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Macroeconomic Determinants of Exchange Rate Dynamics in Nigeria

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Abstract

The study examined Nigeria's macroeconomic determinants of exchange rate dynamics over thirty-seven years, from 1986 to 2022. The major data sources are the Central Bank of Nigeria Statistical Bulletin, the Nigerian Bureau of Statistics, World Bank Development Indicator, the Organization of Petroleum Exporting Countries, the U.S Federal Reserve Bank, and other relevant literature. The study adopted the structural Vector Autoregressive (VAR) estimate to test the responses of exchange rates. Other estimation techniques considered are Impulse Response Function and Variance Decomposition Test. The study reported that past exchange rate (EXCR) values respond positively to an increase in innovation shock, and the response is statistically significant up to the second horizon. More so, past values of broad money supply and changes in crude oil prices positively impact the exchange rate. However, the study affirmed that past government capital expenditure and trade openness values are statistically insignificant but positively impact the exchange rate. Again, exchange rates respond speedily to changes in broad money supply, government expenditure, oil price fluctuation, degree of trade openness, and inflation rate. Hence, the study concludes that past values of broad money supply, government capital expenditure, changes in crude prices, and inflation rates are major macroeconomic determinants of the exchange rate in Nigeria. As such, the study submits that policymakers are to pay close attention to the rising rate at which more money is outside the shores of the Nigerian banking industry. Lastly, more federal government expenditures should be allocated to capital expenditure.

Keywords: Macroeconomic Determinants, Exchange Rate Dynamics, Oil Price Fluctuations, Broad Money Supply, Inflation Rate

Introduction

The exchange rate plays a crucial role in the monetary policy space all over the globe. This is because of its crucial impact on the country's trade relations with other countries, first,

as a mono-product (oil) export-dependent economy and second, as an import-dependent (developing) nation (Ajao, 2015). Notably, the transmission effect of changes in oil price onto exchange rate, particularly for oil exporting and importing economies, is entrenched in both theory and practice. However, the debate on the nature of this transmission effect on the exchange rate of nations has continued to receive attention from economists and policymakers (Abubakar, 2019). This is a result of the fall of Bretton-Woods system in 1973. Since then, the exchange rates of numerous countries have experienced significant volatility. Nigeria witnessed the greatest depreciation of its currency since its existence as a country (Algaeed & Algethami, 2023).

Iwedi (2021) argued that some ke macroeconomic variables determine a country's optimal real exchange rate and that suitable (permanent) macroeconomic variables determine the long-term value of the optimal real exchange rate. Notable amongst these macroeconomic determinants are broad money supply (BMS), government capital expenditure, degree of trade openness, and inflation rate. Specifically, the nexus between broad money supply and the exchange rate is in theory and practice. If the exchange rate is pegged or managed in any way, the central bank will need to purchase or sell foreign exchange. These transactions in foreign exchange will affect the monetary base similar to open market purchases and sales of government bonds; if the central bank buys foreign exchange, the monetary base expands, and vice versa (Algaeed & Algethami, 2023)

Theoretically, the effect of oil price shocks on oil-exporting economies should differ from that of oil-importing economies. Chatziantoniou, Elsayed, Gabauer, and Gozgor (2023) propose that a positive shock in oil price is expected to lead to an appreciation of the exchange rate of an oil exporting nation through an increase in foreign exchange earnings and a buildup of foreign exchange reserve. However, the exchange rate of oil-importing countries is expected to depreciate. Inflation is closely related to interest rates, both of which can influence the exchange rate such that if consumer spending increases such that demand exceeds supply, inflation may arise, which is not necessarily a bad outcome but is more likely to have a negative effect rather than a positive effect, on a currency's value and foreign exchange rate (Sreenu, 2023). Meanwhile, government expenditure policy may also influence the exchange rate in Nigeria. However, for equilibrium exchange rate value to be attained, there is a need to identify the variables that determine exchange rate dynamics and their respective effects within each peculiar economy so that these proximate variables could be used to nudge the exchange rate towards its long-run equilibrating value (Manuel, Mbazima-Lando, & Naimhwaka, 2023).

Nevertheless, the issue of exchange rate determination has generated intense debate since the fall of Bretton-Woods system in the 1970s and the subsequent introduction of floating exchange. This is because even when stringent economic policies are in place, the issue of exchange rate volatility still persists. Meanwhile, most Nigerian-based studies, like the studies of Yusuf (2019), Idris (2021) and Ani &Mashood (2021), employed nominal, demand and supply shock variables but did not subject the data to the possibility of structural breaks due to regime change. They also used the nominal variables in their absolute forms rather than using them in terms of relatives or differentials. This current study bridges these gaps by investigating the determinants of exchange rate dynamics using impulse Response Functions, Variance

Decomposition and Vector Error Correction Modeling. The rationale is that some information may be lost due to smoothening due to macro time frames.

