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SENSITIVITY OF MACROECONOMIC VARIABLES TO EXCHANGE RATE SHOCK IN NIGERIA AND SOUTH AFRICA: A STRUCTURAL VECTOR AUTO REGRESSION APPROACH

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Abstract:
This study investigates the sensitivity of macroeconomic variables to exchange rate shocks in Nigeria and South Africa between 1982 and 2018. Specifically, the study investigated the response of Foreign Direct Investment (FDI), Gross Domestic Product growth rate (GDPGR), Import rate (IMPORTR), Export rate (EXPORTR) and Inflation rate (INFR) to exchange rate shock in these Countries. The data used for analysis is secondary by nature and was obtained from the World Development Bank Indicators. The estimation technique employed was structural Vector autoregression (SVAR), impulse response function (IRF), and variance decomposition function (VDF). The Structural Var result revealed that exchange rate shock had negative effect on FDI in the countries but insignificant. The result on GDPGR revealed that the effect is only positive in South Africa but insignificant in both economies. For IMPORTR and EXPORTR, the effect is positive in all the zones but significant only in Nigeria. For INFR, the effect is significantly positive in South Africa at 5% significant level but insignificantly negative in Nigeria. Impulse response result revealed that in Nigeria and South Africa, all the variables were negatively sensitive to exchange rate shock but temporal except INFR that was positive and permanent in South Africa. However, the variance decomposition function for the zones revealed that apart from own shock, exchange rate shock had relatively high contributions to variations in IMPORTR, EXPORTR, and INFR in Nigeria. Also, in South Africa, exchange rate shock contributed the largest variations in EXPORTR and INFR. Based on the findings, this study concludes that the macroeconomic variables of the countries are sensitive to exchange rate shock more in the short run but undecided in the long run. Moreover, the permanent response of INFR to exchange rate shock in South Africa calls for serious attention by the regulatory authorities in this economy. Therefore, this study recommends that conscientious effort be made by policy makers in ensuring

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exchange rate management in the zones for better performance of the macroeconomic variables.

JEL: F31, F41, N1, N10, N17

Keywords: exchange rate shock, macroeconomic variables, sensitivity, structural VAR

1. Introduction

In developed and emerging nations, it is impossible to overstate the efficacy of a stable exchange rate in attaining macroeconomic goals. Every free market economy in the world relies on the rate of exchange to determine its level of trade, which is crucial in the economic integration process. Surprisingly, the rate of exchange of currencies among countries of the world is one of the major closely monitored, examined, and manipulated macroeconomic indicators by governments (Ngerebo and Ibe, 2013; Vidyavathi, Keerti, and Pooja, 2016). Exchange rates are what allow you to compare the prices of goods, services, and assets in different currencies from different nations. In addition, the exchange rate is one of the determinants used to evaluate an economy's performance. A perfectly viable economy is portrayed in a strong and viable exchange rate.

An extremely weak currency, on the other hand, reflects a very sensitive and fragile economy. The rate of foreign exchange has key influence in the capability of many developing countries, particularly those in Sub-Saharan Africa, to achieve optimal levels in industrial activities (Allen, 2004; Ramasamy and Abar, 2015). However, regardless of the fact that the relevance of the exchange rate in any economy cannot be overstated, it should be highlighted that, if not adequately managed, it can lead to anomalies in consumption and production patterns, as suggested by (Mordi, 2006). Exchange rate swings, he added, have an equal impact on inflation, pricing incentives, fiscal viability, efficiency in resource allocation, confidence in international trade, export competitiveness and equilibrium of balance of payments. Aliyu (2011) opined that when exchange rate appreciates it leads to fall in exports and a rise in importation while a reduction in the value of a country’s currency would result to exports expansion and a decrease in imports. A shift from foreign to domestic goods is also common when the currency rate depreciates. These fluctuations in the currency rate are caused by a number of factors, including the country's exports, imports, and structural forces. Therefore, exchange rate shock and its impact are major concerns that determine the quantum and direction of foreign trade and commerce.

The majority of the world's economies have seen a significant real rapid increase in exchange rates, resulting in a high degree of uncertainty in the achievement of major macroeconomic and objectives of monetary policy in the areas of price stability and growth in an economy (Ajao, 2013; Ajao, 2015). Foreign investments, price stability, and stable economic growth are all influenced by exchange rate stability (Ajao, 2015; Ajao and Igbekoyi, 2013), whereas exchange rate innovation is one of the barriers to

macroeconomic policy success (Ajao, 2015; Ajao and Igbekoyi, 2013), (Amasoma, 2017). In poorer countries, exchange rate shock is fairly common. In particular, in Sub-Saharan African countries such as Nigeria and South Africa, there has been a significant increase in exchange rate shocks in recent years. Over the years, governments, especially for developing countries, have implemented various policies in managing exchange rate so as to achieve a realistic and stable exchange rate. Nonetheless, the majority of these countries witnessed significant exchange rate fluctuations, resulting in a high level of uncertainty or volatility (Adamu, Abubakar and Dantama, 2017). Fluctuations in the exchange rate were found to inhibit foreign investment in South Africa, as evidenced by the works of Dahir, Fuaziah Bang- Ariffin and Rasak (2017).

As a result of its economic importance, academic and policy researchers continue to pay attention to exchange rate modeling. However, several studies (Akinlo and Adejumo (2014), Amassoma (2016), Achouak, Ousama and Mourad (2018), Idris, Hassan, and Muhammed (2016) have focused on the effect of volatility of exchange rate on macroeconomic variables, with little consideration given to the responses of selected macroeconomic variables to exchange rate shocks, notably in Sub-Saharan Africa. This study explores the impact of exchange rate shocks and the reactions of some selected macroeconomic indicators in Nigeria and South Africa between 1982 and 2018 (36 years) on the basis of being the two largest economies by GDP in respective zones.

