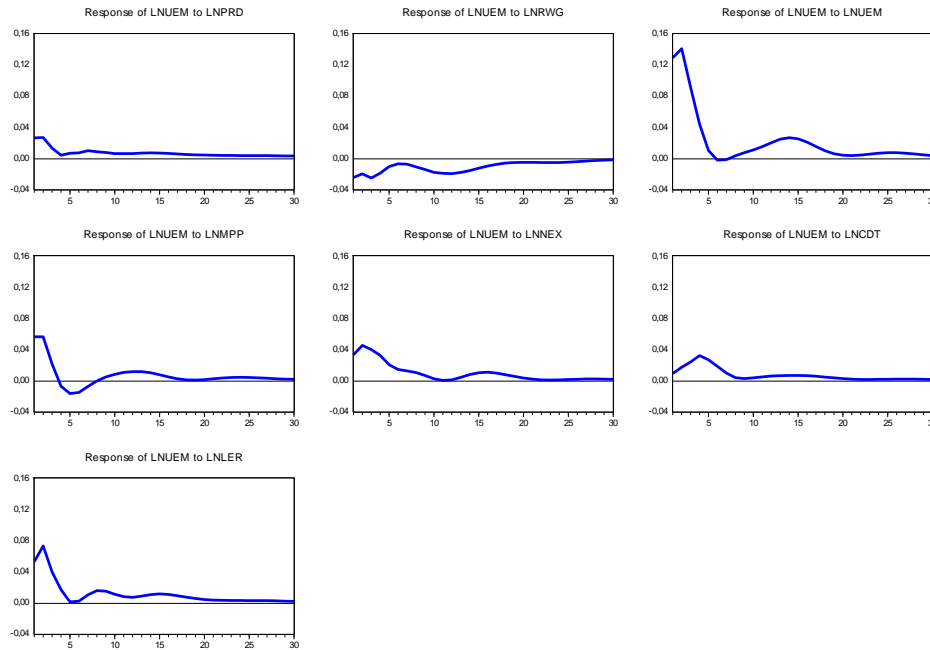
Graph 6. Impulse responses of unemployment in the small macroeconometric model

Further, unemployment rate increases in the short run after a positive increase in interest rates and the effect dies down with time as the response tends towards the baseline. After the second year, the response of unemployment is entirely positive. Specifically, unemployment falls from approximately 8 percent in the first year to zero in the 5th year after which it generally remains in positive territory. This means that monetary policy affects unemployment in Namibia in the short run and in the long run the effect tends towards zero.

3.2.6. Variance decompositions for the macroeconometric model

In this section, the article determines the proportion of unemployment fluctuations caused by different shocks over a 30 year time horizon. The article only concentrates on the variance decomposition of the unemployment rate. Table 1 suggests that the greatest proportion of unemployment is explained by shocks to unemployment in both short run and long run. In addition, productivity and real wage shocks each explain on average 4 percent of the fluctuations in unemployment in both short run and long run. However, the monetary policy variables explain insignificant proportions of variations in unemployment in Namibia.

Table 2. *Variance decomposition of unemployment in the small macroeconometric model*

Variance Decomposition of LNUEM							
Period	S.E.	LNPRD	LNRWG	LNUEM	LNMPP	LNNEX	LNCDT	LNLER
1	0.129282	4.115461	5.538139	90.34640	0.000000	0.000000	0.000000	0.000000
5	0.224637	3.244972	5.815228	84.99582	3.965839	0.361442	1.389579	0.227121
10	0.230552	3.671459	7.362596	80.89601	4.803822	1.110188	1.476566	0.679360
15	0.238435	3.818876	10.01331	78.51479	4.577248	1.051821	1.382618	0.641339
20	0.240903	3.974027	10.38980	77.86397	4.674029	1.076035	1.363033	0.659102
30	0.242063	4.148732	10.73012	77.39900	4.636119	1.074495	1.350760	0.660776

4. The robustness of the models

The robustness checks were conducted for both the basic and the small macroeconometric model and the results are reported below. Given the relatively small number of observations, the article checks the robustness of the reduced form VAR results by analysing stability of parameters using the CUSUM and the CUSUM of squares. The parameter stability tests results indicate that in spite of minor episodes of instability the residual variance of each equation is largely stable (the test statistics remain within the 5% critical bands). In addition, results also established that the individual variables are normally distributed and this is a critical property when using VAR and SVAR. The structural estimates of coefficients in matrices A and B in all models indicate that all coefficients in the models have standard errors with values less than one suggesting that they are efficient and hence form a solid basis for measuring shocks. In addition, inverse roots of the characteristics AR polynomial for the determination of stability or stationarity show that all inverse roots of the characteristic AR polynomials have moduli less than one and lie inside the unit circle, implying that at the chosen lag length of order two the estimated models are stable or stationary. Lastly, serial correlation test results show that there is no evidence of any serious serial correlation in the models. Therefore, both the basic and the small macroeconometric models are robust and their inferences are reliable[6].

5. Summary and conclusions

This article analysed the effects of monetary policy on unemployment in Namibia using the structural VAR model. Specifically, the study investigated how much of the fluctuations in unemployment are caused by monetary policy shocks and how persistent these effects are. The basic model (specified using productivity, real wage, unemployment and lending rates) results show that a shock to interest rates leads to an increase in unemployment, which reaches a maximum of 2.8 percent in the fourth year. Between the fourth and the 15th year, unemployment declines after a monetary policy shock and becomes zero after the 15th year. The magnitude of this short run response is not very strong and this is corroborated by the variance decomposition analysis, which indicates that the fluctuations in unemployment are mainly explained by unemployment and productivity both in the short run and long run. Besides, monetary polcy and real wages do not significantly explain unemployment fluctuations in both the short run and long run.

The study then used that basic model and the demand and exchange rate channels variables to find out if these channels variables have important

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[6] Not all the test results discussed here are shown in the main thesis but they can be obtained from the authors if needed.

information that explain the monetary policy transmission to unemployment. Since in each of the three cases considered the response of unemployment to a monetary policy shock when the channel variables was either endogenous or exogenous diverged at some point, this meant that each channel variable had important additional information which explained the monetary transmission process to unemployment. This also implies that these demand and exchange rate channel variables could be incorporated in the small macroeconometric model for Namibia. The impulse response functions for the small macroeconometric model mean that unemployment is only affected slightly in the short run by the various shocks and in the long run the responses dies out. Unemployment increases in the first year from 5 percent to reach a maximum of 7 percent after a monetary policy shock and then declined but remained positive up to the 5th year after which it dies out. The variance decomposition results also confirm the basic model results that the monetary policy variable does not significantly explain the variations in unemployment in both the short run and long run.

The article therefore concludes that monetary policy slightly affects unemployment in the short run in Namibia and in the long run it has a neutral effect. These results differ from those found by Alexius & Holmlund (2007) (for Sweden) and Jacobs *et al.* (2003) who established that monetary policy has a significant role to play in explaining unemployment. This means that there is still need to investigate the explanations of long run unemployment in Namibia so that appropriate policies are instituted to address it effectively.

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