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Does exchange rate volatility reduce South African domestic consumption?

Nancy Mukalayi

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Corresponding author: nancymukalayi@gmail.com

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Abstract: This paper analyses how exchange rate volatility affects domestic consumption. It uses a Bayesian vector autoregression model to measure impulse response, based on South African data from 1990 to 2016, which helps to detect how domestic consumption reacts to shocks in exchange rate volatility and other economic variables. Variables such as gross domestic product, inflation, and interest rate are used to explain movement in domestic consumption. The exchange rate volatility series is generated using the GARCH(1,1) approach. A one-unit shock in exchange rate volatility is found to temporarily decrease domestic consumption. This negative response gradually increases until the middle of second period, when it hits its steady-state value. The forecast error variance decomposition shows that exchange rate volatility, domestic consumption, inflation, and interest rate are typically driven by their own shocks, particularly exchange rate volatility in the first period, while the historical decomposition in respect of domestic consumption shows that exchange rate volatility shocks and inflation shocks appear to represent the bulk of domestic consumption fluctuations.

Key words: Bayesian vector autoregression model, GARCH (1,1) model, impulse response, forecast error variance decomposition, historical decomposition

JEL classification: C22, F31

1 Introduction

Does exchange rate volatility hurt South African domestic consumption? A high level of volatility in the exchange rate causes expectations over the future price level to be more uncertain. In the case of South Africa, a small open economy, vulnerable to foreign trade, that attracts foreign savings to support domestic investment, exchange rate uncertainty creates a risk premium for long-term arrangements, raises costs of production, reduces trade, causes unanticipated redistribution of wealth, and leads to fluctuations in the real economy, with an adverse effect on the growth of domestic consumption (Oseni 2016).

Since the last century, many papers have been interested in more carefully analysing the relationship between exchange rate volatility and macroeconomic variables, firstly because countries are becoming more open (Sin-Yu and Iyke 2017) and secondly because of the significant effect of exchange rate volatility on welfare as well as on the social life of the entire economy. Previous empirical studies have not been able to clearly determine if a relationship exists between exchange rate volatility and domestic consumption in Africa. This study will thus contribute to the literature on the impact of exchange rate volatility on real variables. Domestic consumption in African countries such as South Africa, Tunisia, Gambia, Togo, and Nigeria accounts for approximately 60 per cent of GDP (Oseni 2016). Most of these countries depend excessively on raw material exports and imported consumer goods. Since the importation of goods is subject to fluctuations in the foreign exchange rate market, any change in the exchange rate will affect individual consumption levels. For these reasons, the need to investigate the impact of exchange rate volatility on domestic consumption becomes very pressing.

South Africa has witnessed consistent exchange rate volatility, especially in January 2016, when the rand (ZAR) depreciated to its lowest level. Previously, South Africa had coped with such depreciation in its currency in 1994 and again in 2001. In January 2016, the rand depreciated by 180 per cent from ZAR3.56 per US dollar to ZAR10.5 per dollar. The cause of this repetitive volatility lies in the fact that South Africa's monetary authority has been floating the exchange rate in foreign exchange markets (Phiri et al. 2016). The main goal of this paper is to analyse how this exchange rate volatility affects domestic consumption in the case of South Africa, based on a Bayesian vector autoregression (BVAR) model. The BVAR model will allow us to detect how domestic consumption reacts to the shocks in exchange rate volatility and in other economic variables, and, in turn, how exchange rate volatility and other economic variables react to shocks in domestic consumption. The rest of the paper is organized as follows: Section 2 presents an overview of the relevant literature, while Section 3 provides a theoretical framework and discusses the methodology. Section 4 presents the data used in the study and Section 5 summarizes the empirical estimation results, while Section 6 concludes.

2 Literature review

There is sufficient literature concerning the impact of exchange rate volatility on consumption. One of the earliest studies to investigate the link between exchange rate volatility and consumption was Alexander (1952). The results obtained in that study suggest that exchange rate volatility influences consumption through its pass-through effects on inflation. In other words, exchange rate uncertainty is accompanied by inflation uncertainty, which may in turn affect household consumption decisions (Sin-Yu and Iyke 2017). Many empirical studies are also interested in exchange rate volatility due to its harmful effect on welfare; a few of these are summarized below.

Oseni (2016) investigates the impact of exchange rate volatility on private consumption in 19 Sub-Saharan African countries using the generalized method of moments model. The paper finds that exchange rate volatility is a major variable in fixing private consumption goods prices. It therefore concludes that exchange rate volatility has a negative and significant effect on private consumption in Sub-Saharan countries, even though the results of the paper may not effectively reveal country-specific information. Bahmani-Oskooee et al. (2015) examine the effect of exchange rate volatility on consumption using data from 12 emergent economies and support Alexander's (1952) conclusion that exchange rate volatility is accompanied by inflation and has a direct negative effect on consumption. Exchange rate volatility had short-run effects on domestic consumption for all countries in the sample, but in the long run these effects were apparent in only half of the countries studied. In contrast to these findings, Sin-Yu and Iyke (2017) investigate the effects of exchange rate uncertainty on consumption in a sample of Asian countries using a distributed lag approach developed by Pesaran et al. (1999). The results show that uncertainty has a negative effect on consumption, especially in the long run. However, the effects in the short run are irrelevant.

In the same thread of ideas, a similar study by Alagidede and Muazu (2017) inspects how real exchange rate volatility in the Ghanaian cedi has affected domestic consumption in Ghana using the autoregressive distributed lag (ARDL) bounds testing approach (Pesaran et al. 2001). Their findings support the conclusions of other studies: exchange rate volatility harms domestic consumption in the short run, and this is reflected in the long run too. As a consequence, exchange rate volatility is considered to be a significant source of output fluctuations or business cycles in Ghana. Bahmani-Oskooee and Xi (2011) examine the effect of exchange rate volatility on domestic consumption in Japan using the bounds testing approach to cointegration. They argue that a change over time in exchange rate volatility contributes to inflation volatility, and that the effect can be negative or positive on consumption. The study used four variables—income, interest rate, exchange rate, and exchange rate volatility itself. The results show that all variables significantly affect consumption in the short run; this effect lasts into the long run for all variables except for exchange rate.