2. Literature Review

2.1 Exchange Rate Shock

Exchange rate shocks are any changes in the exchange rate that are not explained by other economic factors like interest rates or trade terms. Foreign exchange shocks are sometimes defined as sudden and large rate swings in foreign exchange that can be unpredictable and only last a short time. With the prospect of a financial crisis, unexpected falls and gains in currency rates can cause uncertainty and discontent in individuals and economies. Shocks to Exchange rate are only a minor consideration when it comes to the volatility of domestic economic variables (Manalo, Perera and Rees, 2015). It can be divided into two categories: positive and negative shocks.

Various macroeconomic indicators are employed to measure how foreign exchange shocks affect any economy. As a result, countries attempt to stabilize exchange rates by intervening in them occasionally using a range of ways, the most common of which are tools of monetary policy handled by central banks (Kartal, Depren and Depren, 2018).

2.2 Sensitivity of Macroeconomic Variables

The sensitivity of macroeconomic variables refers to how the uncertainty and reactions of macroeconomic variables can be assigned to various sources of uncertainty or fluctuations in an economy (Saltelli, 2002). It can also include assessments of how events in one section of the economy affect other parts, as well as how events in the international

economy affect the home economy. Internal or external shocks could have triggered the response. An unexpected change in an economic variable that occurs outside the economy is referred to as an external shock. As a result of a large reliance on trade with other economies, macroeconomic variables in an economy adapt to these unexpected and fast shifts. External shocks might take the shape of economic downturns or technological advancements. Internal shocks, on the other hand, are sudden changes within an economy resulting from domestic reasons.

2.3 Theoretical Foundation

The Mundell-Fleming theory, which describes the relationship between exchange rate and macroeconomic variables as well as the causes of short-run changes in aggregate income in an open economy, underpins this research. Robert Mundell and Marcus Fleming popularized this hypothesis in 1968, and it was a major supporter for currency stabilization. The model's most important contribution has been a thorough examination of the impact of international capital mobility in determining the efficacy of macroeconomic policy under various exchange rate regimes (Jacob and Assaf, 1987). This is an example of an explanatory hypothesis. The IS-LM was first introduced in the Keynesian theory, which is the basis for this theory. In a closed economy, the IS-LM model examined the relationship between interest rate, investment, aggregate demand, and income in goods and money markets. It goes on to say that the interest rate is the price that brings the two markets back into balance. The Mundell Fleming, on the other hand, expands the Keynesian theory by include international capital mobility, which encompasses both export and import. It examines a small open economy whose capital mobility is perfect, which means that from global financial markets a country can borrow or lend easily at the current rate of interest because the global rate controls the domestic rate. consequently, the rate of interest is not a policy variable in the small economy under study. This also explains why macroeconomic adjustment is limited to changes in exchange rates. The Mundell-Fleming Model was born as a result of the addition of an exchange rate to the IS-LM model.

2.3 Empirical Studies

The relationship between the exchange rate and other macroeconomic variables is still a hot topic in international finance as well as in emerging countries, as it is a precondition for economic development (Adeniran, 2014). As a result, empirical studies have been conducted on it, with mixed results, particularly in terms of exchange rate volatility.

The impacts of currency rate volatility on economic growth in West African English-speaking countries were studied by Umaru, Aguda, and Nordiana (2018). The study employed both a qualitative and quantitative research design. Data from a focus group for four countries, including Ghana, Gambia, Nigeria, and Sierra Leone, panel datasets from 1980 to 2017 were combined. Descriptive, pooled OLS regression, fixed effects, and random effects estimations were used to examine the data. The study found

that in West African English-speaking countries, the real exchange rate is statistically significant and adversely connected to GDP.

Oloyede and Essi (2017) looked at the impact of currency rate shocks on imports and exports in Nigeria between 1996 and 2015. The study used the Vector Auto Regression (VAR) modeling technique to regress exchange rate on both imports and exports, revealing that imports and exports are unaffected by the exchange rate. Between 1970 and 2013, Amassoma (2017) investigated the impact of exchange rate fluctuations on Nigerian economic growth. Using econometric tools such as Multiple Regression and Error Correction Model, the author discovered that exchange rate fluctuation had a beneficial but minor impact on Nigerian economic growth. The currency rate and its volatility, oil price, inflation, and trade openness were used as independent factors, with GDP as the dependent variable.

Abimbola and Olusegun (2017) investigated the relationship between exchange rate, shock price movement, and aggregate output and found that the variables have a high degree of positive correlation. From the first quarter of 1986 through the fourth quarter of 2008, Akinlo and Adejumo (2014) studied the influence of currency rate fluctuation on non-oil exports in Nigeria. The finding shows the existence of a positive and statistically significant association between real exports and exchange rate volatility in the long run but is inconsequential in the short run, according to the result from the error correction technique.

Omotola (2016) looked at how exchange rate variations affected manufacturing sector output in Nigeria. The influence of exchange rate changes on manufacturing output, the Consumer Price Index (CPI), and the Real Effective Exchange Rate (EXC) were investigated using Autoregressive Distribution Lag (ARDL). The findings revealed that the exchange rate has a favorable but insignificant link with manufacturing sector production. In a similar vein, Chimaobi, Onyinye, and Kenneth (2016) investigated the vitality of the Nigerian currency rate, its causes, and consequences on the manufacturing sector. In Nigeria, the currency rate was unstable and variable, and the official exchange rate had a substantial impact on the manufacturing sector. Okorontah and Odoemema (2016) studied the impact of exchange rate variations on Nigerian economic growth. To investigate the relationship between exchange rate and economic growth, the researchers used the ordinary least square (OLS) technique, the Johansen co-integration test, and the error correcting mechanism (ECM). According to the findings, there is no clear link between the exchange rate and economic growth in Nigeria.