Furthermore, the current study also departs from previous studies in the Nigerian exchange rate literature space by introducing core macroeconomic determinant variables into the exchange rate determination model. The variables considered include BMS, government capital expenditure, oil price fluctuations, trade openness and inflation rate. This is another departure from some other researchers, especially those researchers that focused on the effect of exchange rates on firm performance, such as the studies of determinants of exchange rate dynamics (see Adenigbo, Mageto, & Luke, 2023; Abdullahi & Wali, 2023; Anachedo, Okeke & Ubah, 2023; Okorontah, & Odoemena, 2016).

Based on the aforementioned absence of literature and established gaps, the current study attempts to bridge the gap by evaluating the determinants of exchange rates in Nigeria. Specifically, the study examined the determinants (BMS, government capital expenditure, oil price fluctuations/variations, trade openness and inflation rate) of exchange rate dynamics (EXCRD) in Nigeria.

Literature Review

The exchange rate is the rate at which one currency is exchanged for another. It is the price of one currency in terms of another (Lawal, 2016; Mkpe, Ekpa, & Ochepa, 2020). The exchange rate is the price of one unit of foreign currency in terms of the domestic currency. The exchange rate indicates the competitiveness of a country in a globalized world. Lawal (2016) observed that the exchange rate involving US dollar and UK pound explains units of US dollars needed to exchange one unit of UK pound in the foreign exchange market. A foreign exchange market refers to a market in which the currencies of various nations are traded (i.e. bought and sold). Specifically, foreign exchange rate fluctuations can affect actual inflation and expectations about future price fluctuations (Abanikanda, 2022; Abanikanda, 2022; Iwedi,2021).

Clear observation of Nigeria's exchange rate and it's determining factors from 1986 to 2021, as presented in Table 1, reflects that the interactions among the Nigeria Nigeria's exchange rate and its determining factors (inflation rate, trade openness/conditions, government capital expenditure & BMS). Nigeria recorded a significant rise in Nigeria's currency to $ from ₦1.75/$/ in 1986 to $401.15/N in 2021. By implication, the constant naira devaluation reflects the country's policy inconsistency and depressed state. Also, BMOS generally increased and peaked in 2017 with a significant value of 24.90%. This suggests higher liquidity or a rise in credit expansion to the public.

Furthermore, the purchasing power parity (inflation rate) evidenced significant fluctuations and peaked in 1988, 1992, and 1993, respectively, with inflation rates above 50%. This could be traced to economic instabilities. Meanwhile, Nigeria's trade policies/conditions reflect liberal trade policies, with the highest trade policy values being 39.53% in 1995. Meanwhile, the oil prices reported substantial variability, with the highest values in 1989 and

1990 and low values in 2016. Also, capital expenditures move upward, suggesting that more attention was placed on investment in infrastructural development to respond to the needs of the public.

The study anchored on the monetary theory of exchange rate determination. This theory postulates that the exchange rates are determined by balancing the total demand and supply of the national currency in each country. According to this theory, the demand for money depends upon the level of real income, the general price level & the rate of interest. The demand for money is the direct function of the actual income and the level of prices. However, it is an inverse function of the rate of interest.

On the other hand, money supply is determined autonomously by the monetary authorities of different countries. Furthermore, the monetary expansion and consequent fall in the interest rate will immediately affect the financial markets and exchange rates in the home country, Nigeria. The decline in the interest rate in Nigeria can result in increased Indian financial investments in the U.S.A. This is likely to cause an immediate depreciation of the rupee by 15%, which exceeds or overshoots the 10% depreciation of the Naira expected in the long run, according to Purchasing Power Parity (PPP) theory.

The monetary equilibrium for two countries is expressed as:

$M_{d1} = M_{S1}$

$M_{d2} = M_{S2}$

The subscripts 1 and 2 denote the two countries.

$M_{S1} = K_1P_1Y_1$

$M_{d2} = K_2P_2Y_2$

Empirically, Ibeto, Ezenekwe, Nzeribe, and Okeyika (2023) examined Nigeria's exchange rate determinants from 1986-2020. Both ARDL and VAR models were used for the analysis. The data was collected from the Nigeria Bureau of Statistics, the U.S Federal Reserve Bank and World Bank Development Indicators. This study confirmed that interest rate, oil price, relative inflation and trade openness are major drivers of exchange rates. Demand and supply shock variables change with exchange rates.