Recent studies have investigated the impact of exchange rate volatility on consumption, through different channels. For instance, Bahmani-Oskooee and Hajilee (2010) examine the effects of depreciation on skilled and unskilled wage rates using data from 18 countries. Their results reveal that real depreciation has short-run effects on skilled wages. They found that depreciation raises skilled labour wages and reduces unskilled labour wages. Following on from their previous work, Bahmani-Oskooee and Hajilee (2012) investigate the empirical evidence on the effect of currency depreciation on domestic consumption for 50 countries. They start from the idea that wages adjust to inflation only in the long run, not in the short run. They found a significant effect of currency depreciation on consumption in most of the countries in their sample.

In Alagidede and Muazu's (2017) study on the real causes of exchange rate volatility and its effect on economic growth in Ghana using the vector error correction model (VECM), the authors find that shocks to real exchange rate volatility are driven by itself and by other factors such as government expenditure, money supply, terms of trade, foreign direct investment, and output. Also, the results show that exchange rate shocks will return to their mean in the long run, as misalignments are corrected very slowly, engendering negative consequences in the short run due to the fact that agents in the economy will revise their consumption and investment decisions.

Bahmani-Oskooee and Hajilee (2013) estimate the effect of exchange rate volatility on domestic investment in each of 36 countries in their sample using time-series data. The results suggest that the uncertainty of the exchange rate had short-run effects on domestic investment in almost all countries in the sample. However, the effect is mixed: in some countries it is positive while in

others it is negative. Regarding the long run, the estimated coefficient is significant only in ten countries at the 10 per cent level.

This paper attempts to analyse the empirical relationship between exchange rate volatility and domestic consumption in a particular open economy in which the exchange rate has been very volatile since the start of the 2000s. In order to achieve this goal, BVAR is used and the exchange rate volatility series is generated using the GARCH(1,1) (generalized autoregressive conditional heteroskedasticity) approach.

3 Theoretical framework

3.1 Model specification and methodology

As mentioned previously, Alexander (1952) finds that exchange rate volatility determines the level of consumption through its pass-through effect on inflation, which may, in turn, affect household consumption decisions. Based on this theory, a measure of exchange rate volatility can be counted among the determinants of the domestic consumption function. In this paper, we include other variables based on others works such as Ando and Modigliani (1963) and Campbell and Mankiw (1991). The form of the consumption equation estimated is follows:

$$lnC = f(lnY_t, lnInt, Inf, Volrer) \quad (1)$$

where lnC is domestic consumption, lnY is GDP income, Inf is inflation, $Volrer$ is the exchange rate volatility and Int is the interest rate. All variables are expressed in logarithmic form except exchange rate volatility and inflation.

Household consumption is essential to improve the welfare of households. According to the theory of consumption, domestic consumption varies according to the income levels of households. Higher-income households tend to allocate higher spending to domestic consumption (Campbell and Mankiw 1991). In most cases, inflation increases the cost of goods and services. Inflation will not have an adverse effect if a household's income increases at the same rate as inflation. Conversely, if income remains at the same level, purchasing power, and hence domestic consumption, will be reduced (Onodje 2009).

Higher interest rates increase the opportunity cost of consumption and consequently encourage households to save in order to earn a higher return (De Serres and Pelgrin 2003). An increase or decrease in the interest rate is expected to induce an intertemporal substitution of consumption and savings (Hall 1988). Compared with previous variables, exchange rate volatility is expected to stimulate or slow down domestic consumption depending on household consumers' reaction to uncertainty in the exchange rate (Obstfeld and Rogoff 1998).

As stated earlier, empirical analysis of the relationship between exchange rate volatility and domestic consumption requires a multivariate approach. One of the appropriate ways to analyse such a dynamic relationship is via impulse response functions obtained from vector autoregression (VAR). Given this, we use the Bayesian version of the classical VAR model, which provides insight into the dynamic effect of shocks on domestic consumption. The basic idea behind BVAR modelling is that it is considered a black box where all variables are dependents and independents at the same time. We assume that domestic consumption, GDP income, inflation, exchange rate volatility, and interest rate somehow affect each other through time as a unique universe. This

allows us to treat shocks in each variable as exogenous and endogenous at the same time. A standard VAR specification based on Equation 2:

$$\begin{pmatrix} VOL_{1,t} \\ LCONS_{2,t} \\ LGDP_{3,t} \\ INF_{4,t} \\ LINT_{5,t} \end{pmatrix} = \begin{pmatrix} a_{11}^1 & a_{21}^1 & \cdots & a_{51}^1 \\ a_{12}^1 & a_{22}^1 & \cdots & a_{52}^1 \\ a_{13}^1 & a_{23}^1 & \cdots & a_{53}^1 \\ a_{14}^1 & a_{24}^1 & \cdots & a_{54}^1 \\ a_{15}^1 & a_{25}^1 & \cdots & a_{55}^1 \end{pmatrix} \begin{pmatrix} VOL_{1,t-1} \\ CONS_{2,t-1} \\ RGDP_{3,t-1} \\ INF_{4,t-1} \\ INT_{5,t-1} \end{pmatrix} + \cdots +$$
$$\begin{pmatrix} a_{11}^p & a_{21}^p & \cdots & a_{51}^p \\ a_{12}^p & a_{22}^p & \cdots & a_{52}^p \\ a_{13}^p & a_{23}^p & \cdots & a_{53}^p \\ a_{14}^p & a_{24}^p & \cdots & a_{54}^p \\ a_{15}^p & a_{25}^p & \cdots & a_{55}^p \end{pmatrix} \begin{pmatrix} VOL_{1,t-p} \\ CONS_{2,t-p} \\ RGDP_{3,t-p} \\ INF_{4,t-p} \\ INT_{5,t-p} \end{pmatrix} + \begin{pmatrix} c_{11} & c_{21} & \cdots & c_{51} \\ c_{12} & c_{22} & \cdots & c_{52} \\ c_{13} & c_{23} & \cdots & c_{53} \\ c_{14} & c_{24} & \cdots & c_{54} \\ c_{15} & c_{25} & \cdots & c_{55} \end{pmatrix} \begin{pmatrix} x_{1,t} \\ x_{2,t} \\ \vdots \\ \vdots \\ x_{5,t} \end{pmatrix} + \begin{pmatrix} \varepsilon_{1,t} \\ \varepsilon_{2,t} \\ \varepsilon_{3,t} \\ \varepsilon_{4,t} \\ \varepsilon_{5,t} \end{pmatrix} \quad (2)$$