Sani, Hassan, and Azam (2016) investigated how exchange rate fluctuation affected output in a few West African nations. Estimation techniques included the co-integration test and error correction models. The study found that exchange rate volatility had a considerable impact on outputs in all of the nations studied, with all but Liberia experiencing a negative impact. With the use of the Correlation Matrix, Ordinary Least Square (OLS), and Granger Causality test, Danmola (2013) investigated the impact of exchange rate volatility on macroeconomic indicators in Nigeria. The study's findings suggest that exchange rate volatility has a favorable impact on GDP, FDI, and trade

openness, but has a negative impact on inflation in the country. Between 1987 and 2011, Tamunonimim and Reginald (2013) evaluated the causal relationship between the exchange rate, the balance of payments, external debt, external reserves, GDP growth rate, and inflation rate in Nigeria. The Johansen cointegration test was used, as well as equation estimation and Granger causality tests. The Granger causality test between the dependent and independent variables reveals that the exchange rate, external reserves, and gross domestic product growth rate are all unidirectionally related. The effects of price and exchange rate variations on agricultural exports (cocoa) in Nigeria were studied by Essien, Dominic, and Sunday (2011).

Using the Ordinary Least Squares Regression, data were applied to a cocoa export supply function and an estimate was made. Exchange rate variations and agricultural credits were found to have a favorable impact on Nigerian cocoa exports. In line with Essien, Dominic, and Sunday (2011), Umaru, Sa'idu, and Musa (2013) also discovered that exchange rate volatility had positive impacts on export in Nigeria in their study on the influence of exchange rate volatility on export, which suggests that when the exchange rate appreciates, export rises alongside.

Habanabakize (2019) analyzed the impact of economic development and the exchange rate on imports and exports in South Africa following the financial crisis of 2008. The unit root test, the autoregressive distributed lag (ARDL) model, the error correction model, and the granger causality test were used to examine the data collected. According to the research, a stronger Rand leads to more imports and less exports in the long run. Ngondo and Khobaai (2018) investigated the effects of the South African currency rate on exports. The study's findings revealed that the exchange rate in South Africa has a substantial negative association with exports. Between 1970 and 2014, Maepa (2016) focused on the impact of exchange rate volatility on investment. The study used the Vector Auto Regressive modeling technique to assess effect of real exchange rate on private domestic investment. According to the findings, currency rate fluctuation has a detrimental impact on investment.

Ekanayake, Thaver, and Plante (2012) used the limits testing methodology and the error correction method to evaluate the influence of exchange rate volatility on South Africa's trade flows over the period 1980-2009. The findings of the study indicated that imports are positively correlated with economic dependency and foreign exchange. In South Africa, between 2000 and 2010, Ncube and Ndou (2011) investigated the link between inflation targeting, exchange rate shocks, and output. The study's dependent variable was inflation, whereas the independent variables were exchange rate, oil price, interest rate, and foreign reserves. The study found that exchange rate stability has a considerable impact on output growth when using the Vector Auto Regression framework for analysis.

Ogunleye (2008) compared the link between exchange rate volatility and Foreign Direct Investment (FDI) in Sub-Saharan African nations between 1970 and 2005, with an emphasis on Nigeria and South Africa. The exchange rate volatility variable was generated using the Generalized Autoregressive Conditional Heteroscedacity (GARCH)

model, and the study used a two-stage least square method. In both nations, the analysis finds that exchange rate volatility and foreign direct investment inflows are endogenous. Exchange rate volatility also has a negative impact on FDI inflows, with FDI inflows exacerbating exchange rate volatility in both nations.

3. Methodology and Data

3.1 Model Specification

This study investigates how sensitive the macroeconomic variables in the Sub Saharan African countries are to Exchange rate shock. Macroeconomic variables selected are Real exchange rate (REER), Foreign direct investment (FDI), Gross Domestic Product growth rate (GDPGR), Import rate (IMPORTR), Export rate (EXPORTR) and Inflation rate (INFR). The model used was adapted from the works of Dlamini (2014) on whether uncertainty or fluctuations in exchange rate affect the macroeconomic variables in Swaziland. The author specifies the model as follows:

$$\boldsymbol{AY_t} = \sum_{\boldsymbol{i=1}}^{\boldsymbol{p}} \boldsymbol{D_i Y_{t-i}} + \boldsymbol{B v_t} \ldots\ldots (\mathbf{3.1})$$

where;
Y = the vector containing the six endogenous variables,
A= a square matrix of coefficients to be estimated,
$\boldsymbol{v}$ = a vector of serially uncorrelated, and mutually orthogonal structuraldisturbances,
$\boldsymbol{D}$ = Coefficient of lag parameters,
$\boldsymbol{B}$ = Covariance matrix,
P = the number of lags.

The reduced form is stated as:

$$\boldsymbol{Y_t} = \boldsymbol{A^{-1}} \sum_{\boldsymbol{i=1}}^{\boldsymbol{p}} \boldsymbol{D_i Y_{t-i}} + \boldsymbol{Z_t} (\mathbf{3.6})$$

