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The Dynamic Effects of Monetary Policy on Real Variables in Namibia

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Abstract

The study develops a small macroeconometric model for Namibia by using labour market and monetary variables for the period 1980 to 2013. The study shows the process through which monetary policy affects real (labour market) variables. Using the structural vector autoregression methodology (SVAR), a small macroeconometric model is developed using three modular experiments, namely; the basic model, and models that incorporate demand and exchange rate channel variables to the basic model and specification of the macro-econometric model. The study finds that demand and exchange rate channels variables have important additional information, which explains the monetary transmission process and that shocks to labour market variables affect monetary policy in Namibia.

Keywords: Unemployment, Structural VAR, Impulse response, Variance decomposition, Namibia, macroeconometric modelling.

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1. Introduction

This article analyses the effects of monetary policy on labour market variables viz: real wage, productivity and unemployment in Namibia. The article specifically investigates the fluctuations in the labour market variables caused by monetary policy shocks and the persistence of these effects. The article uses a structural VAR model for the period 1980 to 2013. Impulse response functions contain information about the magnitude and duration of the effects of a specific structural shock and variance decompositions show which shocks that have caused movements in a variable during the sample period.

It is noteworthy that although the effects of monetary policy on labour market variables, particularly, unemployment have not been investigated that much, there exist a few studies that relevant. For example, Ravn and 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 caused by monetary policy shocks.

The sources of fluctuations in unemployment were analysed using variance decompositions by several researchers who include Jacobson et al. (1997), Dolado and Jimeno (1997) and Carstensen and Hansen (2000). Dolado and Jimeno (1997) studied the Spanish unemployment and established that the main source of unemployment variability in Spain is the productivity shocks followed by labour supply and demand shocks, respectively. In addition, Maidorn (2003), established that demand shocks explain the greater part of the fluctuations in Australian unemployment while, Gambetti and Pistoresi (2004) found long lasting effects of demand shocks on the Italian economy. Christoffel and Linzert (2005) and Karannassou and Sala (2010) among others, found long lasting effects on European unemployment rates using other approaches instead of the VAR models. Additionally, Carstensen and 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 and Serati (2003) also found that unemployment rates in several European countries are affected permanently by the demand shocks. Furthermore, Jacobson et al (1997) found that transitory labour demand shocks negligibly affected unemployment in the Scandinavian nations. Jacobson et al. (2003) also 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.

It is against this background that the current article develops and simultaneously estimates a system comprised of real wage (wage-price), labour productivity and the unemployment rate[3]. This system is a major component of the basic model for the current article, which incorporates

[3] See Broadberry and Ritschl (1995), Marcellino and Mizon (2001), Marcellino and Mizon (1999) and McHugh, 2004 for explanations relating to the simultaneous treatment of these three variables.

the interest rate variable, to determine if demand and exchange rate channel variables have important additional information, which explains the monetary transmission process in Namibia. In addition, the inclusion of interest rates is justified using the stylised illustration of the complete macroeconometric model in Figure 1. In the figure, the policy rate is shown to be directly explained by unemployment and exchange rates. In addition, the policy rate directly explains bank credit to the private sector, real gross domestic product and exchange rates. It is also noteworthy that the demand, monetary, exchange rate and labour market channels in Figure 1 are all connected either directly or indirectly. Additionally, the article specifies all the models it discusses as Structural Vector Autoregression models with the ultimate aim of deriving impulse response functions and forecast error variance decomposition functions.

This article differs from previous studies in several respects. First, the demand, labour market and exchange rate channels of the economy are used to develop the small macroeconometric model. Second, the article uses three modular experiments to develop the small macroeconometric model used in the final analysis. The finding in previous work that demand shocks are unimportant to unemployment fluctuations may well be a consequence of the rudimentary modelling of the demand side of the economy. Our results indicate that around 10 and 24 percent of the fluctuations in unemployment are caused by shocks to monetary policy in the short and long run, respectively. The macroeconometric model of the Namibian economy is developed using three SVAR modular experiments explained in Section 2.1 below.

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 describes 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 of the article 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 and 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) original article, Stock and 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:

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

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 $X_t = (X_{1t}, X_{2t}, \ldots X_{nt})$; 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 $\varepsilon_t = A^{-1}\mathrm{B}\mu_t$. 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]:

$$A\Sigma A' = BB' \qquad [4]$$

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. (1998) 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 and 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 and Mihov, 1998; Eichenbaum and Evans, 1995; Sims and Zha 2006; Basher et al. 2010). However, Christiano et al. (2006) 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 and Leeper (1997) assert that there is frequently an insufficient number of tenable contemporaneous restrictions to achieve identification. Literature that is more recent 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 and Mihov, 1998; Sims and 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). Real wages, productivity and unemployment are included in the SVAR as labour market variables; import prices as demand variables, exchange rates and bank lending rates as monetary variables. From equation [3], we get the following equations using matrix notation:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 & 0 & 0 & 0 \\ a_{41} & 0 & a_{43} & 1 & 0 & 0 & 0 \\ a_{51} & 0 & a_{53} & a_{54} & 1 & 0 & 0 \\ a_{61} & 0 & a_{63} & a_{64} & a_{65} & 1 & 0 \\ a_{71} & 0 & a_{73} & a_{74} & a_{75} & a_{76} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{PRD} \\ \varepsilon_t^{RWG} \\ \varepsilon_t^{UEM} \\ \varepsilon_t^{MPP} \\ \varepsilon_t^{NEX} \\ \varepsilon_t^{CDT} \\ \varepsilon_t^{LER} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 & 0 & 0 & 0 \\ 0 & 0 & b_{33} & 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & b_{44} & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 & b_{55} & 0 & 0 \\ 0 & 0 & 0 & 0 & 0 & b_{66} & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & b_{77} \end{pmatrix} \begin{pmatrix} \mu_t^{PRD} \\ \mu_t^{RWG} \\ \mu_t^{UEM} \\ \mu_t^{MPP} \\ \mu_t^{NEX} \\ \mu_t^{CDT} \\ \mu_t^{LER} \end{pmatrix} \quad [5]$$

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. This section 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 makes use of 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

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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 is noteworthy 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 and 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 article 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 the 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 the 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 the 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. The essence of this basic model that incorporates interest rates to the key variables of the article is to establish which labour market variables are 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 the 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 the variable of interest calculated endogenously, while the other calculates the variable of interest exogenously (Disyatat and Vongsinsirikul, 2003; Morsink and Bayoumi, 2001; Ngalawa and 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 and Vongsinsirikul, 2003). The next stage in the second 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.

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 composite SVAR, which the article labels 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. This implies that only the short run analysis of the article conforms to the subject matter under examination. 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 and Vongsinsirikul, 2003).

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 under literature review 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 sources of the data and the variable definitions used are outlined in Table A1 in Appendix A. The variables are subjected to stationarity tests which reveal that they are all integrated of order one [I(1)][4]. The article proceeds to estimate the SVAR in levels, and

[4] 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 and can be provided on demand.

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

Bernanke and 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 and Pagan (2000), Dungey and Pagan (2009), Brischetto and Voss (1999), Bernanke and Mihov (1998), Ngalawa and Viegi (2011), Baffoe-Bonnie and Gyapong (2012), among many others. Kim and Roubini (2000) and Becklemans (2005), explained that what partly explains the preference of SVARs is an unwillingness to impose conceivably wrong restrictions on the model. Kim and 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 and Giannini (1997) and Enders (2004) argue that other 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 and Viegi, 2011).

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:

$$X_t' = [PRD_t, RWG_t, UEM_t, LER_t] \qquad [6]$$

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:

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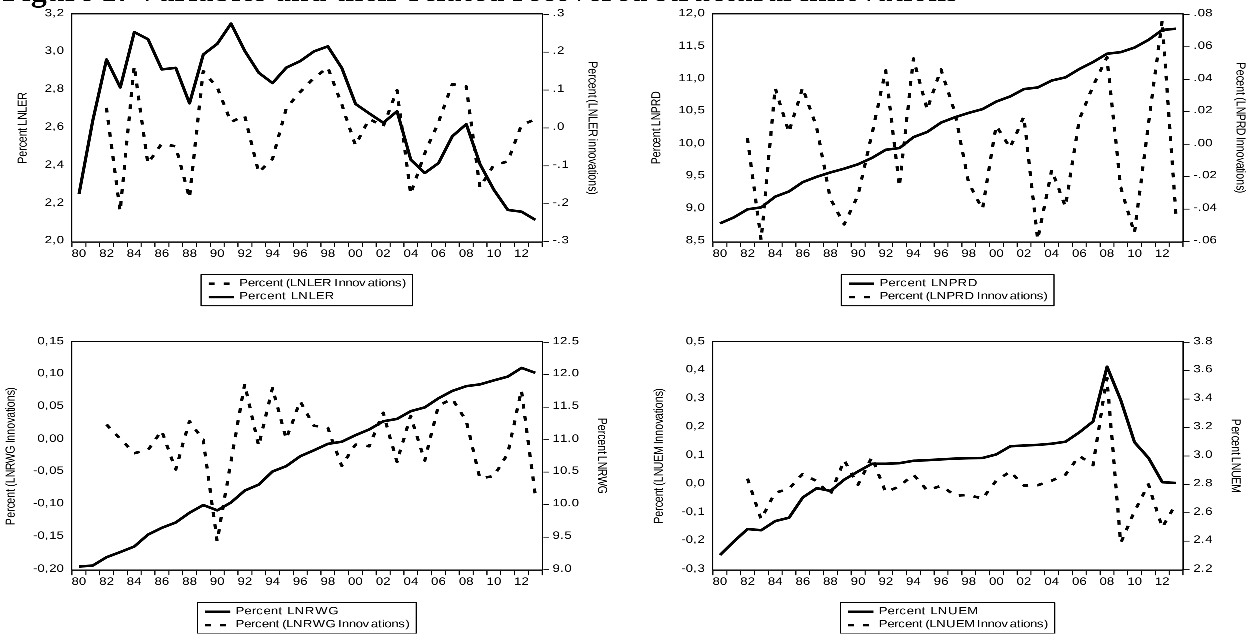
$$\begin{pmatrix} 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ a_{41} & 0 & a_{43} & 1 \end{pmatrix} \begin{pmatrix} \varepsilon_t^{PRD} \\ \varepsilon_t^{RWG} \\ \varepsilon_t^{UEM} \\ \varepsilon_t^{LER} \end{pmatrix} = \begin{pmatrix} b_{11} & 0 & 0 & 0 \\ 0 & b_{22} & 0 & 0 \\ 0 & 0 & b_{33}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