can be written as:

$$y_t = A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + C x_t + \varepsilon_t \quad (3)$$

where $y_t = (y_{1,t}, y_{2,t} \ldots y_{n,t})$ is an n × 1 vector of variables, $A1, A2 \ldots Ap$ are p matrices of dimension n × n, C is an n × m matrix, and x_t is an m × 1 vector of constant terms, and $\varepsilon_t = (\varepsilon_{1,t}, \varepsilon_{2,t} \ldots \varepsilon_{n,t})$ is a vector of residuals that are normally distributed.

The principle of Bayesian analysis is the Bayes rule, typically written as:

$$\pi(\theta|y) = \frac{f(\theta|y)\pi(\theta)}{f(y)} \quad (4)$$

where $\pi(\theta|y)$ is the posterior distribution of θ conditional on the information contained in y and $f(y|\theta)$ is the data likelihood function, while $\pi(\theta)$ is the prior distribution and $f(y)$ the density of the data. The basic idea behind the BVAR analysis is to combine previous information about the distribution of the parameters with the information contained in the data to obtain an updated distribution accounting for both of these sources of information, known as the posterior distributions (Dieppe et al. 2016). Since the denominator $f(y)$ is independent of θ, it plays only the role of a normalizing constant with respect to the posterior $\pi(\theta|y)$, such that it is often appropriate to ignore it and rewrite Equation 4 as:

$$\pi(\theta|y) \alpha\, f(y|\theta)\pi(\theta) \quad (5)$$

Bayesian estimation can thus be reduced to Equation 5. This expression allows the obtaining of the posterior distribution $\pi(\theta|y)$, which characterizes the central object for inference as it combines in one single expression all the information we have about θ (Dieppe et al. 2016). It is this posterior distribution which is then used to carry inference about the parameter values, compute point estimates, draws comparisons between models, and so on (Dieppe et al. 2016).

4 Data

The data used to analyse the effect of exchange rate volatility on domestic consumption have been drawn from the Federal Reserve Economic Data (FRED) online databases (Federal Reserve Bank of St Louis 2018, cited hereafter as FRED). The empirical analysis employs quarterly time series covering the period from 1990 to 2017. The variables of interest are domestic consumption, exchange rate volatility, GDP income, interest rate, and inflation.

While there are several studies on exchange rate volatility, there is no agreement in the literature on how to measure it. Recently the introduction of new and refined measures has not significantly been changed the result. The measure of the variance is the common point in most approaches, but there are differences in implementation (Toseef Azid and Kousar 2005). Oseni et al. (2016) argue that the conditional variance is the true measure of volatility in a variable, given a model and information set.

Hence, we apply the GARCH (1,1) in order to obtain the conditional variance. We check for robustness by looking at different measures of volatility, such as standard deviation of exchange rate (SDER) and the CBOE (Chicago Board Options Exchange) Volatility Index, known by its ticker symbol VIX. The GARCH (1,1) process is specified as follows:

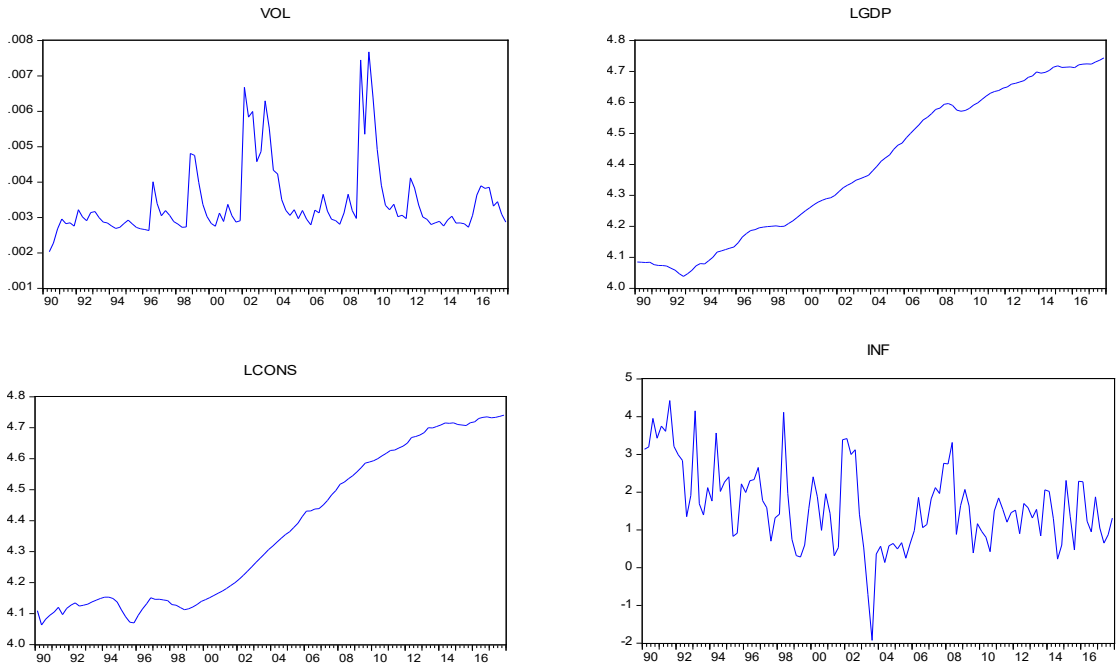
$$Ex = \gamma_0 + \gamma_1 Ex_{t-1} + e_t \quad (6)$$