Since the reduced form of the model has been established, the relationship between the reduced form VAR residuals ($\boldsymbol{v_t}$) and structural shocks ($\boldsymbol{z_t}$) can be expressed as follows:

$$\boldsymbol{S v_t} = \boldsymbol{z_t} \ldots\ldots (\mathbf{3.7})$$

The matrix form of the SVAR model for this research is expressed as follows:

$$\begin{pmatrix} y_t^{REER} \\ y_t^{FDI} \\ y_t^{GDPGR} \\ y_t^{IMPORTR} \\ y_t^{EXPORTR} \\ y_t^{INFR} \end{pmatrix} = \begin{bmatrix} a11 & 0 & 0 & 0 & 0 & 0 \\ a21 & a22 & 0 & 0 & 0 & 0 \\ a31 & a32 & a33 & a34 & a35 & a36 \\ a41 & a42 & 0 & a44 & a45 & a46 \\ a51 & a52 & 0 & 0 & a55 & a56 \\ a61 & 0 & 0 & 0 & 0 & a66 \end{bmatrix} \begin{pmatrix} e_t^{\text{shock to Exchange rate}} \\ e_t^{\text{shock to Foreign Direct investment}} \\ e_t^{\text{shock to GDPGrowth rate}} \\ e_t^{\text{shock to Import rate}} \\ e_t^{\text{shock to Export rate}} \\ e_t^{\text{shock to Inflation rate}} \end{pmatrix} \quad \dots (\mathbf{3.8})$$

In the specification above, Real exchange rate (REER), Foreign direct investment (FDI), Gross Domestic Product growth rate (GDPGR), Export (EXPORTR), Import (IMPORTR) and Inflation rate (INFR), are the endogenous variables. It's assumed that in the diagonals, each variable is affected by own shocks. Also, all other variables are assumed to be contemporaneously respond to exchange rate shock. Gross domestic product growth rate is affected by innovations to foreign direct investment, export rate, import rate, inflation rate while import rate is sensitive to shock to Foreign Direct Investment, export rate and inflation rate. Also export rate is sensitive to FDI and inflation rate. From the structural matrix in equation (3.8), 16 restrictions were identified in order to determine the effect of a unit shock of one variable on another variable.

The data used for the purpose of analysis of this study is secondary in nature. The study focused on Nigerian and South African Economy which was purposively selected based on their unique peculiarities as the largest economy in their zones between 1982 and 2018.

4. Results and Discussions

4.1 Unit Root Test Result (Pre- test)

Table 4.1: ADF test result at level

Variables	**Nigeria P-Value**	**South Africa P-Value**
REER	0.0743*	0.0001***
FDI	0.0953*	0.0007***
GDPGR	0.0394**	0.0182**
IMPORTR	0.0000***	0.0004***

EXPORTR	0.0000***	0.0001***
INFR	0.0714*	0.0137**
Note: (***) significant at 1%, (**) significant at 5%, (*) significant at 10%		

Source: Author's Computation (2021).

The results of the ADF unit-root test of the variables for Nigeria and South Africa are presented in Table 4.1. From the table, ADF test statistics shows that all the variables are stationary at 1%, 5%, and 10% levels of significance respectively. Since the variables are all stationary at level, estimation of the structural VAR model with valid inferences can be conducted with this result.

4.2 Structural Vector Autoregressive Short Run Result

Table 4.2: SVAR Result for Western Africa Zone (Nigeria)

Variables	Coefficient	Std. Error	z-Statistic	Prob.
C(1) REER	62.43298	7.462170	8.366599	0.0000
C(2) FDI	-0.074574	0.154412	-0.482955	0.6291
C(3)GDPGR	-0.008371	0.707299	-0.011836	0.9906
C(4)IMPORTR	7.336072	4.117768	1.781565	0.0748
C(5)EXPORTR	5.853745	3.358109	1.743167	0.0813
C(6)INFR	-0.889268	2.304940	-0.385810	0.6996

Source: Author's Computation (2021).

Table 4.2 shows the result of contemporaneous effect or the immediate effect of individual variable shocks on the endogeneous variables and itself in West African Zone The result shows further that, exchange rate shock had an insignificantly negative immediate effect on FDI, GDPGR and INFR with significant and positive effect on itself, Exportr and Importr. This implies that a sudden appreciation in Naira will bring about an insignificant decrease of 0.074, 0.008371 and 0.889268 in FDI, GDPGR and INFR respectively and vice versa. Only Exportr and Importr increased significantly to appreciation in the exchange rate and vice versa in case of sudden depreciation by 7.336072 and 5.853745 respectively.

Table 4.3: SVAR Result for Southern Africa Zone (South Africa)

Variables	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C(1)REER	9.006782	1.061460	8.485280	0.0000
C(2)FDI	-0.100987	0.184864	-0.546278	0.5849
C(3)GDPGR	0.175451	0.318784	0.550376	0.5821
C(4)IMPORTR	1.212940	1.604579	0.755924	0.4497
C(5)EXPORTR	-0.637385	0.724863	-0.879318	0.3792
C(6)INFR	-1.041391	0.358324	-2.906285	0.0037

Source: Author's Computation (2021).