Figure 1, in the introduction indicates that there is a relationship between unemployment and labour productivity, gross domestic product, real wages and lending rates. This is what led to the specification of the equation in [7]. To select the optimal lag length the article uses the established criteria, which include the Akaike, Hannan-Quinn and Schwatz Information Criteria. These criteria chose a lag length of two, which result in the inverse roots of the 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. The VAR lag exclusion Wald test reveals that all endogenous variables in the model are jointly significant at each lag length for all equations collectively. Separately, at lag length of order one all equations except productivity are significant while at lag two productivity unemployment and lending rates are insignificant[5].

Figures 1, shows the analysis of the correlation between the movements in the variables included in the basic model and their corresponding recovered structural shocks to verify if the analysis of the shocks in basic model is reasonable. The figures plot the variables lending rates and productivity on the primary axis and their recovered innovations on the secondary axis. In the case of real wages and unemployment, the primary axis denotes the recovered innovations and secondary axis denote the variables. The figures indicate that there is some correlation in the movements of productivity, unemployment, real wage and lending rates and their respective recovered innovations. However, the correlations appear to be stronger between unemployment and lending rates and their recovered innovations compared to productivity and real wage and their recovered innovations. 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.

[5] The results described here can be made available on demand. Same applies to the results of structural coefficients of the A and B matrices.

Figure 1: Variables and their related recovered structural innovations



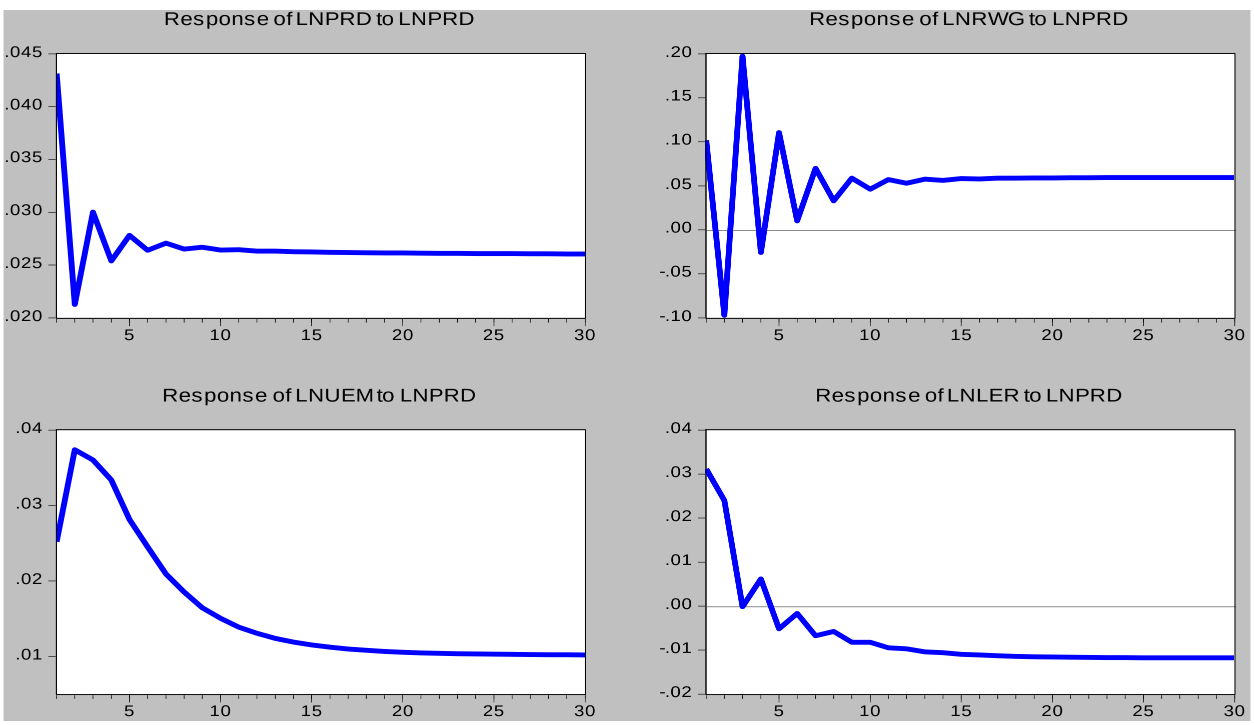
Source: Authors' calculation from Eviews 8

Next, the article analyses the behaviour of the shocks to the basic model variables and the resultant impulse responses, this indicates whether the results make sense or not. Additionally, Figure 2 presents impulse responses of productivity, real wage, unemployment and interest rates to structural one standard deviation innovations in of the same variables over a thirty-year time horizon. The primary horizontal axis measures the time scale in years and the solid lines represent the responses to generalised one standard deviation innovations, which are not affected by the way the variables are ordered (see Fonseca, 2008).

3.1.1 Impulse response functions of the basic model

Figure 2 shows the impulse response functions of technology and real wage shocks. The responses of productivity, real wages, unemployment and lending rates to a technology shock are significantly different from zero. Moreover, unemployment significantly rises on impact from 2.5 percent to 3.8 percent in the first year after which it falls but remains positive. Furthermore, this can be explained by the fact that a positive shock to technology leads to an increase in interest rates which in turn leads to a fall in gross domestic product and hence an increase unemployment. In the long run, that is, after 15 years unemployment equilibrates at 1 percent above the baseline. Additionally, the lending rate increases in the first four years after a technology shock and then significantly decreases from then onwards. A positive productivity shock implies that the economy is performing at its best and this leads to an increase in interest rates in the first four years. There are situations where the economy and demand for loans grow simultaneously which in turn bid up the price of money. As an illustration, lending rates fall from 3 percent to zero percent in the first three years after a technology shock; and then fall to equilibrate at about 1.2 percent below the baseline after ten years. Next, the article looks at the response of productivity to a technology shock. As expected, productivity responds positively to a technology shock. During the entire period, the response of productivity to technology shocks is positive falling from 4.5 percent in the first year to 2.2 percent at the end of the first year. The next impulse response analysed is the real wage. Figure 2, also shows that in the first half of the first year, real wage responds positively to a productivity shock and then negatively in the second half of the first year. Despite the brief negative response of real wages to a technology shock, they generally respond positively and equilibrate at about 5 percent above the baseline after ten years. Naturally, an economy whose productivity is increasing is expected to have increasing real wages if the nominal wages are rising faster than the average prices in the economy. The evidence presented here is similar to the results obtained by, Watzka (2006), Christiano et al. (2006), Carstensen and Hansen (2000) and Marques (2008).

Figure 2 also illustrates the impact of the shocks to real wage on the other variables that are in the basic model. Productivity increases insignificantly after a positive real wage shock as workers increase the work effort they put in their work. In the first half year of the real wage shock, lending rates decrease and then increase in the next half year and then permanently decrease from the beginning of the second year and equilibrate at about -0.5 percent below the baseline. As far as the response of unemployment to real wage shocks is concerned, the employers start experiencing the negative effects of the real wage shocks after five years and this makes them cut back on employment, which consequently increases unemployment. In the first five years, unemployment actually decreases as people who previously considered the existing wages low start looking for jobs after the positive wage shock. In addition, the response of the lending rates to real wage shocks is generally negative and equilibrates at negative 0.5 percent after approximately seven years. Additionally, real wage responds positively in the first six years to a real wage shock and equilibrates on the baseline from the seventh year onwards. The explanation for this could be linked to the fact that real wages are closely linked with the nominal wages, which can also not have permanent long run effects on other variables.