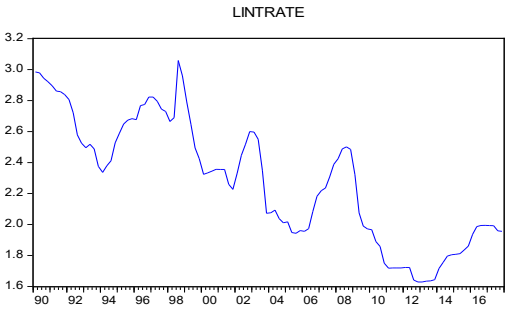
$$e_t/\Omega_{t-1} \sim iid(0, 6_t^2)$$

$$6_t^2 = \rho_0 + \sum_{i=1}^{q} \delta_i 6_{t-1} + \sum_{i=1}^{p} \beta_i \mu_{t-j}^2 \quad (7)$$

where Ex is the exchange rate, Ex_{t-1} captures the past value of the exchange rate, and e_t represents the error term. The estimated conditional variance 6_t^2 in Equation 7 is used to generate the exchange rate volatility. Figure 1 presents a graphical representation of the variables.

Figure 1: Graphical representation of variables





Source: author's illustration based on FRED.

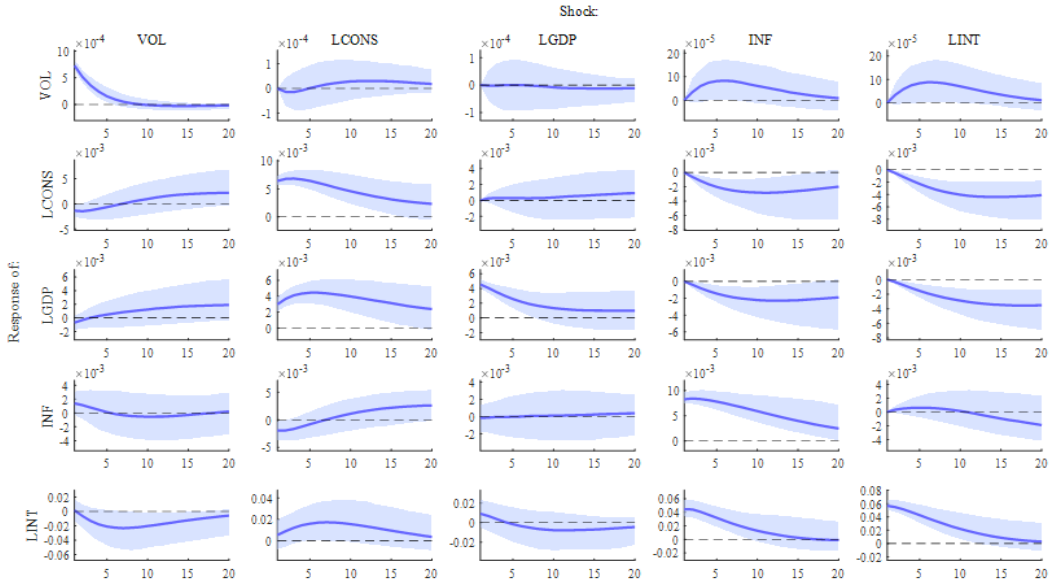
5 Results and discussion

In this section, we present and discuss the results. The empirical analysis of the impact of South African exchange rate volatility on domestic consumption was investigated with the aid of the Matlab software package. The models used, such as impulse response, forecast error variance decomposition, and historical decomposition, will help to analyse the dynamic relationship in this section.

5.1 Impulse response function

Impulse response function (IRF) analyses the reaction of any dynamic system to some external change. It shows how each variable reacts to each other variable when a one-unit shock presents itself. The impulse responses for our VAR are calculated with the following ordering: exchange rate volatility, log domestic consumption, log real GDP, inflation, and log interest rate. Figure 2 shows the impulse response to a 1 per cent shock in the exchange rate volatility function.

Figure 2: Impulse response function



Source: author's illustration based on FRED.

According to the figure, a one-unit shock in exchange rate volatility temporarily decreases domestic consumption. This negative response gradually increases until the middle of second period, when it hits its steady-state value. From the middle of the second period, domestic consumption expenditure rises above its steady-state value and remains in the positive region in the long run. In response to a transitory exchange rate volatility shock, real GDP deteriorates by a small magnitude and very quickly reaches its steady-state value. Given that real GDP remains in the positive region in the long run, a shock to exchange rate volatility tends to produce a negative relationship in the short run while in the long run it becomes positive. We observe that an exchange rate volatility shock has a small positive magnitude until it reaches its steady state in the second period and become stable. Finally, a one-unit shock in volatility provokes a largely negative response in the interest rate during all periods, although the negative response progressively increases in the middle of the second period.

The impulse response analysis has shown that movement in volatility has a negative effect on domestic consumption in the short run, and any change in domestic consumption has a negative and diminishing effect on volatility in the short run that gradually increases in the long run. Overall, these results are in line with the findings in Bahmani-Oskooee et al. (2015), Iyke and Sin-Yu (2017), and Oseni (2016), i.e. that most of the time, uncertainty in the exchange rate has negative short-run effects on domestic consumption for all countries in the sample while the short-run effects last into the long run in only half of the countries in the sample. However, Bahmani-Oskooee et al. (2015) and Sin-Yu and Iyke (2017) found different results for the same economies.