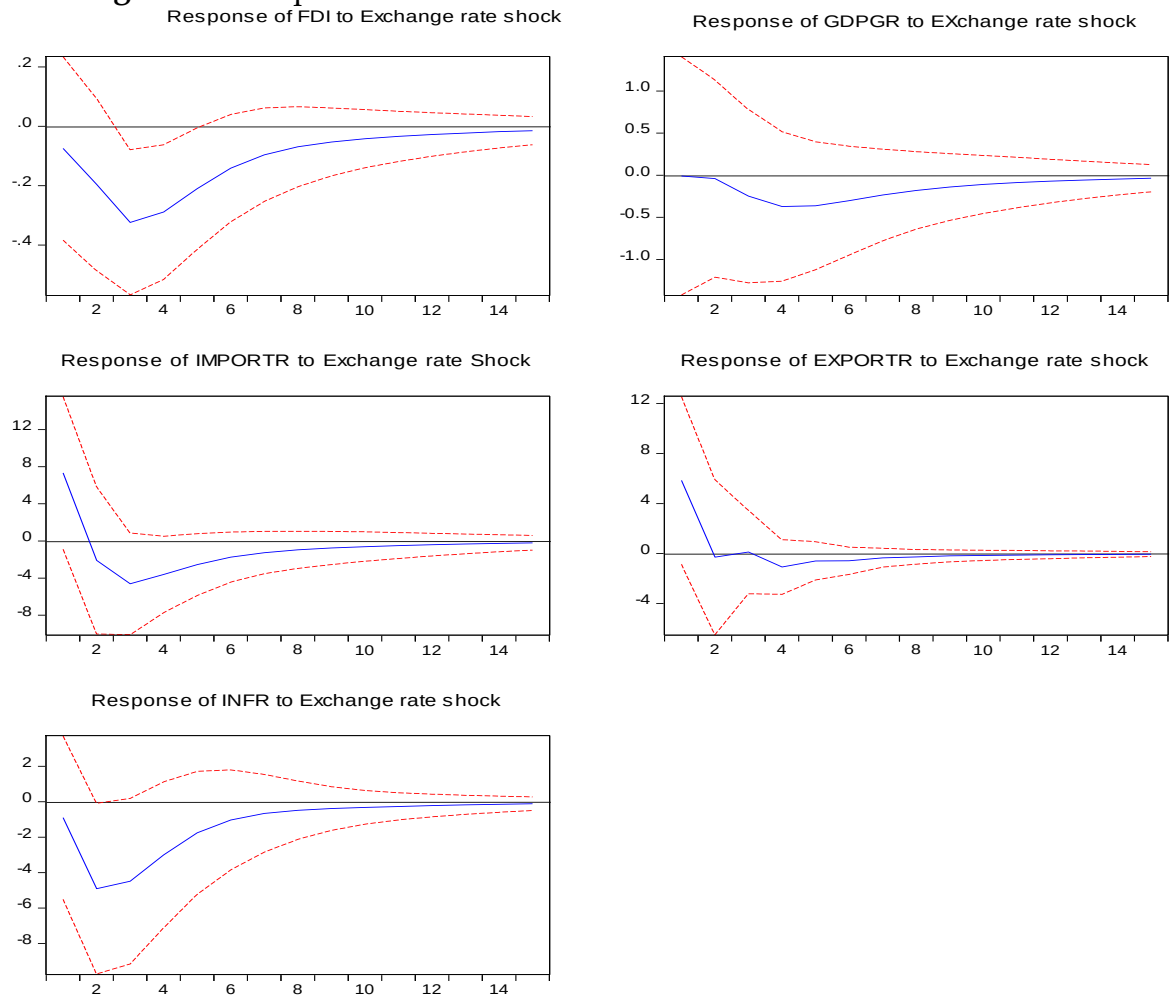
Table 4.3 reveals that only FDI, EXPORTR and INFR are negatively affected by exchange rate shock while other variables are positively affected. It can also be deduced that the

contemporaneous effect of exchange rate shock on the variables is only significant on Inflation. These imply that a sudden appreciation in Rand will cause FDI, EXPORTR and INFR to reduce by 0.100987,0.637385 and 1.041391 respectively and vice versa. Also, a sudden depreciation in Rand will lead to a fall in IMPORTR and GDP Growth rate by 0.175451 and 1.212940 respectively.

4.3 Impulse Response Function Result

4.3.1 Western Africa Zone (Nigeria)

Figure 4.1: Response of variables to Structural VAR Innovations ± 2 S.E.



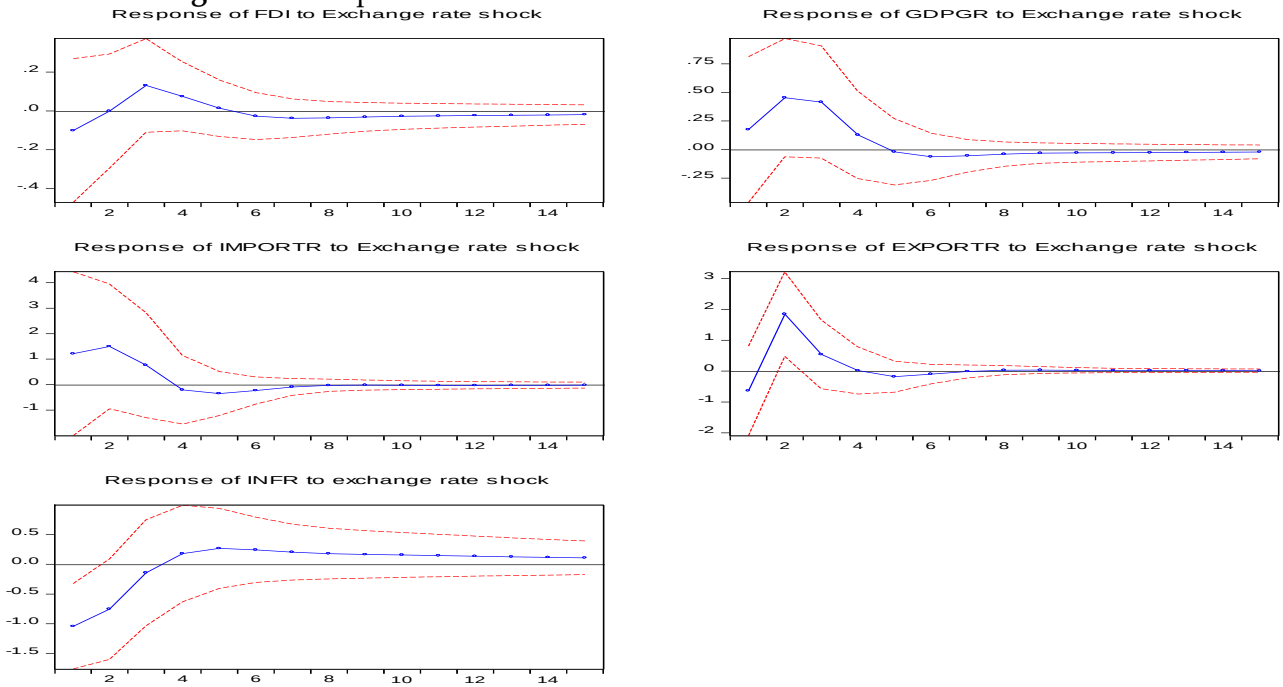
Source: Data Analysis (2021).