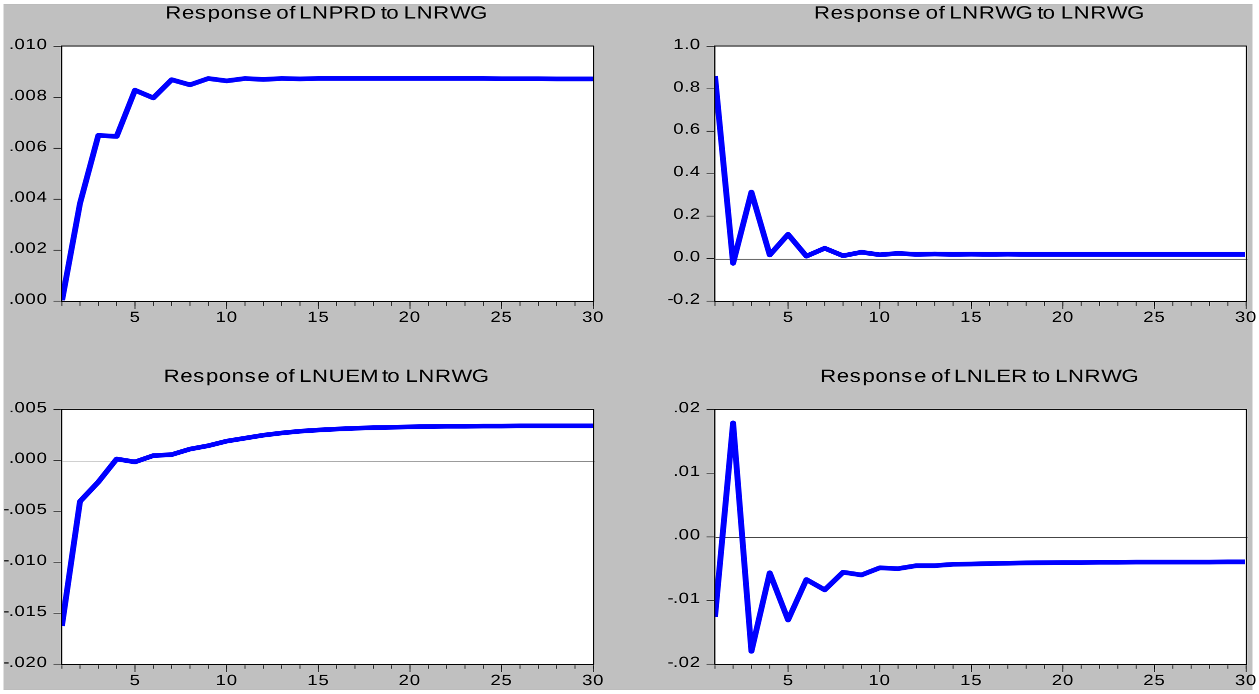


Figure 2: Effects of technology and real wage shocks in the basic model
Source: Authors' calculation from Eviews 8

Figure 3 shows the effects of positive shocks to labour supply and interest rates in the basic model. First, the figure shows that a positive shock to labour supply leads to a decrease in productivity. This means that when there is a positive shock to labour supply the economy is not performing at its best and this leads to a decrease in gross domestic product and hence productivity. Second, a positive shock to labour supply, leads to a decrease in real wages to reach a minimum of approximately 14 percent after five years. This is explained by the fact that an increase in labour supply leads to an increase in the number of people looking for jobs and this has the effect of pushing down the nominal wages and hence the real wages. Third, a positive shock to labour supply increases interest rates. This means that demand for loans may go up as more and more people attempt to get loans to cushion themselves against loss of income through loss of employment. However, a counter argument can also be advanced that the less the people who are working the less the people who are eligible to be advanced loans in the economy. The former argument appears to be the one applicable to the Namibian situation. Lastly, a positive shock to labour supply, as expected, leads to an increase in unemployment. Overall, the figure shows that all the four variables significantly respond to labour supply shocks.

Figure 3 also 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 the interest rate shocks in Namibia is insignificant as it falls from 0 percent to negative 0.28 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 when the economy is growing the demand for both real wages and loans increases. Third, unemployment responds positively to a sudden increase in interest rate and it reaches its optimum of approximately 3 percent after three years. This can be explained by an argument advanced earlier that an increase in interest rates, leads to a decrease in production and gross domestic product and hence 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. What is more, is that, 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.

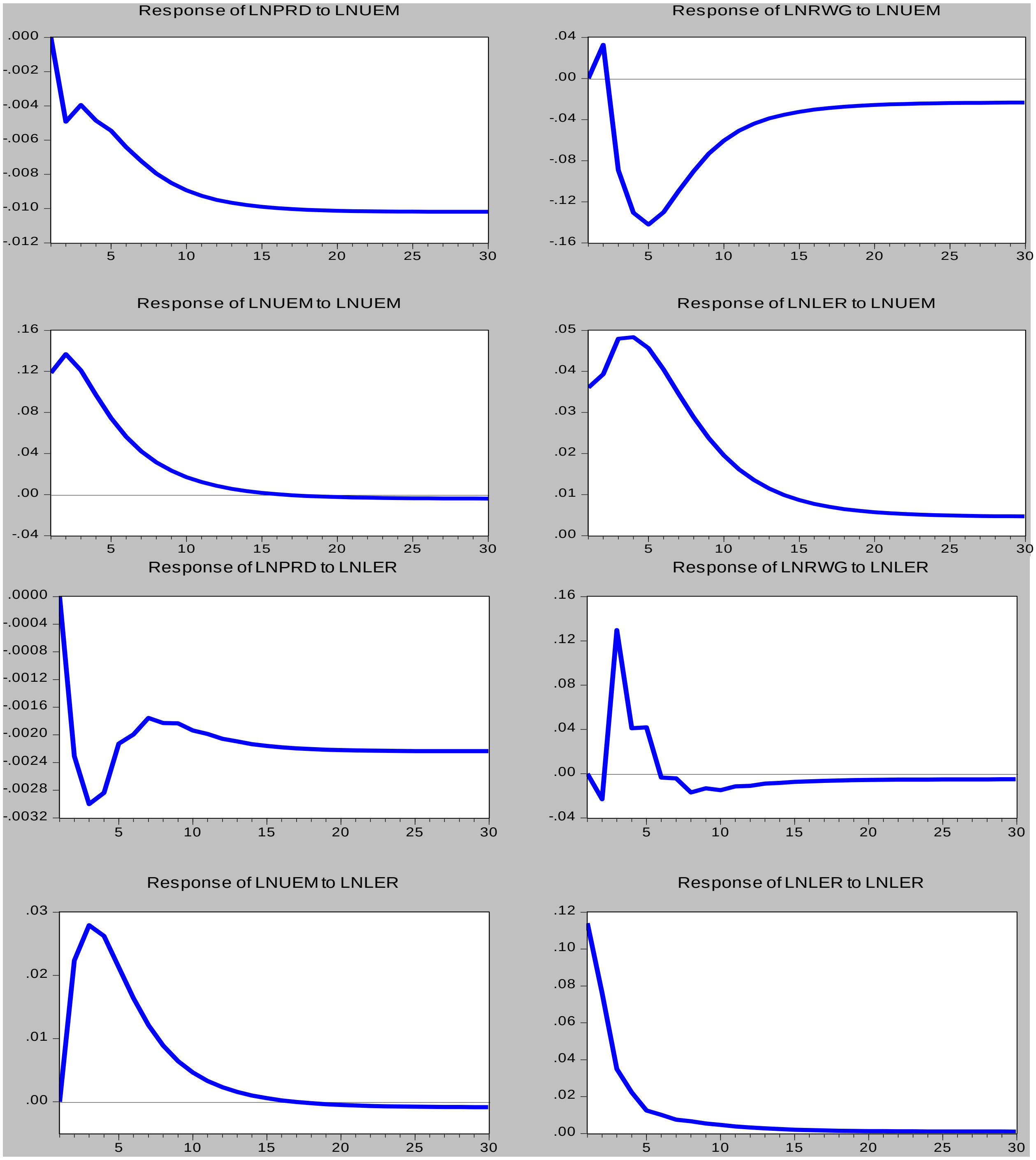


Figure 3: Effects of unemployment and lending rate shocks in the basic model
Source: Authors' calculation from Eviews 8

3.1.2 Variance decomposition of the basic model

Table 1 illustrates the variance decomposition of the variables that are in the basic model. Variance decomposition of productivity shows that technology shocks explain a large proportion of the movements in productivity throughout the thirty-year horizon considered. To illustrate, technology shocks explain 100 percent of the movements in productivity in the first year and about 85 percent in the thirtieth year, implying that technology shocks become increasingly less important with time. However, all the shocks to the other series become increasing more important with time in accounting for movements in productivity. As an illustration, in the first year real wages, unemployment and lending rate shocks all account for zero percent of the movements in productivity, while they account for 8, 9 and 1 percent, respectively in the thirtieth year. Further, the article notes that lending rates are the ones that are contributing insignificantly to the movements in productivity. Thus, productivity shocks are the most important shocks accounting for the movements in productivity followed by unemployment and then the real wage.

Table 1, also illustrates that the real wage shocks are more important in accounting for the movements in real wages since they account for 99 percent in the first year, and about 75 percent in the thirtieth year. While real wage shocks become increasingly less important in explaining movement in real wages, shocks to productivity and unemployment become increasingly more important and shocks to interest rates decrease from their highest of 2.1 percent in the fifth year to approximately 2 percent in the thirtieth year. Besides, in the first year, productivity explains 1 percent of the movements in real wage and both unemployment and lending rates explain zero percent of the movements. In addition, in the thirtieth year productivity, unemployment and lending rates explain 13, 10 and 2 percent of the movements in real wage, respectively. Consequently, real wage shocks are the most important shocks explaining movements in real wage followed by productivity and unemployment shocks, respectively.