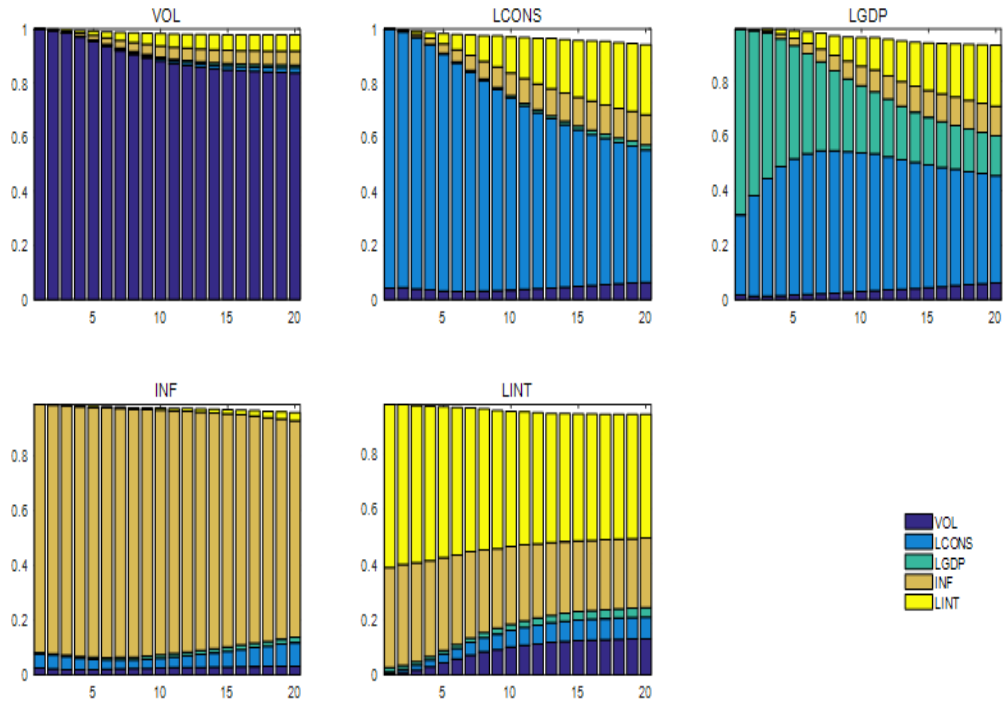
5.2 Forecast error variance decomposition

The focus of this part of the paper is to determine how the variability in endogenous variables is lagged by their own variance, and also to show which exogenous shocks are most important in explaining the variability of these variables over time (Floyd 2005). The variance of the dependent variable in response to orthogonal shocks is supposed to be the variance of the errors in forecasting, for the reason that without the shocks the variable would remain unchanged (Floyd 2005).

We investigate the dynamics of the BVAR by considering the proportion of the movement in each variable in the system that is due to its own shocks, versus shocks to other endogenous variables. The results of the forecast error variance decomposition (FEVD) are shown in Figure 3. The figure shows that exchange rate volatility, domestic consumption, inflation, and interest rate are typically driven by their own shock—particularly exchange rate volatility in the first period, where it fully accounts for all of its own shock. Conversely, in the second period, exchange rate volatility explains about 95 per cent of its own volatility while inflation and interest rate account for about 2 per cent and 3 per cent, respectively. With time, we notice that the shock in each variable in the system increases in explaining the movement in volatility, until exchange rate volatility explains about 80 per cent in the fourth period and 20 per cent of movement is explained by other variables. However domestic consumption explains about 93 per cent of its own shock, with 7 per cent explained by exchange rate volatility. In the second period, domestic consumption is explained at nearly 65 per cent by domestic consumption while exchange rate volatility, interest rate, and inflation account respectively for 15 per cent, 10 per cent, and 5 per cent. Further, the results show that real GDP is explained by domestic consumption by more than 30 per cent in the first period, while in the second period this figure is more than 50 per cent. At the end of the period, 20 per cent of real GDP is explained by itself while volatility, consumption, inflation, and interest respectively explain about 8 per cent, 32 per cent, 5 per cent, and 30 per cent. Other variables in the system are not significantly explained by inflation, according to the figure. Regarding the interest rate, its ability to explain its own movement consistently decreases over time as the role of

other variables increases, from 58 per cent at the beginning to 49 per cent at the end of the fourth period.

Figure 3: Forecast error variance decomposition



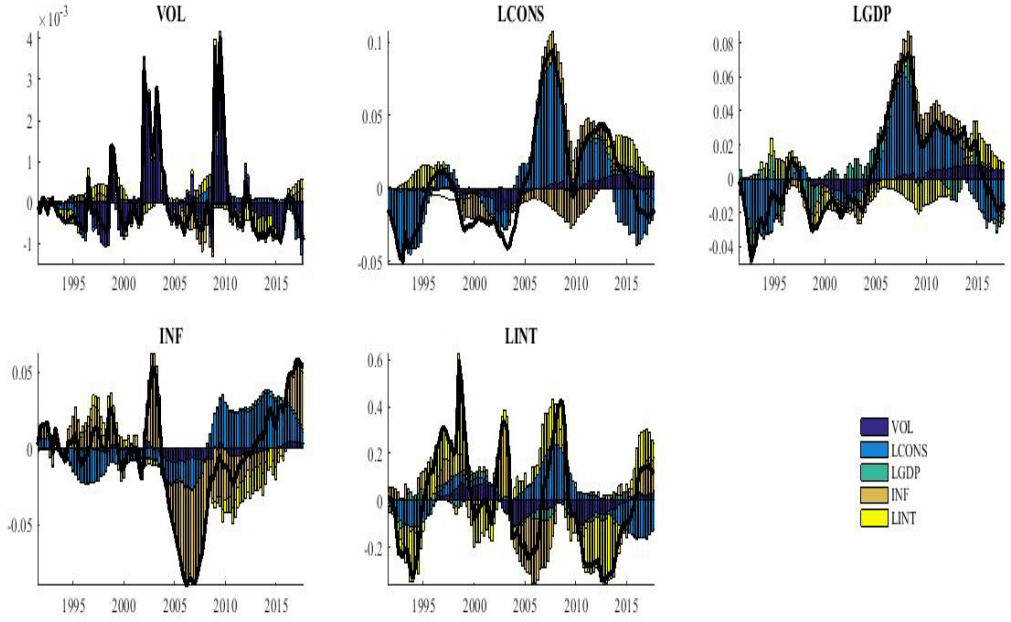
Source: author's illustration based on FRED.