From Figure 4.1, initially, a one standard deviation shock to Exchange rate has a negative impact on FDI in Nigeria which sharply causes FDI to decline to the 3rd period from where it gradually moves upward to the 10th period. In the long run, Exchange rate shock has maintained a negative effect on FDI. Also, the impulse response output reveals that following a one standard shock to exchange rate, Gross domestic product growth rate (GDPGR) initially maintains a steady state value which gradually declines from the 2nd to 4th period in the negative region. From the 4th period, it appears that GDPGR

gradually remains in the negative region with increasing tendencies in the long run (10th to 15th). At the initial state, a one standard deviation shock to Exchange rate has a positive impact on import rate (Importr) which sharply declines to the negative region from the 1st period to the 3rd period. From the 4th period it appears that Importr begins to gradually ascend in the negative region till it hit a steady state value in the 10th period (long run) with increasing tendencies towards the 0 value. Likewise, one standard deviation shock to Exchange rate has a positive impact on Export rate which later causes the variable to decline sharply to negative value in the short run and hit a steady state value from the 2nd period. However, in period 4, Export rate sharply increases in the negative region till the 8th period where it also hits a steady state value with increasing tendencies. Following a one standard deviation shock in Exchange rate, it appears clearly that the sensitivity of inflation rate to this shock is negative. The extent of this effect sharply deteriorates from initial stage to the 3rd period (short run). But from period 4, the impact gradually reduces by moving upward in the long run with increasing tendencies.

4.3.2 Southern Africa Zone (South Africa)

Figure 4.2: Response of variables to Structural VAR Innovations ± 2 S.E.



Source: Data Analysis (2021).

The impulse response presented in Figure 4.2 for South Africa depicts that a one-time shock to exchange rate initially has a negative impact on FDI which sharply moves in period 2 to the positive region. In period 3 the shock causes FDI to sharply decline to negative region and remains at a steady state value from period 6 to 14. However, one standard deviation shock to exchange rate caused GDPGR to be positively sensitive with a sharp increase in the short run. From period 2, exchange rate shock causes GDPGR to gradually decline with a sharp decrease from period 3 to the negative region. In period

6, GDPGR remains in a steady state value with increasing tendencies. Similarly, in the short run, a one standard deviation shock to exchange rate causes a positive impact on Importr with a gradual increase. But in the 2nd period, Importr has a sharp decline to the negative region with increasing tendencies to point 0. Also, at the initial stage, a one standard deviation shock to Exchange rate has a negative impact on Exportr which sharply moves to the positive region to period 2. In the same period, Exportr sharply declined to period 3 but a gradual decline to period 4. But in the 5th period, Exportr tends to the negative region and later hits a steady state value, that is, point 0. A one standard deviation shock to Exchange rate initially pushes inflation rate (INFR) from the negative region to the positive region. This increase gradually declines from period 6 and hits a steady state value with decreasing tendencies but still remains in the positive region.

4.4 Variance Decomposition Result

4.4.1 Western Africa Zone (Nigeria)

Table 4.4: Variance Decomposition of FDI, GDPGR, IMPORTR, EXPORTR AND INFR as explained by Exchange rate shock in Nigeria

Period	FDI	GDPGR	IMPORTR	EXPORTR	INFR
1	0.664202	0.000400	8.675146	8.320612	0.424381
2	3.767654	0.008148	6.801564	6.389054	8.141284
3	10.77882	0.290051	9.014750	6.200508	12.74239
4	15.65800	0.902171	10.32282	6.351102	14.78531
5	18.04579	1.473872	10.92470	6.399710	15.47490
6	18.96515	1.860537	11.17144	6.453034	15.66489
7	19.27618	2.091720	11.28287	6.470914	15.71134
8	19.38403	2.225734	11.34229	6.481820	15.72778
9	19.43378	2.305112	11.37953	6.486857	15.73971
10	19.46579	2.353731	11.40443	6.490158	15.75014
11	19.48912	2.384389	11.42123	6.492175	15.75846
12	19.50587	2.404037	11.43238	6.493547	15.76445
13	19.51739	2.416713	11.43968	6.494437	15.76849
14	19.52500	2.424897	11.44439	6.495024	15.77112
15	19.52994	2.430173	11.44741	6.495403	15.77279

Source: Data Analysis (2021).

For the purpose of interpretation, the short run period is assumed to be from 1 to 3 while the long run is assumed to be from 10th period. From Table 4.6, the contribution of exchange rate shock to variation in FDI, GDPGR, IMPORTR, EXPORTR and INFR in Nigeria is 10.77%,29.05%, 9.01%, 6.20% and 12.74% respectively in the short run. It appears that Exchange rate shock contributes highly to the fluctuation in GDPGR in Nigerian economy in the short run. However, in the long run (period 10-15), exchange rate shock contributed the highest variation in INFR.