The variance decomposition of interest rates shows that in the first year productivity, real wage, unemployment and interest rates explain about 6, 1, 8 and 84 percent of the variation in interest rates, respectively. Moreover, interest rate shocks become increasingly less significant in accounting for movements in interest rates, while productivity, real wage and unemployment become increasingly more significant. Specifically, in the thirtieth year productivity, real wage, unemployment and interest rates explain about 10, 4, 36 and 50 percent of the variation in interest rates, respectively. As a result, lending rates, labour productivity and technology shocks are the important shocks explaining interest rates, respectively.

The variance decomposition of unemployment indicates that the labour supply 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 labour supply 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 shocks explaining the variation in unemployment are labour supply, productivity and lending rates, according to their order of importance.

Table 1: Variance decomposition for the basic model

Variance Decomposition of LNPRD

Period	S.E.	LNPRD	LNRWG	LNUEM	LNLER
1	0.043132	100.0000	0.000000	0.000000	0.000000
5	0.070138	94.15952	3.401199	1.892606	0.546679
10	0.095655	89.33850	5.784889	4.391371	0.485244
15	0.116093	86.34303	6.750488	6.415480	0.491007
20	0.133467	84.54845	7.249730	7.694109	0.507709
25	0.148807	83.40276	7.554245	8.522258	0.520741
30	0.162675	82.62098	7.758924	9.089954	0.530147

Variance Decomposition of LNRWG

Period	S.E.	LNPRD	LNRWG	LNUEM	LNLER
1	0.865406	1.386836	98.61316	0.000000	0.000000
5	0.994637	7.241555	85.97779	4.679393	2.101262
10	1.025503	7.920946	81.25109	8.782799	2.045165
15	1.038588	9.197980	79.42994	9.334981	2.037102
20	1.049748	10.56362	77.93660	9.487874	2.011907
25	1.060531	11.91445	76.53845	9.562833	1.984270
30	1.071118	13.21930	75.20629	9.617422	1.956991

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
25	0.286319	11.01698	0.530986	84.79162	3.660418
30	0.287461	11.56246	0.596454	84.20560	3.635485

Variance Decomposition of LNLER

Period	S.E.	LNPRD	LNRWG	LNUEM	LNLER
1	0.124241	6.288665	1.022898	8.412762	84.27567
5	0.181250	4.905439	3.057678	29.11962	62.91727
10	0.195270	4.795991	3.172169	37.15850	54.87334
15	0.198869	5.953421	3.318170	37.71541	53.01300
20	0.201277	7.411831	3.447232	37.36025	51.78069
25	0.203508	8.901111	3.564732	36.86638	50.66778
30	0.205680	10.34956	3.675151	36.35919	49.61610

Source: Authors' calculation from Eviews 8

3.2 Possible channels of monetary transmission in the macroeconometric model

This section, analyses the specific monetary transmission channels that relate to the labour market variables as illustrated in Figure 1. 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 an exogenous variable. Comparison of the 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 and Vongsinsirikul, 2003). The article investigates two channels, which influence labour market variables, 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 transmission process by looking at the significance of each channel shocks in affecting the labour variables in the basic model. If the channel shock is significant in influencing the labour market variables and itself then it is considered as a candidate to be included in the small macroeconometric model. Concerning the demand channel, the article experimented with three variables, namely imports prices, bank credit to the private sector and output and established that import prices and bank credit had a greater influence on labour market variables as compared to output. For this reason, the import prices and bank credit results are the demand channel variables discussed in this section. Additionally, the section also discusses the results of the exchange rate channel.

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 the 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:

$$X_t' = [PRD_t, RWG_t, UEM_t, \; MPP_t, LER_t] \qquad [8]$$

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:

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

Figure 4 presents the impulse response functions of productivity, real wage, unemployment, import prices and interest rates to import price shocks. The results depict that the responses of productivity to an import price shock are insignificant while the responses of the other three variables are significant. Moreover, a positive shock to import prices reduces the real wages in Namibia in the first five years. The relationship between the latter two is not direct, but import prices affect real wages through their effect on nominal wages and nominal prices. Further, it appears that in the short run, prices in Namibia increase faster than nominal wages so that real wage decreases during the first five years or so, before returning to their pre-shock equilibrium, which coincides with the baseline. Figure 4 also depicts that a positive shock to import prices indirectly affects the lending rates through its effects on the nominal exchange rate and prices. In fact, a positive shock to import prices leads to an increase in lending rates. From a theoretical viewpoint, a positive shock to import prices leads to a depreciation of the exchange rate which in turn leads to inflation and hence an increase in the nominal interest rates. The response of the lending rates to an import price shock becomes zero after about fifteen years after the shock. Lastly, import prices increase after an import price shock. In brief, higher import prices hurt the manufacturing sector since Namibian companies heavily rely on imported machines, equipment and raw materials from both the developed and developing countries. These results compare favourably with the results obtained by Duarte and Marques (2009) and Marques et al. (2010).

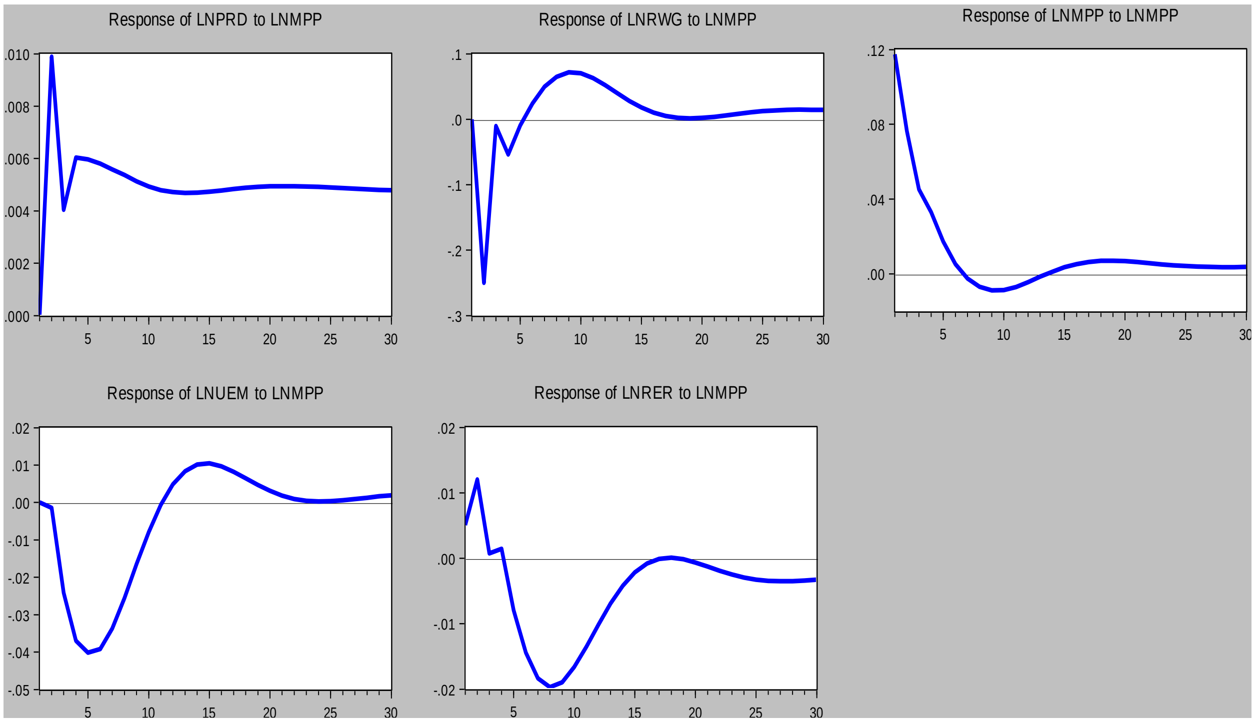


Figure 4: Impulse responses of the demand channel model
Source: Authors' calculation from Eviews 8

To establish the importance of the demand channel to the monetary transmission process in Namibia, impulse responses of productivity, real wage, unemployment and lending rates are plotted with 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 5 indicates that in all four cases, there is significant difference in the magnitude of impulse responses when import price is endogenous and when it is exogenous. 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. As expected, a positive shock to monetary policy causes productivity and real wages to initially respond negatively in both cases where import prices are endogenous and exogenous. In addition, both unemployment and lending rates increase after a tight monetary policy shock, and this is applicable to both the endogenous and exogenous cases. Note that all the responses here are in line with the theoretical predictions.