Abanikanda (2022) examined the effect of exchange rate changes on Nigeria's financial system from 1986-2018 using the ARDL approach. The study shows that exchange rate volatility reduces financial institutions' depth & efficiency in both the short and long run.

Osho and Efuntade (2019) examined the effect of exchange rate fluctuation on the performance evaluations of multinational companies in Nigeria. Data were tested using the OLS model. They confirmed that exchange rate fluctuation improves the performance of multinationals in Nigeria.

Williams (2018) explored the impact of exchange rate fluctuations on a firm's performance in Nigeria from 2012 to 2016. The study makes use of descriptive and OLS methodology. The study confirmed that exchange rate improves banks' performance.

Adegbemi (2018) studied how macroeconomic factors affected Nigeria's manufacturing sector output from 1981 to 2015. The study conducted a preliminary investigation using both stationarity tests and descriptive statistics. The results showed that interest rate, BMS, inflation rate, and exchange rate reduce manufacturing output.

Musembi (2018) examined the effect of foreign exchange on financial performance of 43 banks in Kenya. Using the descriptive research design, the study confirmed that exchange rates improve the ROA of Kenya banks. Similarly, Ugwu (2017) reported that exchange rate fluctuation improved Nigeria's manufacturing sector from 1986-2016.

Research Method

This study examined Nigeria's exchange rate determinants using the *Expost facto* research design. The study population and sample size are in Nigeria, considering that the variables under review are macroeconomic data. Hence, the census sampling technique was adopted. The study uses secondary quarterly time series data from 1986 to 2021, covering the overall flexible/managed float exchange rate regime. The major sources are the Central Bank of Nigeria Statistical Bulletin, the Nigerian Bureau of Statistics, World Bank Development Indicator, the Organization of Petroleum Exporting Countries, the U.S Federal Reserve Bank and other relevant literature (books, Journals, research papers and electronic sites). The study adopted the structural VAR model to estimate the responses of exchange rates. Other estimation techniques considered are Impulse Response Function and Variance Decomposition Test.

This study is anchored on the monetary approach of exchange rate determination. This is expressed as:

$Md_1 = MS_1$

$Md_2 = MS_2$

1 and 2 are the two countries.

$Md_1 = K_1P_1Y_1$

$MS_2 = K_2P_2Y_2$

Dividing equation (1) by (2), we get:

$M_{S1}/ M_{S2} = K_1P_1Y_1/ K_2P_2Y_2\ P_1/ P_2 = M_{S1}/ M_{S2}.\ K_2Y_2/\ K_1Y_1$

P_1/ P_2 = exchange (R) based on the PPP theory

$EXCR = M_{S1}/ M_{S2}.K_2Y_2/ K_1Y(3)$

By assuming the Ks to be constant, equation (3) can be re-written as:

Exchange rate (R) = f (relative BMOS, relative real ₦I) (4)

Other relevant variables were added to ensure the regression result is robust, given Nigeria's peculiarity. The re-modified model is stated as:

EXCR=f (BMOS, GOVX, OILF, TROP, INFR) (5)

The mathematical specification of the model is:

$EXCR = \beta_o + \beta_1 BMOS + \beta_2 GOVX + \beta_3 OILF + \beta_4 TROP + \beta_5 INFR$ (6)

Changing this to an econometric model by including the error term gives:

$EXCR = \beta_o + \beta_1 BMOS + \beta_2 GOVX + \beta_3 OILF + \beta_4 TROP + \beta_5 INFR + \mu$ (7)

Where;

EXCR = Exchange Rate

BMOS= Broad Money Supply

GOVX = Government Expenditure

OILF = Oil Price Fluctuation

TROP= Trade Openness

INFR= Inflation Rate

β_o = Constant/ Intercept

$\beta_1 - \beta_5$ = Partial slope coefficients

Econometrically, model 7 is restated as:

$$\Delta EXCR_t = \beta_o + \Sigma^p_{i=1}\beta_{1i}\Delta EXCR_{t-1} + \Sigma^q_{i=1}\beta_2\Delta BMOS_{t-1} + \Sigma^q_{i=1}\beta_2\Delta GOVX_{t-1} + \Sigma^q_{i=1}\beta_3\Delta OILF_{t-1} + \Sigma^q_{i=1}\beta_5\Delta TROP_{t-1} + \Sigma^q_{i=1}\beta_6\Delta INFR_{t-1} + u_t$$

Where;

b_{1i}, b_1-b_6 is the short-run dynamic coefficients of the model's adjustment to long-run equilibrium.