4.4.2 Southern Africa Zone (Nigeria)

Table 4.5: Variance Decomposition of FDI, GDPGR, IMPORTR, EXPORTR and INFR as explained by Exchange rate shock in South Africa

Period	FDI	GDPGR	IMPORTR	EXPORTR	INFR
1	0.825521	0.837903	1.574783	2.124959	20.99903
2	0.735022	5.458941	3.672254	13.59259	17.87975
3	1.832034	8.424265	4.09990	13.79722	14.87985
4	2.109840	8.435761	4.110814	13.67530	13.91697
5	2.069305	8.357132	4.220813	13.72828	13.71440
6	2.084932	8.399174	4.268590	13.73105	13.55332
7	2.151361	8.427839	4.275227	13.72038	13.34868
8	2.211201	8.431145	4.275257	13.71888	13.15041
9	2.253420	8.425448	4.274894	13.71972	12.98708
10	2.285090	8.419821	4.274849	13.71947	12.85939
11	2.311561	8.416345	4.275101	13.71848	12.75839
12	2.334798	8.414387	4.275419	13.71739	12.67601
13	2.355138	8.413043	4.275678	13.71647	12.60731
14	2.372666	8.411881	4.275871	13.71573	12.54954
15	2.387624	8.410818	4.276022	13.71513	12.50085

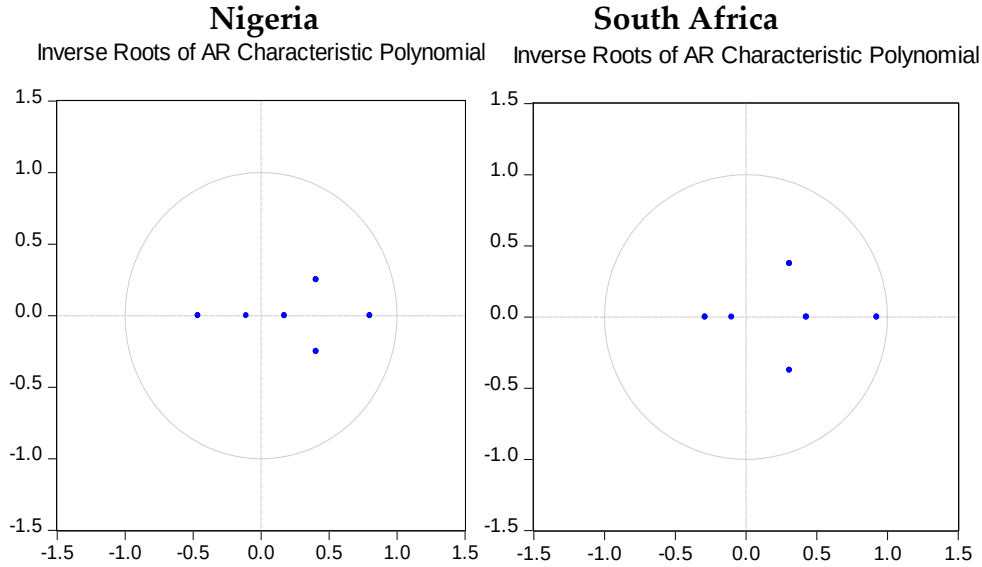
Source: Data Analysis (2021).

The results in Table 4.5 reveals that at the initial stage, Exchange Rate Shock contributed 0.82%, 0.83%, 1.57%, 2.12% and 20.9% to the variations in the fluctuation of FDI, GPDPR, IMPORTR, EXPORTR and INFR respectively in South Africa while the fluctuation is most evident in INFR. However, in the long run, the percentage of the variations in the variables caused by exchange rate shock are 2.3%, 8.4%, 4.2%, 13.7% and 12.5% respectively.

From the results, it is revealed that in South Africa exchange rate shock caused the major fluctuations in inflation rate and Export rate.

4.5 Robustness Check

This is done to ensure that the estimated VAR is stable. If the inverse of the calculated coefficient matrix characteristic root is smaller than 1 and the inverse roots of the AR characteristic polynomial are located within the unit circle, the model is stable. The figures below show the stability test result of the estimated SVAR models for each zone.



The inverse roots of AR reveals that the model is stable for the countries under investigation, since the inverse roots of the AR characteristic polynomial lie within the unit circle.

4.6 Discussion of Findings

The study examines the sensitivity of some selected macroeconomic variables to exchange rate shock in Nigeria and South African. The SVAR and Impulse response function's result for Nigeria reveals that Foreign Direct Investment, GDP Growth rate and inflation rate are negatively affected by innovation to exchange rate while import rate and export rate are positively affected. This is in consonance with the works of Danmola (2013) but contrary to the works of Oloyede and Essi (2017). Also, only the effect on Importr and Exportr are statistically significant. The result implies that innovations to exchange rate will discourage foreign investors and reduce the growth rate of goods and services produced in the zone. It also implies that a sudden spike in exchange rate would increase export and import in the zone while inflation rate declines. However, the response of the variables in the long run was negative but temporal as evident in the works of Wang (2017). This implies that exchange rate shock in western African zone reduce the performance of other macroeconomic variables but the variables later became insensitive which could be as a result of measures put in place by the monetary authorities.

Also, the Variance Decomposition explains further the fraction of forecast error of variance in the macroeconomic variables as a result of shocks to exchange rate in Nigeria. The result shows that apart from own shock, exchange rate shock and inflation rate shock contribute significantly to variations in FDI, GDPGR, EXPORTR, IMPORTR and inflation both in the short run and long run. This result confirms the sensitivity of the variables to a unit shock to Exchange rate in Nigeria as depicted in the impulse response result. This goes further to imply that exchange rate management in the sub-Saharan African

countries, specifically in West African region, is paramount for performance of all other macroeconomic variables in the zone.

In South Africa, the SVAR result reveals that exchange rate shock has Positive effect on GDPGR, IMPORTR and INFR but negative effect on FDI and EXPORTR. This is confirmed in the works of Ngondo and Ofori (2018), Mwinlaaru and Ofori (2017) and Jarita (2008). Also, the result is in consonance with the *aprior* expectation except for GDPGR that shows a contrary result. The effect is only significant on inflation. In the long run, the impulse response function (IRF) shows that all the variables were negatively sensitive and temporarily sensitive to innovations to exchange rate except in INFR which is positive and permanent. This is in line with the works of Choudri and Hakura (2006) and Leigh and Rossi (2002). For instance, FDI has a sharp rise to the positive region and later drops to the negative region where it hits its steady state value as responded also by GDPGR. Importr and Exportr also decline to the negative region but remain undecided by maintaining value of zero in the long run. Also, a one standard deviation in exchange rate causes INFR to maintain its steady state value on the positive region in the long run.