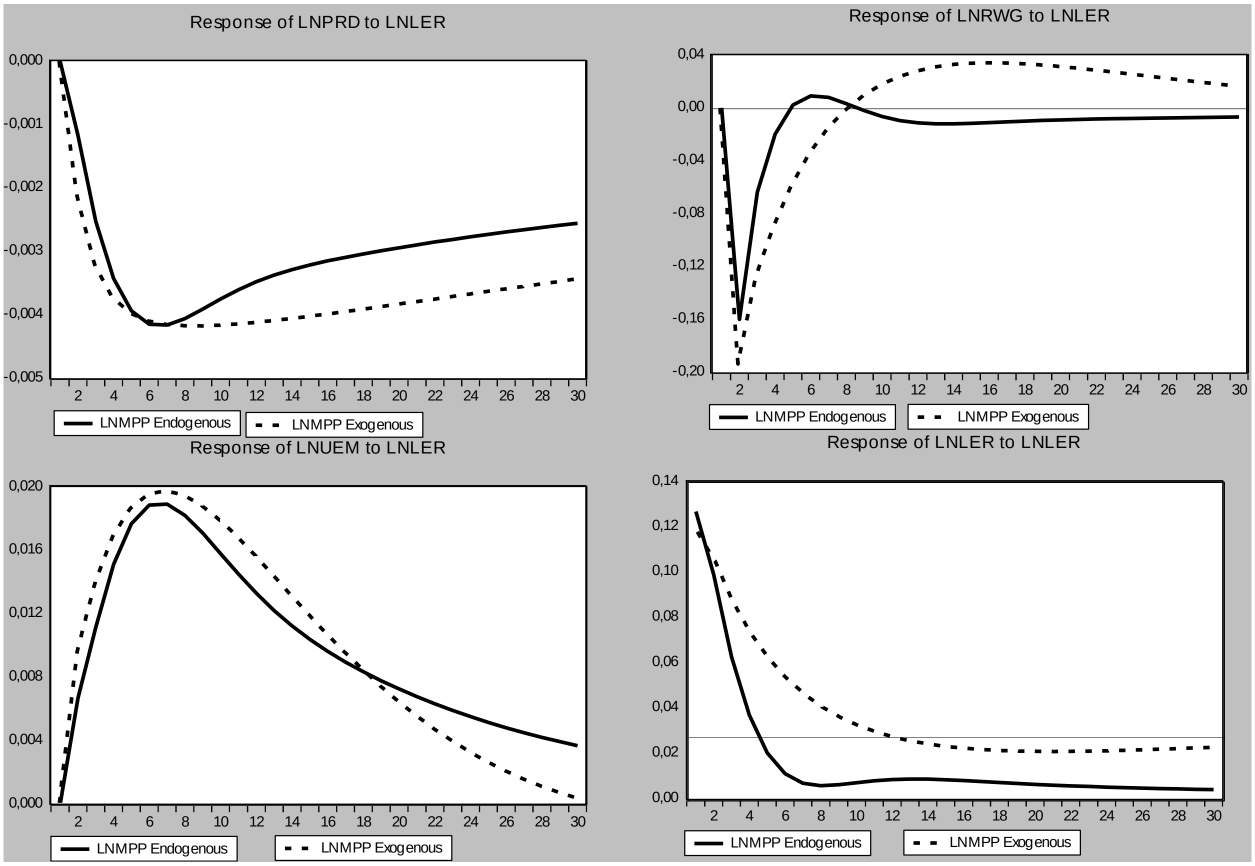


Figure 5: Monetary policy shocks with endogenous and exogenous import prices

Source: Authors' calculation from Eviews 8

3.2.2 The demand channel using the bank credit

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. The next stage is to determine the responses of the variables in the basic model when bank credit is endogenous and exogenous.

The model estimated here is: $X_t' = [PRD_t, RWG_t, UEM_t,\ CDT_t, LER_t]$. [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:

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

The article appends the bank credit (CDT_t) variable to the basic model to get this equation. According to Figure 6, a positive shock to bank credit leads to an increase in bank credit and it remains positive and well above the baseline for the entire period. When bank credit suddenly increases, this shows that the economy is performing at its best and many people and businesses seek loans because they can afford them. This increases aggregate demand and the economy's gross domestic product. In addition, real wages in Namibia increase from zero percent to a maximum of 20 percent after a positive shock to bank credit in in the first year. Overall, real wages increase after an interest rate shock in the first five years after the shock. Concerning the response of lending rates to a positive bank credit shock the figure shows that they respond negatively in the first two years to a positive bank credit shock and then positively from the second year onwards. This makes theoretical sense in that an increase in the demand for bank credit has the effect of putting upward pressure on interest rates. The figure also shows that bank credit increases after a bank credit shock; and this is in line with the a priori expectations. Additionally, unemployment increases after bank credit shock and this is contrary to what is expected.

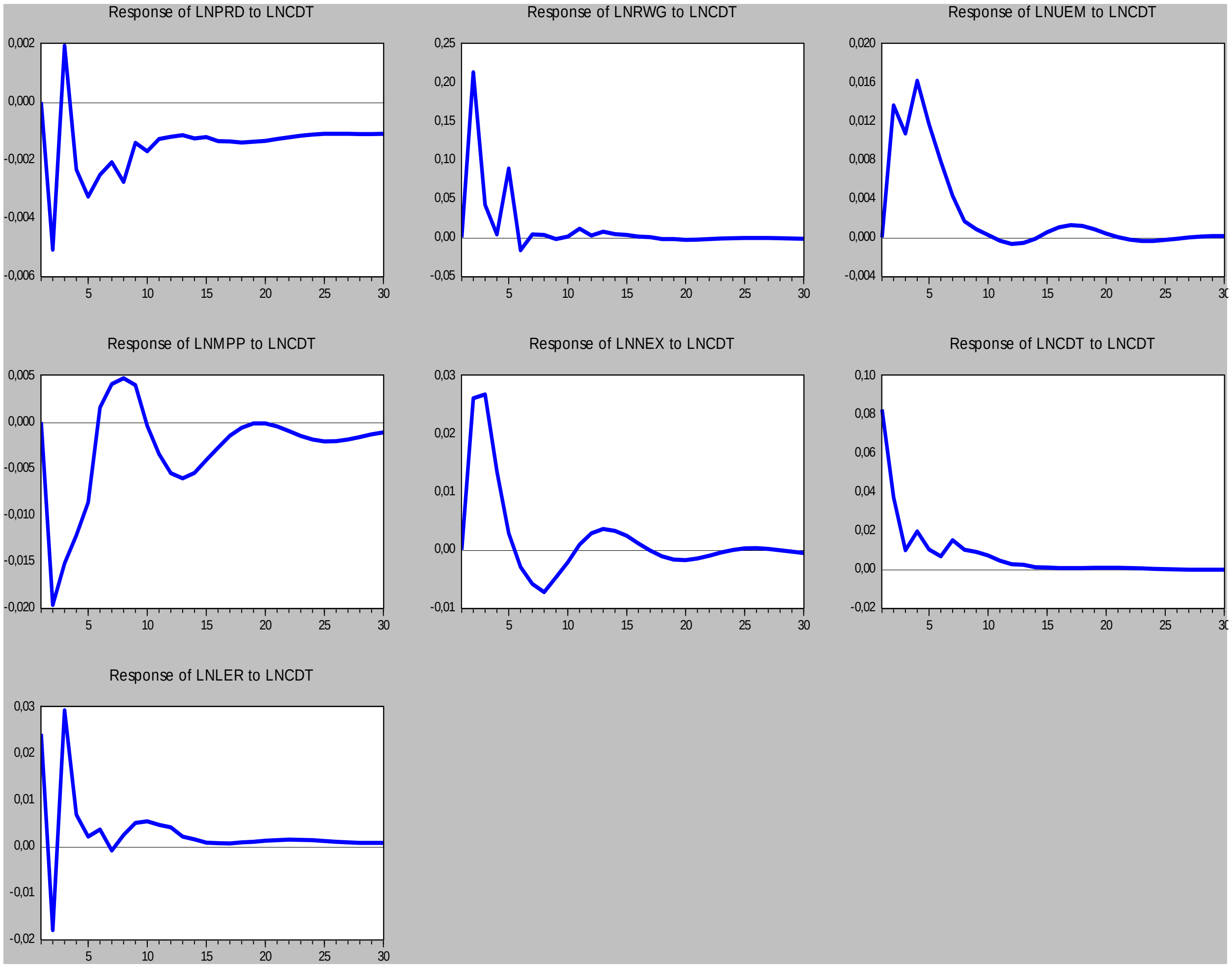


Figure 6: Impulse responses of the bank-lending channel
Source: Authors' calculation from Eviews 8

To determine the significance of the bank credit model to the monetary transmission process, Figure 7 presents impulse responses of productivity, real wages, unemployment and interest rates to sudden tightening of monetary policy under two scenarios: endogenous and exogenous bank credit. First, productivity decreases after a tight monetary policy shock since this increases the cost of borrowing in the economy. The response of productivity when bank credit is exogenous commences to diverge from the response of productivity when bank credit is endogenous after the fifth year. Second, the responses of real wage to a tight monetary policy shock are almost the same for endogenous and exogenous bank credit in the first two years. After the second year, they start to diverge. Third, unemployment increases after a positive tight monetary policy shock for both the case where bank credit is endogenous and when it is exogenous. The two responses commence to diverge from each other after the third year. Lastly, lending rates respond positively to lending rates shocks in both cases where bank credit is endogenous and exogenous. Both responses closely follow each other throughout the entire period studied. The figure confirms that bank credit contains important additional information in the monetary transmission process, which is more pronounced in the responses of real wage, unemployment and productivity, respectively.