Table 2: Variable Measurement

S/N	Variable	Type of Variable	Measurement	Apriori Expectation
1.	Exchange Rate	Dependent	Naira to Dollar	Nil
2.	Broad Money Supply	Independent	Proportion of BMOS to GDP	Positive
3.	Government Expenditure	Independent	Volumes of Capital Expenditure	Negative
4.	Oil Price Fluctuation	Independent	Percentage Change in Oil Price	Positive
5.	Trade Openness	Independent	Sum of Import and Export to GDP, i.e. $\frac{Import+Export}{GDP}$	Negative
6.	Inflation Rate	Independent	Annual Consumer Price Index	Positive

Source: Authors' Compilation (2024)

Result and Discussion

Various preliminary tests were done before the main regression. Specifically, descriptive statistics were presented in this part of the study to assess the relationship between the explanatory variable (Macroeconomic Determinants) and the dependent variable (Exchange Rate Dynamics).

Table 3: Summary (Descriptive) Statistics

	EXCR	BMOS	GOVX	OILF	TROP	INFR
Mean	122.9967	16.00350	695.9191	12.34994	34.35777	19.44256
Median	123.1931	13.12265	468.3620	12.60535	34.32022	12.70721
Maximum	401.1520	24.89526	4645.000	28.70544	53.27796	72.83550
Minimum	1.754523	8.464230	6.372500	2.684290	9.135846	5.388008
Std. Dev.	109.2979	5.461235	883.3541	6.043141	10.69048	17.57477
Skewness	0.861062	0.332269	2.753347	0.395818	-0.322777	1.737863
Kurtosis	3.019887	1.447992	12.32607	2.908488	2.580779	4.700181
Jarque-Bera	4.449157	4.275512	175.9489	0.952594	0.888730	22.45693
Observations	**37**	**37**	**37**	**37**	**37**	**37**

Source: Authors' Computation (2024)

From Table 3, Exchange rate, denoted by EXCR; broad money supply, denoted by BMOS; government expenditure, denoted by GOVX; oil price fluctuation, denoted by OILF; trade openness, denoted by TROP and inflation rate, denoted by INFR have average/mean values of N122.9967/$1, 16.00350%, N695.9191 Billion, 12.35%, 34.36%, and 19.44% respectively but deviated by N109.30/$1, 5.46%, N883.35 billion, 6.043%, 10.69%, and 17.57477%. This indicates that most of the study variables clustered around their mean values.

Furthermore, the study reported maximum values of N401.15/$1, 24.90%, N4645 Billion, 28.71%, 53.28%, and 72.84% and a minimum value of N1.75/$1, 8.46%, N6.38 billion, 2.68%, 9.14%, and 5.39%

The correlation analysis, which is concerned with the linear relationship between dependent and regressor, is presented in Table 4:

Table 4: Correlation Analysis

	EXCR	BMOS	GOVX	OILF	TROP	INFR
EXCR	1.000000					
BMOS	-0.831580	1.000000				
GOVX	-0.822275	0.291476	1.000000			
OILF	0.558508	-0.165159	-0.193685	1.000000		
TROP	-0.170143	-0.188138	-0.223396	0.110511	1.000000	
INFR	0.378140	-0.335743	-0.291989	0.120328	-0.113403	1.000000

Source: Authors' Computation (2024)

The result of the pairwise correlations indicates that changes in the prices of crude oil and the inflation rate are positively related to exchange rate. Still, such a relationship is strong since their coefficient values are above 30% but not up to 70%. However, broad money supply,

government expenditure, and trade openness negatively relate to exchange rate. This implies that the wider the money supply, government expenditure, and trade openness, the higher the Nigerian currency appreciates.

Lastly, the overall correlation among the regressors fell below 0.7, signifying a negligible level of collinearity between the variables. The model was subjected to variance inflation factors to substantiate this claim further. The result reaffirmed that the model is devoid of multicollinearity problems.

Table 5: Multicollinearity test

Variables	Variance Inflation Factors	Tolerance Value	Conclusion
EXCR	3.6166	0.2765	No Multicollinearity Problem
BMOS	1.5801	0.6329	No Multicollinearity Problem
GOVX	1.8277	0.5471	No Multicollinearity Problem
OILF	4.0591	0.2464	No Multicollinearity Problem
TROP	1.0344	0.9667	No Multicollinearity Problem
Average	2.4236	0.5339	No Multicollinearity Problem

Source: Authors' Computation (2024)

Furthermore, the unit root test was done to determine the suitability of the variables for a time series regression. This test is necessary because most economic time series have proved empirically to be non-stationary. To achieve this, the Augmented Dickey-Fuller (ADF) test was adopted. The null hypothesis is that variables are non-stationary. As such, for the variables to be stationary, the t-statistics must be less than the critical value in absolute terms. The ADF test result is therefore presented in Table 5:

Table 5: Unit Root Test- ADF Test

At Level

Study Variables	ADF Test Statistic	MacKinnon Test Critical 5%	P-Value	Order of Integration	Conclusion
EXCR	-1.9124	-3.0124	0.3203	1(0)	Non-Stationary
BMOS	-2.5440	-3.0124	0.1200	1(0)	Non-Stationary
GOVX	-1.5819	-3.0124	0.4738	1(0)	Non-Stationary
OILF	-2.0236	-3.0124	0.2752	1(0)	Non-Stationary
TROP	-2.0653	-3.0124	0.2593	1(0)	Non-Stationary
INFR	-2.7665	-3.0124	0.0801	1(0)	Non-Stationary

At First Difference

Study Variables	ADF Test Statistic	MacKinnon Test Critical 5%	P-Value	Order of Integration	Conclusion
EXCR	-11.1117	-3.0207	0.0000	1(1)	Stationary
BMOS	-5.2856	-3.0300	0.0005	1(1)	Stationary

GOVX	-3.4895	-3.0207	0.0195	1(1)	Stationary
OILF	-6.0285	-3.0207	0.0001	1(1)	Stationary
TROP	-4.9505	-3.0207	0.0009	1(1)	Stationary
INFR	-4.9861	-3.0300	0.0009	1(1)	Stationary

Source: Authors' Computation (2024)

It is evident from the unit root test result in Table 5 that all the study variables did not attain stationary at their natural level of I(0). This is because, at their natural levels, their Augmented Dicker Fuller Test (ADF) Test Statistics were all lesser than their MacKinnon critical value at 5% significance level. More so, their p-values were greater than 5%. However, when subjected further (at first difference), they all became Stationarity as evidenced by the high ADF test statistics values, low MacKinnon critical value, and p-values all less than 5% level. Hence, we conclude that the variables attained Stationarity only at first differencing. This, therefore, rationalizes the need to conduct Johansen co-integration test.

Having established that all the study variables attained stationary at first differencing, the co-integration test is given thus in Table 6:

Table 6: Johansen Co-integration Test (Logged Form)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.999716	343.6910	95.75366	0.0000
At most 1 *	0.992613	180.3929	69.81889	0.0000
At most 2 *	0.930230	82.23108	47.85613	0.0000
Unrestricted Co-integration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.999716	163.2981	40.07757	0.0001
At most 1 *	0.992613	98.16181	33.87687	0.0000
At most 2 *	0.930230	53.25113	27.58434	0.0000

Source: Authors' Computation (2024)

The Johansen Julius co-integration test stated above clearly indicates at least three (3) co-integration equations. The result, therefore, confirms the existence of Co-integration among the variables. Consequently, the study affirmed that the exchange rate dynamic variables exhibit long-run relationships.

Although the interpretations of the Vector Autoregressive (VAR) estimates may not be meaningful because of the theoretical nature of this model, this study relied on the GAARCH, forecast error variance decompositions and impulse response functions as a basis of analysis as suggested by Sim (1980). More so, to ensure that our model was well-fitted, we first subjected the VAR Estimates to residual tests vis-à-vis VAR Autocorrelation test, VAR

Residual Serial Correlation LM Tests, and the White Test for Residual Heteroskedasticity, and VAR Stability Test. They are presented in table 7:

Table 7: VAR Residual Serial Correlation LM Tests

Lags	LM-Stat	Prob
1	16.73502	0.4029

Source: Authors' Computation (2024)

The VAR Residual Serial Correlation LM Test results, show that the null hypothesis of no serial autocorrelation in residuals cannot be rejected. This is because the p-value estimated at 0.4029 is higher than 5% significant level. Hence, we conclude that the model is free from Serial Auto-Correlation.

Table 8: VAR Autocorrelation Test

Lags	Q-Stat	Prob.	Adj Q-Stat	Prob.	df
1	27.84188	NA*	29.30724	NA*	NA*
2	156.1207	0.8442	200.2285	0.0928	25

*The test is only valid for lags larger than the VAR lag order.
df is degrees of freedom for (approximate) chi-square distribution

Source: Authors' Computation (2024)

Furthermore, the VAR Autocorrelation Tests show that the null hypothesis of no serial autocorrelation in residuals cannot be rejected. This is because the p-value estimated at 0.09928 is higher than 5% significant level. Hence, we conclude that the model is free from Serial Auto-Correlation.