5.3 Historical decomposition

Structural FEVDs and structural IRFs refer to the average movements in the data. They represent unconditional expectations. Researchers are rarely interested in quantifying how much a given structural shock explains of the historically observed fluctuations in the VAR variables. In other words, they would like to know the cumulative effect of a given structural shock on each variable at every given point in time (Kilian and Lütkepohl 2017). The focus of this part of the study is to decompose the actual movement in a series into the movements that happened based on each individual shock. The contribution of each shock is calculated as the median of the posterior distribution, and we consider the total shock contributions to be defined as the sum of the individual contributions.

The historical decomposition illustrated in Figure 4 with respect to domestic consumption shows that exchange rate volatility shocks and inflation shocks appear to represent the bulk of domestic consumption fluctuations, while real GDP shocks and interest rate shock are not significant in representing domestic consumption shocks. There are some reflections of this in the figure: 1992, with the institution of economic sanctions, and the 2009 crisis obviously appear as events driven by exchange rate volatility and inflation shocks. Interest rate shocks appear to have increased influence in the period after the crisis. The contribution of volatility shocks appears to be negative not only in domestic consumption but again in real GDP and interest from 2000 to 2004 and 2008 to 2010, which corresponds to the periods of the East Asian and global financial crises. Comparing the two graphs for consumption and real GDP, we notice some similarities in their fluctuations.

Figure 4: Historical decomposition



Source: author's illustration based on FRED.

Lastly, in order to check for robustness, different measures of exchange rate volatility were calculated. The first one is the moving average standard deviation and the second is the CBOE Volatility Index, which reflects volatility in the market. We performed the estimations using these measures and the results are reported in the Appendix. According to Table A1, the CBOE Volatility Index measures show that a one-unit shock in exchange rate volatility temporarily decreases domestic consumption and the same is observed for GDP until both variables hit their steady-state value at the end of the period. Thus, exchange rate volatility has a negative effect on both domestic consumption and GDP in the short run. In contrast to the results with the conditional variance measure of volatility, the short run is reflected in the long run. According to Table A4, the moving average standard deviation is not an appropriate measure of exchange rate volatility in the case of South Africa.

6 Conclusion

A high level of volatility in the exchange rate causes expectations over future price levels to be more uncertain. In the case of South Africa, a small open economy, vulnerable to foreign trade, that attracts foreign savings to support domestic investment, exchange rate uncertainty creates a risk premium for long-term arrangements, raises costs of production, reduces trade, causes unanticipated redistribution of wealth, and leads to fluctuations in the real economy, with an adverse effect on the growth of domestic consumption.

The main goal of this paper was to analyse how exchange rate volatility affects domestic consumption in the case of South Africa. The empirical analysis of the relationship between exchange rate volatility and domestic consumption requires a multivariate approach. One of the appropriate ways to analyse such a dynamic relationship is via impulse response functions obtained from a VAR. Given this, we use the Bayesian version of the classical VAR model, which provides insight into the dynamic effect of shocks on domestic consumption.

Regarding the relationship between exchange rate volatility and domestic consumption, we find that a one-unit shock in exchange rate volatility temporarily decreases domestic consumption. This negative response gradually increases until the middle of second period, when it hits its steady-state value. We investigate the dynamics of the BVAR by considering the proportion of the movement in each variable in the system that is due to its own shocks, versus shocks to other endogenous variables.

The results of the FEVD show that exchange rate volatility, domestic consumption, inflation, and interest rate are typically driven by their own shock—particularly exchange rate volatility in the first period, where it fully accounts for all of its own shock. Conversely, in the second period, exchange rate volatility explains about 95 per cent of its own volatility while inflation and interest rate account for about 2 per cent and 3 per cent, respectively. The historical decomposition in respect of domestic consumption shows that exchange rate volatility shocks and inflation shocks appear to represent the bulk of domestic consumption fluctuations, while real GDP shocks and interest rate shocks are not significant in representing domestic consumption shocks.

Finally, such exchange rate volatility influences domestic consumption in the context of high dependence on raw material exports and imported consumer goods in the country. Policy-makers should reduce exchange rate volatility in order to promote domestic consumption growth. The upturn in domestic consumption is causing poverty to fall in the country.