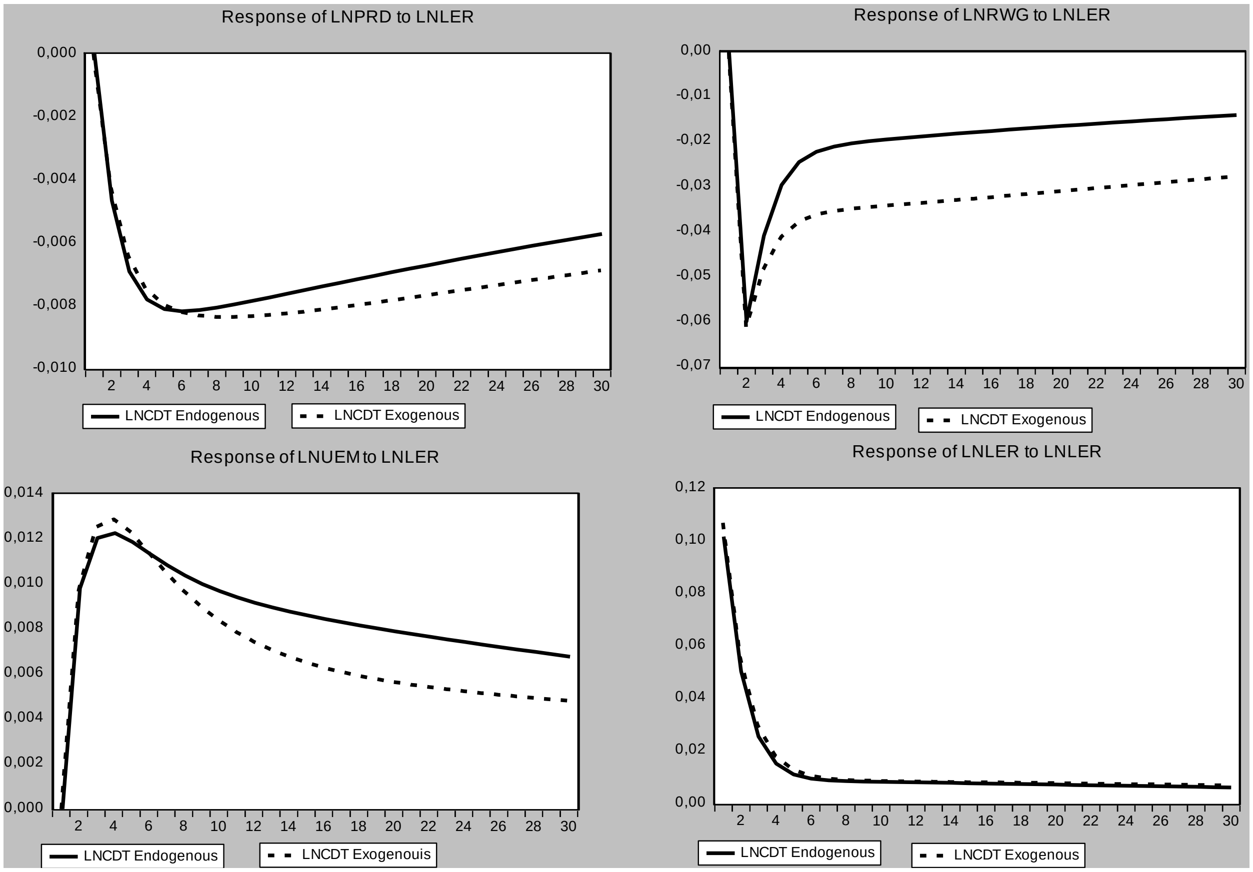


Figure 7: Monetary policy shocks with endogenous and exogenous bank credit
Source: Authors' calculation from Eviews 8

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 the 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 and Melina, 2011; Ajilore and Ikhide, 2013). The strength of the exchange rate channel is dependent on the sensitivity of the exchange rate to monetary shocks, the level of openness of the economy, and the sensitivity of net exports to exchange rate variations. According to Disyatat and Vongsinsirikul (2003) substantial unanticipated exchange rate depreciation can reduce output when a significant share of debt in the economy is foreign currency denominated[6].

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

$$X_t' = [PRD_t, RWG_t, UEM_t, NEX_t, LER_t] \quad [12]$$

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

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:

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

Figure 8 shows the impulse responses of the variables in the exchange rate channel model to shocks in the exchange rate. First, a sudden increase in exchange rates implies that the local currency has depreciated. This increases the import prices in local currency terms and makes imports more expensive, which negatively affect the local producers and eventually gross domestic product and productivity. Second, a sudden increase in nominal exchange rates leads to an increase in real wages in the first five years in Namibia. A possible explanation for this increase is that the nominal exchange rate increases nominal wages by a greater margin than they increase the prices so that the real wage increases. Note that after five years, real wages decrease after a positive shock to the exchange rate and this is what is related to the fact that exchange rates increases affect economic activity negatively. Third, a sudden increase in nominal wages leads to an increase in unemployment and this is because increases in nominal wages decrease gross domestic product and productivity as explained above, which are closely connected with the behaviour of unemployment. Fourth, a positive shock to nominal exchange rates leads to an increase in lending rates, through its effects on prices and output. Lastly, the positive shock to nominal exchange rate leads to an increase in nominal exchange rates. As shown in the figure, the only response that is insignificant to a sudden increase in nominal exchange rates in Namibia is that of productivity even though it responds in the correct direction.

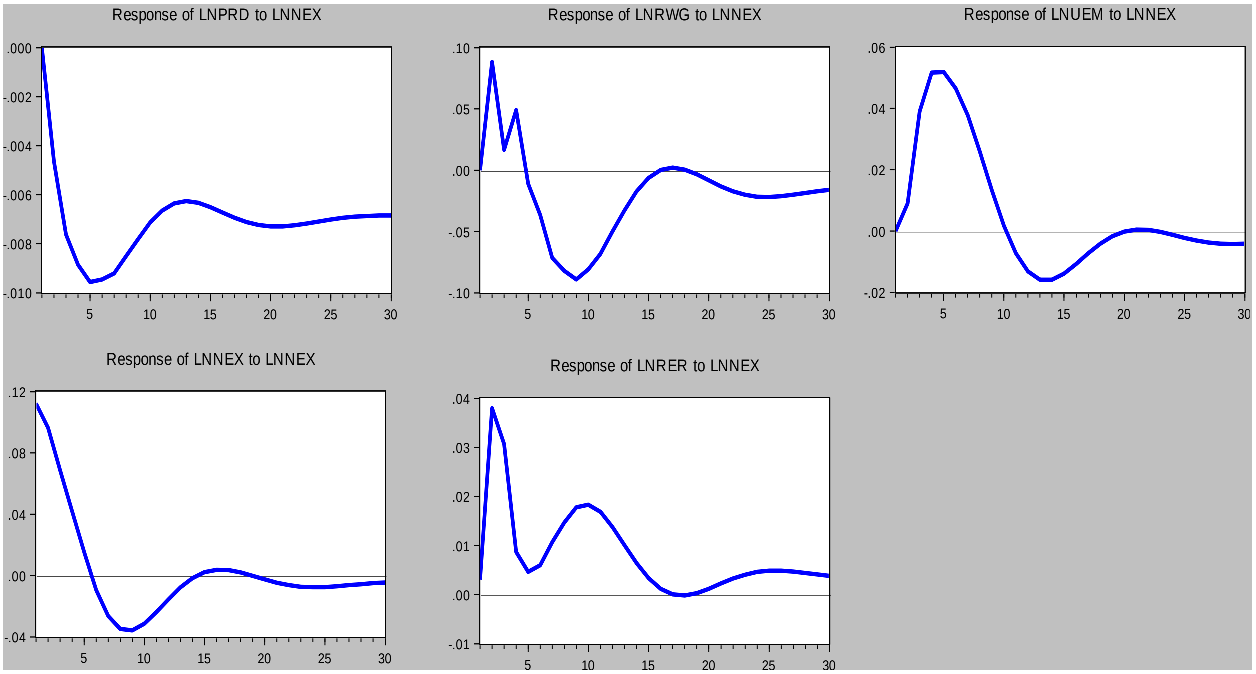


Figure 8: Impulse responses of the exchange rate channel
Source: Authors' calculation from Eviews 8

To determine the significance of nominal exchange rates in the monetary transmission process, Figure 9 presents impulse responses of productivity, real wages, unemployment and interest rates to monetary policy shocks under two scenarios: endogenous and exogenous nominal exchange rates. The responses of productivity, real wages, unemployment and lending rates are all in line with the a priori expectations after a sudden positive exchange rate shock under both cases where exchange rates are endogenous or exogenous. To demonstrate, productivity decreases after a positive monetary policy shock irrespective of whether nominal exchange rates are endogenous or exogenous. Both responses remain below the baseline for the entire period. The response of real wages in both cases where the nominal exchange rate is endogenous and exogenous is a decrease in real wages throughout the period studied. In addition, 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. The figure, therefore, confirms that exchange rates contain important additional information in the monetary transmission process, which is more pronounced in the responses of productivity, unemployment and real wages, respectively.