Table 9: Other Diagnostic Tests

Models	**Heteroskedasticity Test**		**Ramsey RESET Test**		
	F-statistic	**Prob. Chi-Square**	**F-statistic**	**Probability**	**Conclusions**
One	0.575653	0.4161	0.127968	0.7298	Homoskedastic & Well-specified

Source: Researcher's Computation (2024)

The VAR Residual Heteroskedasticity Tests are illustrated in Table 9 with a p-value of 0.4161 and the Ramsey Reset Test with Prob. value of 0.7298 indicates that the variance of the disturbance term is constant (the null cannot be rejected). As such, the model may be devoid of Homoskedastic and well-specified. The result further revealed the residual series generated by VAR unrestricted equations.

Table 4.9: Roots of Characteristic Polynomial

Root	Modulus
0.659663 - 0.361505i	0.752224
0.659663 + 0.361505i	0.752224
0.541683 - 0.203366i	0.578600
0.541683 + 0.203366i	0.578600
-0.547612	0.547612

Source: Authors' Computation (2024)

The VAR stability condition check test shows that t the VAR satisfies the stability condition. To further substantiate this, the Inverse Root AR Characteristics Polynomial Test in Figure 1 reaffirmed that the VAR satisfies the stability condition.

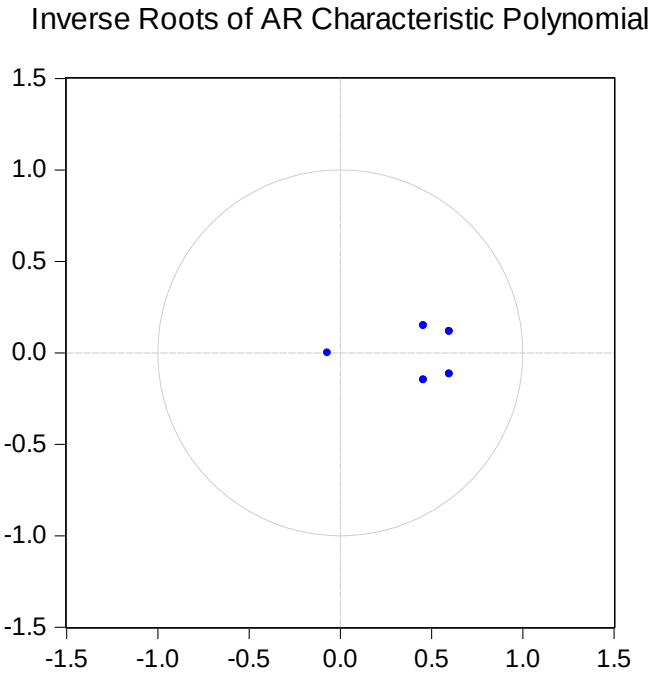

Figure 4.1 - Inverse Roots of AR Characteristic Polynomial
Source: Authors' Computation (2024)

Sequel to the above, our VAR Estimate is therefore discussed below:

Table 10: Vector Autoregressive Estimates
Dependent Variable: EXCR

	Coefficient	Std. Error	t-Statistic	Prob.
ECT(-1)	-0.647179	0.177007	-3.656236	0.0023
BMOS(-1)	0.491183	0.196147	2.504156	0.0235
GOVX(-1)	-0.809538	0.371360	-2.179929	0.0456
OILF(-1)	0.650021	0.169192	3.841917	0.0014
TROP(-1)	-0.003960	0.039832	-0.099415	0.9221

INFR(-1)	0.494313	0.171046	2.889941	0.0112
C	0.830847	0.163245	5.089585	0.0001
R-squared	0.848084	Adjusted R-squared		0.797446
		Durbin-Watson stat		2.100684
F-statistic	16.74779	Prob(F-statistic)		0.000011

Source: Authors' Computation (2024)

The error correction term for the model is -0.647179, which is statistically significant, less than 1, and negative. It implies that about .6472% of disequilibrium in exchange rate for the previous year is corrected in the current year. More so, the R-Squared with a value of 0.848084 evidenced that the model has a high predictive power such that a change in exchange rate is caused by the determinants considered to about 84.81% while the remaining 23.19%. The high adjusted R^2 value further reaffirms this. Again, the Prob. (F-statistic) value of 0.000011 reaffirmed that the model is highly statistically significant.

Furthermore, the VAR regression estimate in Table 10 revealed that past exchange rate (EXCR) values respond positively to an increase in innovation shock, and the response is statistically significant up to the second horizon. This further suggests that past exchange rate (EXCR) values increase the current exchange rate (EXCR). This result is in tandem with the findings of Ibeto, Ezenekwe, Nzeribe, and Okeyika (2023); & Abanikanda (2022) but deviated sharply from Adegbemi's (2018) findings.