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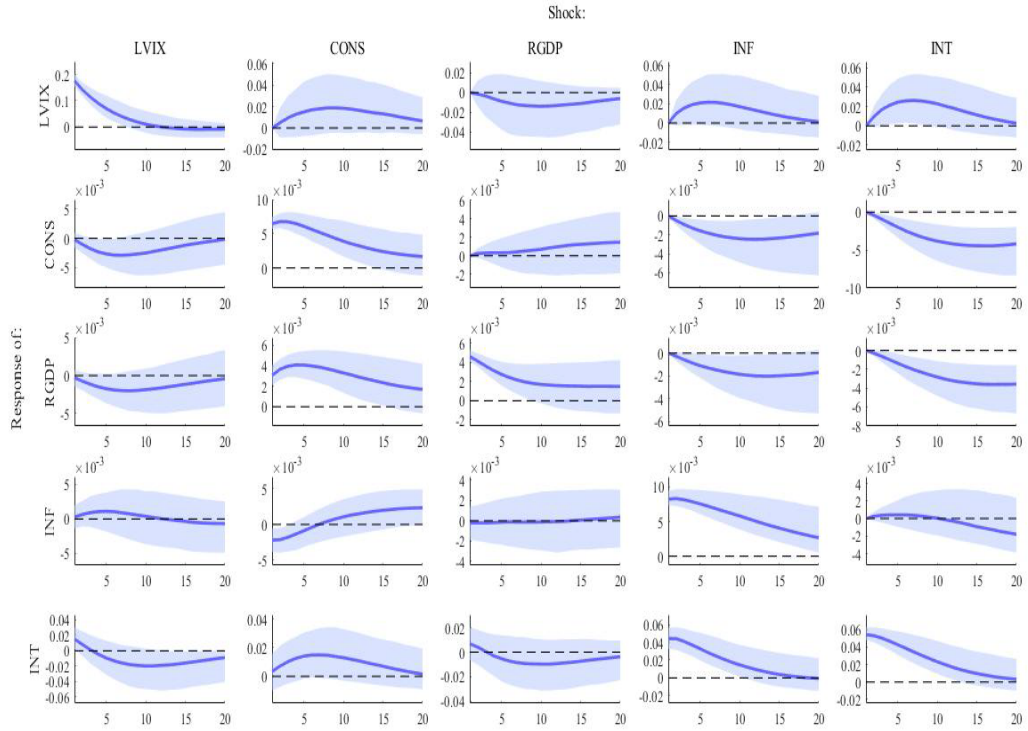
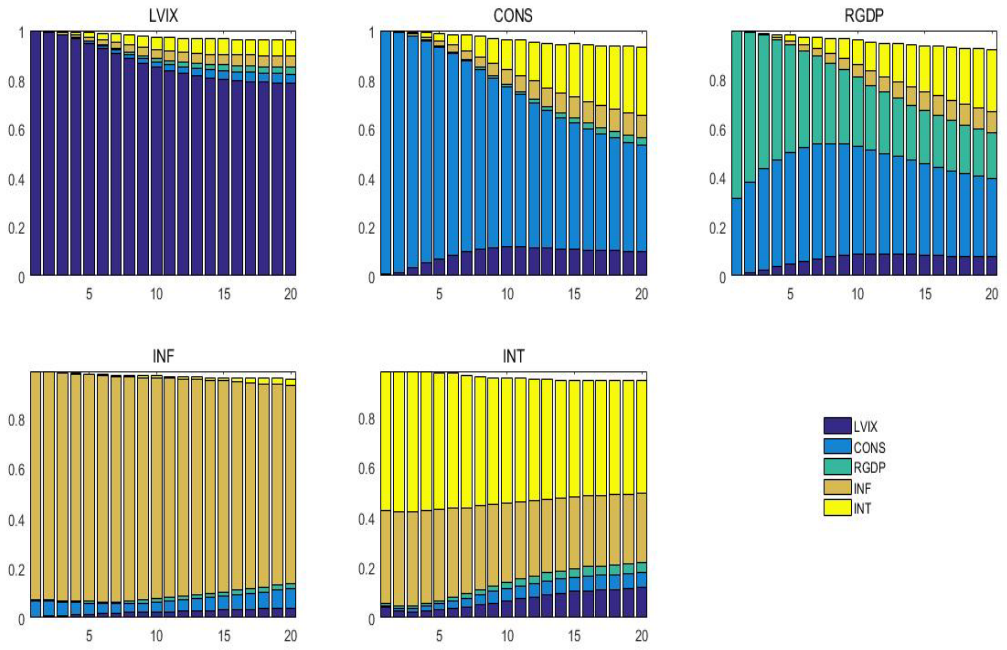
Appendix

Table A1: Impulse response function (LVIX)



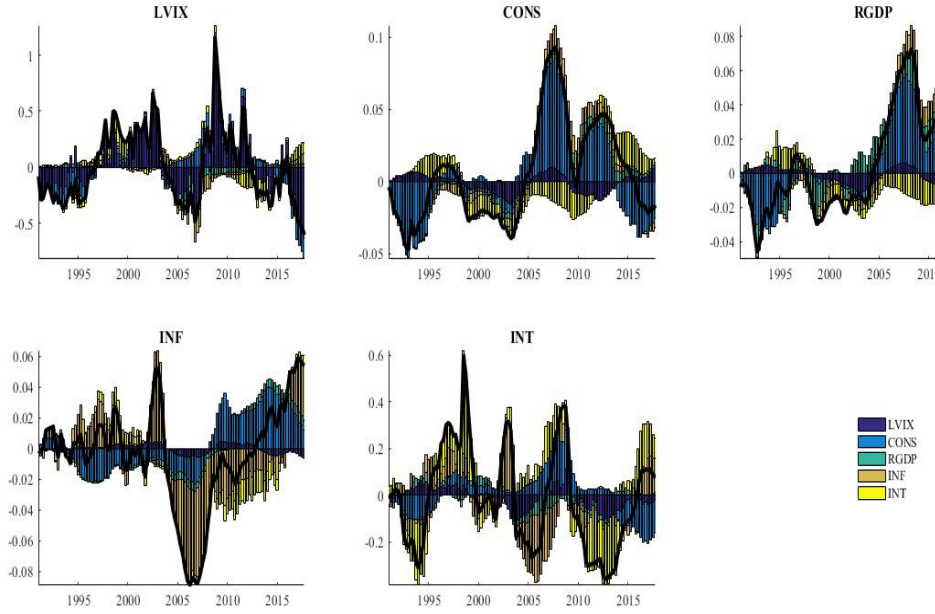
Source: author's illustration based on FRED.