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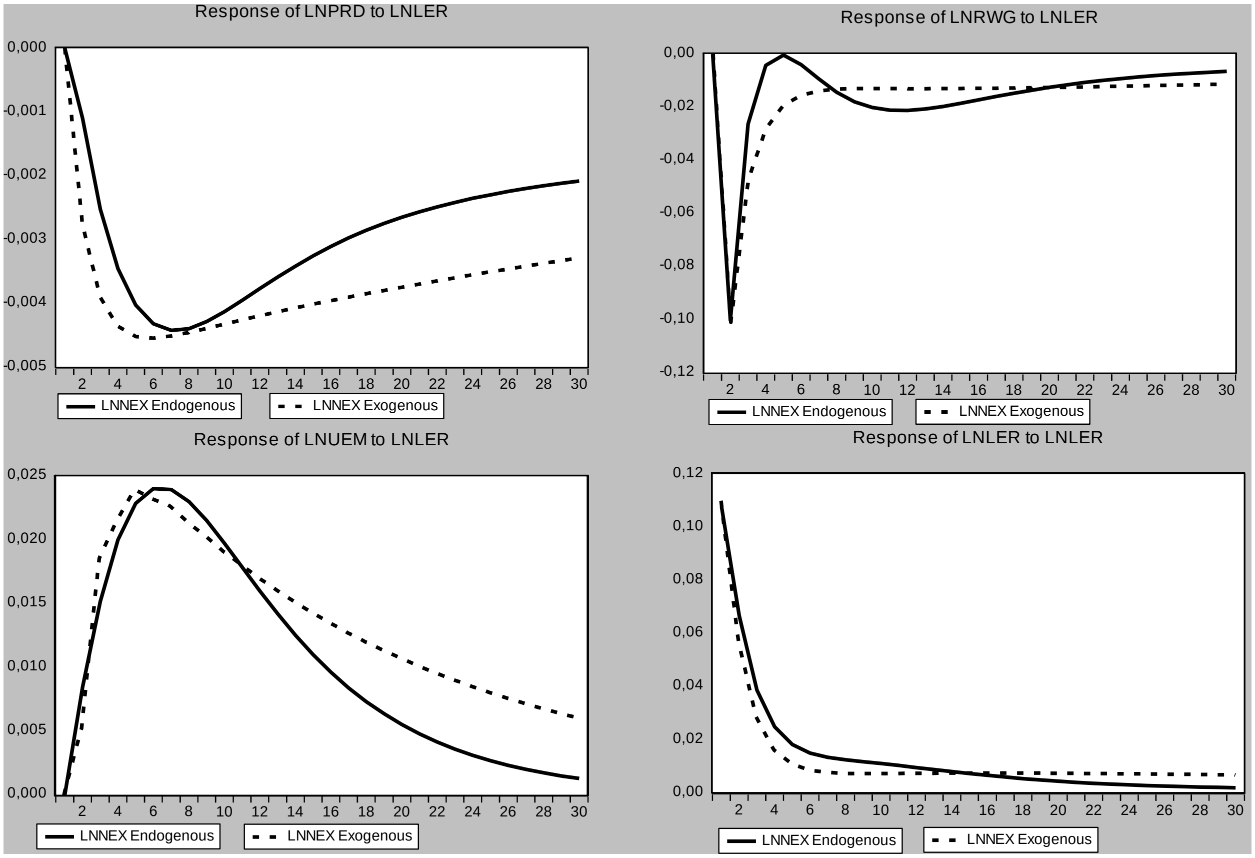

Figure 9: Monetary policy shocks with endogenous and exogenous exchange rates
Source: Authors' calculation from Eviews 8

3.2.4 The small maroeconometric model for Namibia

The results from the preceding section indicate that the variables in the basic model largely influence each other correctly and significantly. This corroborates the findings by McHugh (2004) that real wage productivity and unemployment can be estimated simultaneously and gives 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 the 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:

$$X_t' = [PRD_t, RWG_t, UEM_t, \ MPP_t, CDT_t, NEX_t, LER_t] \qquad [14]$$

which is identified in accordance with the system of equations in [5]. It is noteworthy that the article experimented with many possible variables and the ones whose results were discussed are the ones that gave significant and meaningful results. The impulse response functions of the small macroeconometric model over a thirty-year period are presented in Figures 10 to 13. The information contained in these figures indicates that import prices, bank lending to the private sector and exchange rates are important channels of monetary transmission in Namibia in the process of trying to influence real variables. Furthermore, most of the responses of the variables in the small macroeconometric model to shocks in these variables are significant.

3.2.5 Impulse response functions for the macroeconometric model

The discussion of the impulse response functions of the small macroeconometric model commences by analysing the impulse responses caused by positive shocks to import prices. Figure 10 illustrate that the responses of productivity to a sudden increase in import prices are the only ones that are insignificant and responding in a way that is contrary to what is expected. Moreover, the initial response of real wages to a shock in import prices is to fall bottoming at 13 percent below the baseline. In the second year, the response of real wages sharply reverses to attain a maximum of approximately 9 percent at the end of the second year after which it largely remains positive and then becomes insignificant after the tenth year. Unemployment responds negatively to a positive import price shock; and the possible explanation for this is that sudden increases in import prices are associated with depreciation of the local currency, increases in export performance, increases in the level of economic activity and hence a decrease in unemployment in the economy. More specifically, unemployment falls from the baseline to a minimum of three percent after four years. This underlines the importance of import prices in influencing monetary policy in Namibia.

A positive shock to exchange rates is just the same as depreciation of the local currency or an appreciation of the currency like the United Sated Dollar, which most countries use when trading with other countries. First, Figure 11 shows that a sudden depreciation of the exchange rate results in a decrease in productivity, which reaches a minimum of 1.5 percent below the baseline in the second year, and then sluggishly increases remaining below the baseline. Second, the response of real wage to a positive exchange rate shock is that it falls and becomes insignificant after ten years. In addition, it responds positively between the second and the third year and then falls sharply back to a level below the baseline before the end of the third year.

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Figure10: Impulse responses for the small macroeconometric model
Source: Authors' calculation from Eviews 8

Third, unemployment increases if the local currency is losing value. It is noteworthy that the currency of Namibia is one of the strongest currencies in Africa and this is thanks to the fact that the Namibian dollar is pegged to the South African Rand. Under this system, the Namibia economy has grown at an average of 4 percent per annum since its independence in 1990. The fact that both the labour market variables and the monetary variables respond to exchange rate depreciation in Namibia as theoretically anticipated underscores the importance of the flexible exchange rate system in both the labour and the monetary sectors.

Figure 10, also illustrates the effects of bank lending shocks in the small macroeconometric model. The monetary variables respond in the expected way to a bank lending shock but the labour market variables did not perform well and this means that these results should be treated with caution even though Figure 7 seems to suggest that bank credit has important additional information to the monetary transmission process.

The figure also illustrated that both the labour and monetary variables respond as expected to the positive monetary policy shocks. Specifically, productivity unambiguously falls after a monetary policy shock bottoming at about 0.4 percent after five years. In addition, productivity sluggishly increases after five years, but essentially remaining in the negative territory. As alluded to earlier, an increase in interest rates decreases volumes of bank loans and the gross domestic product and hence productivity. Following from the latter, nominal and real wages are expected to decline and this is confirmed in Figure 10 despite the fact that the real wages increase in the second year only. Further, unemployment rate increases after a positive increase in interest rates and then sharply falls in the second year bottoming at an insignificant 0.2 percent below the baseline. After the second year, the response of unemployment is entirely positive. The figure also illustrates that nominal exchange rate increases after a sudden increase in interest rates attaining its maximum point at 2.6 percent after just a year. The article concludes that shocks to real variables influence the monetary policy variable in Namibia.

3.2.6 Variance decompositions for the macroeconometric model

In this section, the article determines the proportion of fluctuations caused by different shocks. Specifically, in Table 2 the article determines the variance decompositions of each variable in the macroeconometric model with forecast horizons of 1 to 30 years. The table shows that productivity fluctuations are 100 percent attributed to technology shocks in the fifth year they are attributed to productivity, exchange rates, unemployment and import prices according to their order of importance. In the thirtieth year, the order becomes productivity, exchange rates and import prices and unemployment is no longer important in explaining productivity fluctuations.

The real wage fluctuations are largely attributed to real wages, exchange rates, productivity and unemployment in the fifth year. The same variables explain real wage fluctuations even in the thirtieth year. In addition, unemployment fluctuations are largely accounted for by labour supply shocks, real wage, import prices and productivity in the fifth year and the same variables influence fluctuations in unemployment in the thirtieth year. In the case of import price fluctuations, after five years, productivity, unemployment, import and exchange rates explain approximately, 8, 16, 35 and 29 percent respectively. In the thirtieth year, the fluctuations in import prices are still accounted for by the same shocks except that the importance of real wages

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has also become increasingly more important at approximately 6 percent. Additionally, in the fifth year exchange rates are mainly accounted for by unemployment shocks (36 percent), import price shocks (36 percent), exchange rates (11 percent) and real wage (11 percent). However, in the thirtieth year the most important shocks accounting for the fluctuations in exchange rates are labour supply shocks accounting for approximately 43 percent. The other important shocks in explaining the exchange rate fluctuations in the thirtieth year include, import prices, real wage, exchange rates and exchange rates (which become increasingly important at approximately 6 percent). In the case of bank credit, excluding own shocks, the important shocks explaining it after five years include real wage, unemployment, productivity and exchange rates. However, after thirty years only real wage, unemployment and productivity are important in that respective order.

The variance decomposition of the monetary policy reaction function indicates that fluctuations in interest rates are accounted for by shocks to all the other variables except import prices after five years. In addition, the most important shocks explaining the fluctuations in interest rates in the first five years are the exchange rate shocks followed by interest rate, productivity, real wage, unemployment and bank credit according to their order of importance. In the thirtieth year, only bank credit shocks appear unimportant in explaining the fluctuations in interest rates at about 4 percent and all the other shocks explain at least 6 percent of the fluctuations in interest rates. It is noteworthy that the top four shocks that account for lending rates are exchange rates, unemployment, productivity and real wage accounting for approximately, 28, 23, 17 and 14 percent, respectively. These results above confirm that real (labour market shocks) have important effects on monetary variables in Namibia and this confirms the impulse response results discussed.