Again, past values of broad money supply changes in crude oil prices conform to economic a-priori expectations in magnitude as it has a statistically significant impact on exchange rate; in terms of sign, it exerts a positive impact (depreciation) on exchange rates. The rationalization here is that more Nigerian currencies are outside the shores of the Nigerian banking industry, and as a result, BMOS reduces the value of the Nigerian currency.

Further, a high inflation rate reduces the value of the Nigerian currency. By implication, a higher inflation rate reduces the purchasing power of the domestic currency but increases the purchasing power of the foreign currency. This further confirmed that a higher inflation rate is more beneficial to the foreign country than the domestic one.

Nevertheless, past government expenditure and trade openness values conform to economic apriori expectations regarding negative signs but deviated from size (statistical significance) in that it was statistically insignificant. By implication, though the more the Nigerian business environment is opened to trade, the more the Naira appreciates it, the Nigerian economy is still not open enough to trade. This result is in tandem with the findings of Ibeto, Ezenekwe, Nzeribe, and Okeyika (2023); & Abanikanda (2022) but deviated sharply from (Adegbemi (2018) findings.

Variance Decomposition Result

Usually, the Variance decompositions separate the variation in an endogenous variable into some component shocks. Thus, it provides information about the relative importance of each random innovation. Here, the study considered the influence of broad money supply,

government expenditure, trade openness, and inflation rate on exchange rate in Nigeria. The result is reported in the table 11:

Table 11: Variance Decomposition Estimates for all Study Variables

Variance Decomposition of EXCR:

Period	S.E.	EXCR	BMOS	GOVX	OILF	TROP	INFR
1	0.805216	100.0000	0.000000	0.000000	0.000000	0.000000	0.000000
2	0.849765	90.54372	4.555880	2.013476	0.003086	2.794396	0.089441
3	0.886109	87.11744	4.579279	2.458344	0.190132	5.557061	0.097741
4	0.909750	83.15008	4.404449	2.598408	0.278717	9.166945	0.401397
5	0.929737	80.24173	4.313265	2.572169	0.508052	11.81469	0.550103
6	0.945414	77.70011	4.356771	2.518367	0.866030	13.83404	0.724681
7	0.957146	75.83941	4.535698	2.461713	1.194411	15.13361	0.835157
8	0.965563	74.52296	4.732685	2.418993	1.479735	15.92642	0.919214
9	0.971171	73.66891	4.918669	2.392727	1.691421	16.35862	0.969651
10	0.974708	73.14930	5.062535	2.379253	1.837240	16.57208	0.999592

Source: Authors' Computation (2024)

Percentage of the forecast error of EXCR indicates that, in the short run of period 1, 0.805216 (80.52%) of forecast variance in EXCR can be explained by itself, while in the long run of period 10, the percentage of the forecast error variance becomes 73.14930% revealing the Exchange Rate tends to dwindle as we further into the future. Exchange Rate is strongly endogenous. Lastly, strictly weak homogeneity exists among the exchange rate determinants, indicating negligible influence on Exchange Rate in Nigeria by 0.00%.

To clearly articulate the response function of each of the study variables, we therefore presented them in Figure 2:

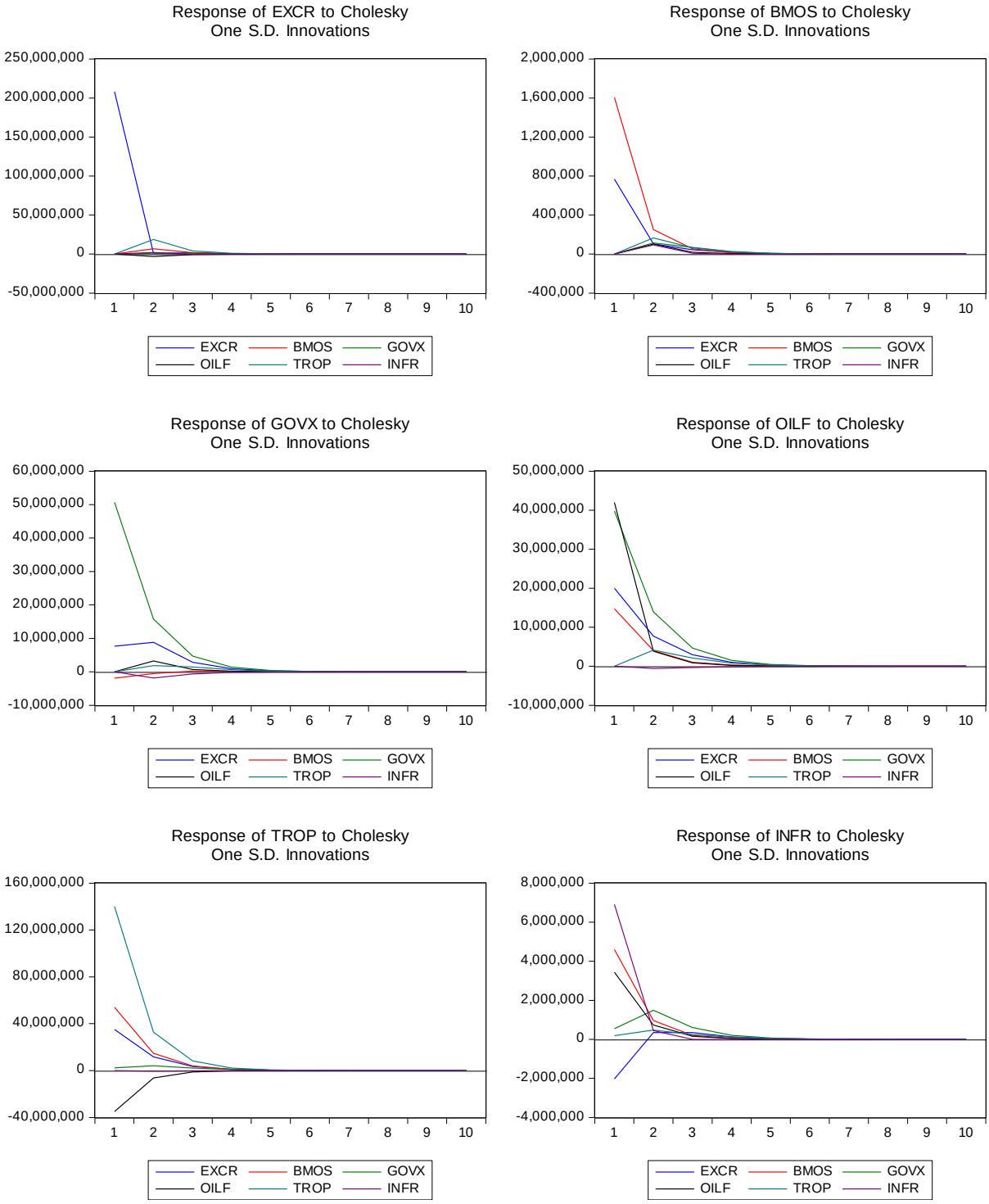

Figure 2: Impulse Response on Study Variables
Source: Authors' Computation (2024)

Figure 1 shows the time plot of the variables throughout the study using a 95% confidence interval. These responses are estimated based on the period of 10 days, which are robust enough to assess the full effects of exchange rate, broad money supply, government expenditure, oil price fluctuation, degree of trade openness, and inflation rate. Furthermore, Figure 4.2 evidenced that exchange rates respond speedily to broad money supply, government expenditure, oil price fluctuation, degree of trade openness, and inflation rate.

Conclusion

Arising from the various findings of this study, the study thus concludes that past values of broad money supply, government expenditure, changes in crude prices and inflation rates are major macroeconomic determinants of exchange rate in Nigeria. Again, exchange rates respond speedily to broad money supply, government expenditure, oil price fluctuation, degree of trade openness, and inflation rate. Arising from the major findings of this study alongside the conclusion reached, the following submissions were made:

1) Policymakers are to pay close attention to the rising rate at which more money is being made outside the shores of the Nigerian banking industry. This rationalizes the reason behind the high depreciating effect of the Nigerian currency.
2) The Nigerian government should ensure that more of its expenditures are allocated to capital expenditures than recurrent expenditures.
3) The Nigerian government should set up a board which fixes or pegs the prevailing price of petroleum products within the economy and then uses this fixed/pegged price as a benchmark to determine when excess oil revenues from exports go into the excess crude account and when it should be used to fund subsidies (instead of having a fixed subsidy as this is not sustainable in the long-run).
4) To ensure that the Nigerian currency does not continually depreciate, Nigerian policymakers should make all efforts to ensure that anti-inflationary policies are fully implemented.
5) The Nigerian government should ensure efforts are directed at improving the Nigerian business environment by reducing trade barriers.

Suggestions for Further Studies

1) This study only considered five macroeconomic exchange rate determinants. Since the state of the economy and interest rate differentials may be considered as other paramount factors that may cause the exchange rate to change, future researchers should add them to their exchange rate model.
2) Due to data availability, the study was limited to yearly data and confined to Nigeria. Hence, the study submits that subsequent research should use quarterly data and conduct country-by-country analysis.

Declaration of conflicting interest

The authors declare that there is no conflict of interest in this work.

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