Table A2: Forecast error variance decomposition (LVIX)



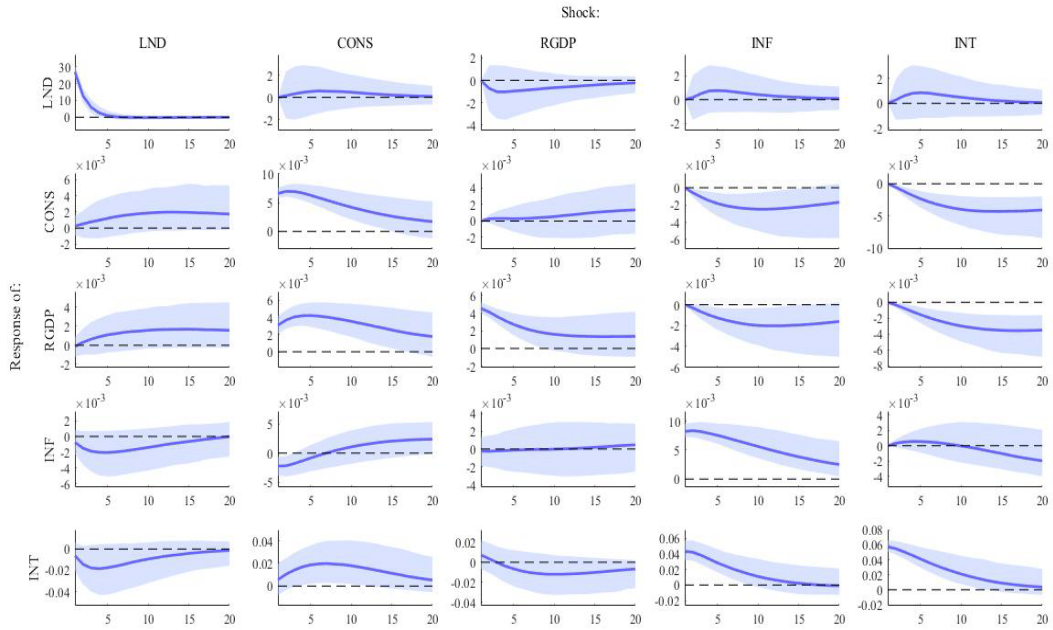
Source: author's illustration based on FRED.

Table A3: Historical decomposition (LVIX)



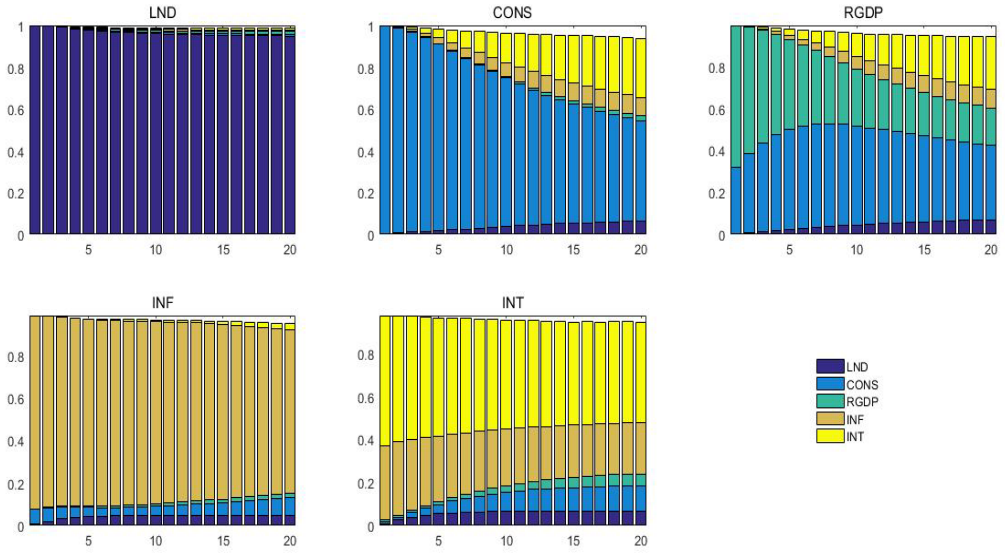
Source: author's illustration based on FRED.

Table A4: Impulse response function (STDV)



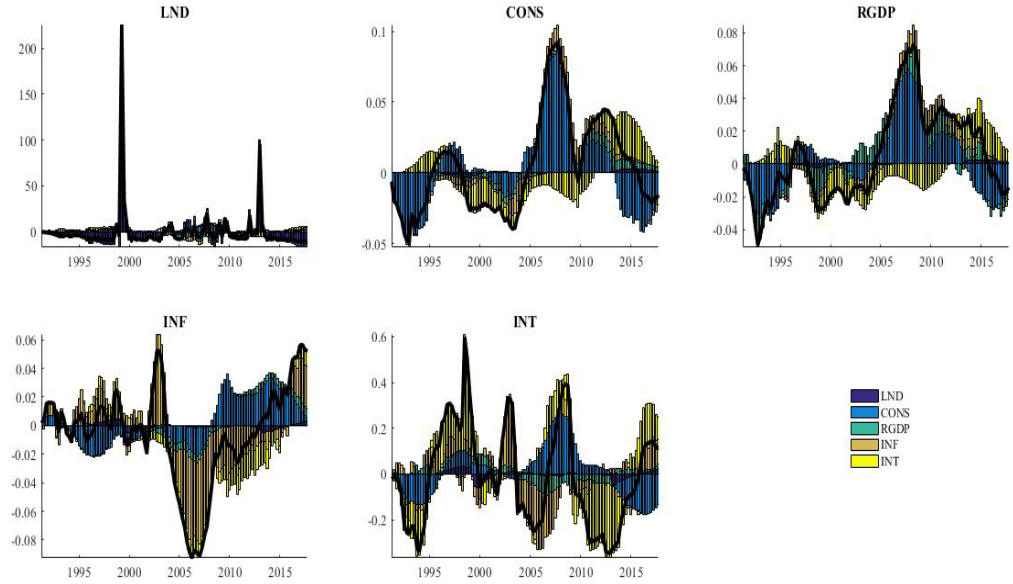
Source: author's illustration based on FRED.

Table A5: Forecast error variance decomposition (STDV)



Source: author's illustration based on FRED.

Table A6: Historical decomposition (STDV)



Source: author's illustration based on FRED.