Summarily, the result reveals that only inflation rate responds positively to exchange rate shock in South Africa and remains permanent. The implication is that exchange rate shock seems to enhance the performances of macroeconomic variables in the short run but later contributes adversely to its performance in the long run over the time horizon except for inflation rate which remains in the positive region. This is in consonance with the earlier works of Egwaikhide, Chete and Falokun (1997) and Ajakaiye and Ojowu (1994).

However, in the variance decomposition function (VDF), it is observed that innovation to exchange rate contributes immensely to fluctuations in Exportr and inflation rate apart from own shocks. This implies that since the effect of this contribution on variation in Exportr and inflation rate is negative and positive respectively in the long run (as displayed by IRF result), rate of exportation in South Africa will reduce while inflation rate will rise in response to the direction of exchange rate shock.

Likewise, shocks to inflation will bring about significant contributions to fluctuations in FDI and GDPGR. This implies that innovation to inflation rate can cause variations in the growth rate of the country's economy and largely determines the level of foreign direct investment in the zone. Moreover, innovation to export is more responsible to variations in Importr and GDPGR and it implies that to determine the cause of fluctuation in both Importr and GDP growth rate, shocks to Exportr is responsible. In the same vein, the result shows that, Importr shocks can explain the variations in GDP growth rate in the Southern African countries.

4.7 Comparative analysis on the Sensitivity of Macroeconomic Variables to Exchange Rate Shock among sub-Saharan African Countries

It is observed from the result of the variance decomposition that own shock explains most of the forecast error variance in the two zones although exchange rate shock also affects other variables in the system.

Specifically, in Nigeria (Western African zone) the contributions of exchange rate shock to variation in the macroeconomic variables seem to be more significant compared to other shocks apart from own shock. Also, exchange rate shock contributes the highest percentage error of variance in Foreign Direct Investment compared to South Africa zones. It is also observed that the effect is negative but insignificant. All the selected macroeconomic variables are negatively sensitive to exchange rate shock but temporal in the system.

In, South Africa (Southern African Zone), the impulse response function result shows that the sensitivity of the selected macroeconomic variables to exchange rate shock is significantly negative than positive. It is either it moves from the negative to the positive or the other way round with increasing tendencies back to the negative region in the long run except for inflation which returns to the positive region. This is not so in Nigeria. In Nigeria, it is also observed that only innovation to exchange rate and own shock contributes significantly to variations in Inflation. However, in the Southern African zone, it is obvious that only inflation rate shock has the highest contribution of variation in other macroeconomic variables compared to exchange rate shock. This is in contrast to what holds in the West African Zone. The sensitivity of all the variables to exchange rate shock in both countries is negative and temporal except for inflation rate that remains positive and permanent in South Africa. This result for South Africa is contrary to Economic theory. However, it justifies the actions taken by the South Africa Reserve Bank in introducing inflation targeting policy as an exchange rate regime.

Therefore, from the above analysis, it appears that each zone responds differently to innovations to exchange rate. This could be as a result of how exchange rate shock is been managed over time or the peculiarities of each zone.

5. Conclusion and Recommendations

Exchange rate is one of the macroeconomic variables that scholars, academicians, policy makers to mention but a few, have sought to place findings on due to the role it plays in determining economic activities of nations of the world. This is an established fact as a result of international trade and transactions among countries. A shock to exchange rate can either cause an expansionary or contractionary effect on other macroeconomic variables. However, from the results obtained, the study concludes that the macroeconomic variables are sensitive to innovations to exchange rate across the zones. Also, exchange rate shock contributes more importantly to variations in the fluctuations of the macroeconomic variables in all the zones apart from own shock.

Moreover, innovations to Exchange rate and inflation interact side by side in the systems to determine the effective performance of other variables across the zones. This is evident in the fraction of forecast error of variance explained by inflation also in the variations of the macroeconomic variables. The study also concludes that the response of inflation rate in the southern African zones to exchange rate shock needs urgent and adequate attention.

Based on the findings, this study recommends, firstly, that, across the zones, effort should be made to determine, first and foremost, the type of exchange rate regime suitable for the peculiarities of each zone and ensuring a conscientious monitoring of the exchange rate. This can be achieved by practicing the regime that is capable of tackling the fundamental economic problems facing each zone. This will assist in maintaining the value of the currencies, thereby enhancing the performance of other macroeconomic variables.

Secondly, exportation should be fostered across the zones in order to reduce inflation rate and boost the rate of goods and services that are produced in the zones most especially in the Southern African zone and import dependent economies by increasing the ratio of export to import. Also, import substituting industries should be established and adequately supported in the zones. This will assist in controlling inflation and averting the effect of shocks to import rate in the economies. Thirdly, the zones should be made conducive for foreign investors by combating hike in the rate of inflation. This will encourage economic growth, increase export and appreciates the value of currencies in the sub-Saharan African countries. Also, Exchange rate shock and inflation rate should be well managed to ensure smooth administrations of economic activities in the zones. When these shocks are managed in the system, other variables will be positively sensitive to their spillover effects.

Finally, this study recommends that, the effect of inflation in the zones and maintaining the value of currencies in each zone must be the paramount concern of the policy makers since exchange rate shock contributes significant variation in inflation rate.

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Conflict of Interest Statement

The authors declare no conflicts of interests.

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