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Table 2: Variance decomposition for the small macroeconometric model

Variance Decomposition of LNPRD

Period	S.E.	LNPRD	LNRWG	LNUEM	LNMPP	LNNEX	LNCDT	LNLER
1	0.042520	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
5	0.078264	72.63743	2.575091	7.966083	6.580702	9.117261	0.746825	0.376612
10	0.104204	71.13674	1.568209	5.256806	8.179471	12.46203	0.633446	0.763301
15	0.121876	72.90730	1.171617	4.014126	7.627067	13.01072	0.512979	0.756196
20	0.135967	73.66392	1.089277	3.334836	7.590929	13.12392	0.462565	0.734558
25	0.147433	74.38207	1.111309	2.837272	7.381343	13.14625	0.425251	0.716505
30	0.156934	74.92325	1.156063	2.507542	7.234055	13.08555	0.399855	0.693687

Variance Decomposition of LNRWG

Period	S.E.	LNPRD	LNRWG	LNUEM	LNMPP	LNNEX	LNCDT	LNLER
1	0.828305	3.809994	96.19001	0.000000	0.000000	0.000000	0.000000	0.000000
5	1.143498	11.88354	56.92145	11.69569	1.771642	12.47142	4.223772	1.032493
10	1.178780	12.03826	54.22276	13.79985	2.411692	12.49591	3.996405	1.035121
15	1.188579	12.72425	53.46904	14.02747	2.393839	12.41186	3.946218	1.027329
20	1.193338	13.20337	53.16462	13.92828	2.416883	12.34945	3.916294	1.021103
25	1.198316	13.63880	52.83129	13.90470	2.417589	12.30798	3.884943	1.014690
30	1.201586	14.00926	52.57793	13.83465	2.420786	12.28342	3.864356	1.009603

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
25	0.241599	4.071285	10.64801	77.53420	4.649678	1.078289	1.355846	0.662701
30	0.242063	4.148732	10.73012	77.39900	4.636119	1.074495	1.350760	0.660776

Variance Decomposition of LNMPP

Period	S.E.	LNPRD	LNRWG	LNUEM	LNMPP	LNNEX	LNCDT	LNLER
1	0.110636	14.76038	0.768346	12.55506	71.91622	0.000000	0.000000	0.000000
5	0.233480	8.466581	2.920689	16.13066	34.62103	29.03645	1.545420	7.279163
10	0.272610	11.24470	7.898226	25.77805	26.47784	22.00402	1.211166	5.385995
15	0.295691	13.03389	7.270204	28.18747	25.52017	20.07715	1.172821	4.738294
20	0.304534	16.04956	6.928560	26.81479	24.31671	20.16824	1.116723	4.605429
25	0.311897	18.37555	6.656360	26.09276	23.59977	19.78756	1.076125	4.411875
30	0.318182	20.52187	6.425994	25.08554	23.00848	19.62965	1.047098	4.281371

Variance Decomposition of LNNEX

Period	S.E.	LNPRD	LNRWG	LNUEM	LNMPP	LNNEX	LNCDT	LNLER
1	0.111929	1.997575	0.215560	6.249670	71.19174	20.34546	0.000000	0.000000
5	0.225441	1.686001	10.52091	36.07514	34.51721	11.20940	3.129734	2.861599
10	0.261035	2.568164	12.87231	41.30742	29.59021	8.879713	2.515457	2.266718
15	0.273889	3.743738	12.54478	43.42115	27.61247	8.221570	2.336278	2.120010
20	0.276247	4.422914	12.61113	43.08876	27.33346	8.118373	2.307720	2.117645
25	0.278767	5.099942	12.71302	42.86183	26.88961	8.076437	2.270856	2.088302
30	0.279716	5.635218	12.66347	42.59176	26.72452	8.054492	2.256104	2.074443

Variance Decomposition of LNCDT

Period	S.E.	LNPRD	LNRWG	LNUEM	LNMPP	LNNEX	LNCDT	LNLER
1	0.105081	0.341663	10.90085	0.041861	15.28207	11.66444	61.76912	0.000000
5	0.280194	7.642478	49.31024	22.18457	3.103312	6.152759	11.18580	0.420836
10	0.401296	7.096695	44.22121	34.51772	4.034029	3.692266	5.762013	0.676066
15	0.436364	7.692025	45.24876	33.99394	3.789367	3.553013	4.889858	0.833031
20	0.453133	8.056354	45.26382	34.34869	3.620955	3.353150	4.535616	0.821417
25	0.458683	8.407350	45.21757	34.26517	3.569794	3.288893	4.426996	0.824225
30	0.461162	8.681445	45.16156	34.17144	3.531913	3.254634	4.379689	0.819319

Variance Decomposition of LNLER

Period	S.E.	LNPRD	LNRWG	LNUEM	LNMPP	LNNEX	LNCDT	LNLER
1	0.097071	2.557356	0.338413	14.51674	0.000452	39.24823	6.254491	37.08432
5	0.159474	12.12718	10.39517	9.766074	1.973010	43.45742	7.182883	15.09826
10	0.198837	9.384209	14.89334	26.09847	4.419355	30.36622	4.809384	10.02902
15	0.208543	11.44515	14.83612	24.42309	5.754514	29.60212	4.477418	9.461599
20	0.215443	13.34737	14.75624	24.17264	5.833438	28.73905	4.203928	8.947328
25	0.220451	15.26640	14.18486	23.50563	6.148843	28.24643	4.033852	8.613984
30	0.224186	17.15340	13.72434	22.77937	6.189966	27.87829	3.907505	8.367132

Source: Authors' calculation from Eviews 8

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 the stability of parameters using the CUSUM and the CUSUM of squares. This is because when using SVAR the starting point is the estimation of the reduced form VAR. 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, the results also established that the individual variables are normally distributed and this is a critical property when using VAR and SVAR. Figure 1 shows the variables in the basic model and their recovered structural innovations, which appear to be (closely) related, and this means that the structural shocks determined are reliable and, therefore, a true reflection of reality. All the preceding tests results indicate that the data being applied is robust and is therefore likely to give reliable results.

The structural estimates of the coefficients in matrices A and B in all the models indicate that all the coefficients in the models have standard errors with values less than one suggesting that they

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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[7].

5. Summary and conclusions

Real wages, productivity, unemployment in Namibia can be jointly determined: models, which estimate these variables separately, are potentially mis-specified and are ignoring a recent trend in other open economies that highlight the contemporaneous relationship between these variables. In this article, the labour market variables were combined with the interest rate variable to create the basic model whose variables contemporaneously and significantly affect each other as illustrated by the IRFs.

The results show that the demand channel variables, particularly import prices and bank credit to the private sector have important additional information, which affects the monetary transmission process in Namibia. In addition, shocks to import prices in the macroeconometric model affected all the labour market and monetary variables significantly. However, shocks to bank credit gave results that were theoretically partially correct. The results also show that the exchange rate has important additional information, which affect the monetary transmission process in Namibia. In addition, shocks to the exchange rate in the macroeconometric model affected all the labour market and monetary variables significantly, which helped to confirm their significance. This underscores the importance of the flexible exchange rate system used in Namibia in both the labour and monetary sectors. As demonstrated both the IRFs and variance decomposition results confirm that real (labour market shocks) have important effects on monetary variables in Namibia.

The article also investigated the effect of monetary policy shocks on the labour and other variables in the macroeconometric model and found that monetary policy shocks affect all variables correctly and significantly. Additionally, shocks to the demand channel and exchange rate channel variables also correctly and significantly affected monetary policy (interest rate). Largely, the labour market and monetary variables respond as expected and significantly to the sudden tightening of monetary policy. There is definitely no ambiguity between the way monetary policy affects or is affected by the real variables. Fluctuations in lending rates are explained by all the real variables in the small macroeconometric model. The only variable that performed poorly in explaining lending rates is bank credit and this means that bank credit results need to be treated cautiously in this article.

Contractionary monetary policy in a small open economy with a freely floating exchange has a sustained downward impact on real domestic activity over the short to medium term. Specifically, contractionary monetary policy reduces productivity and real wage and increases

[7] All the test results discussed here are not shown in the article but they can be obtained from the authors if needed.

unemployment implying that expansionary monetary policy results in favourable outcomes. This suggests that money is non-neutral in Namibia. If the central bank is able to modify long run interest rates, then monetary authorities can reduce unemployment using expansionary monetary policy. However, sometimes the central bank is unable to affect the long-term interest rates since they depend on the effect of fiscal policy over long-term cost of borrowing. This issue is beyond the scope of this article. This means that the current article only notes that demand policies which affect long-term interest rates can reduce unemployment, though it is unclear what form these polices need to take.

The impact of rising world import prices on the economy (or the negative terms of trade shock) is that a fall in the exchange rate is cushioned by a rise in the lending rate, which controls inflation, but does not allow for a large and sustained decrease in output and an increase in unemployment. The article therefore concludes that higher import prices hurt the manufacturing sector since Namibian companies heavily rely on imported machines, equipment and raw materials from both the developed and developing countries. The country has to ensure that it comes up with policies that ensure stability of the exchange rate so as not to hurt the manufacturing sector. The fact that demand, and exchange rate channel variables were found to have important additional information that explain the monetary transmission channel, it implies that monetary policy can be influenced through these channels.

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