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# Exchange Rate Volatility and Balance of Trade in Nigeria

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**Abstract**

The study examined exchange rate volatility and balance of trade in Nigeria from 1994Q1 – 2022Q4. The objectives of the study are to; determine the effects of dollar exchange rate, British Pound exchange rate and Euro exchange rate on Nigeria balance of trade. Data was collected from Central Bank of Nigeria statistical bulletin. The techniques adopted include; the unit root test, the Johansen cointegration, vector error correction model (VECM), and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to capture the volatility of exchange rates. The GARCH model result showed that, volatility exists in exchange rate from 1994Q1 to 2022Q4. The unit root test result showed that, all the variables were stationary at first difference. While the co-intregration test showed that, there is long run relationship between the independent and the dependent variables. Based on the VECM results, it was reported that; exchange rate volatility has short run positive effect on balance of trade. Also, the past value of balance of trade is significant at 5percent. Based on the findings, it was recommended amongst others that, monetary authorities should design effective exchange rate regime so to ensure exchange rate stability which has the capacity to improve the trade position of the country.

**Keywords:** Balance of Trade, Exchange Rate, GARCH, Heteroskedasticity, Volatility

## 1. Introduction

The subject of instability in exchange rate has generated serious discuss amongst public commentators since the collapsed of Bretton Woods fixed exchange rate regime in the early 1970s. Essentially, a statistical measure of an exchange rate's propensity to significantly increase or decrease over a brief period of time is called exchange rate volatility (Agbaez, Alamba & Ejelonu, 2023) [3]. On the other hand, balance of trade also known as trade balance is the difference between the monetary value of goods and services sold to other countries and that purchased from other countries (Merovci & Sekiraca, 2014) [13]. Thus, failure to properly manage the exchange rate induces distortions in the production patterns and excessive volatility in exchange rate creates uncertainty and risks for economic agents with destabilizing effects on the macro economy. Also, volatility can impact on trade by altering the relative prices of exports and imports, thereby affecting the trade balance (Aliyu, 2009) [4].

Since Nigeria`s independence in 1960 till date, Nigerian government has introduced various exchange rate regimes ranging from fixed exchange regime at par with the British pound and later the American dollar. However, the emergency of the Structural Adjustment Programme (SAP) in 1986 marked the beginning of exchange rate volatility in Nigeria (Aderemi, Ogunleye, Abalaba & Owolabi, 2020) [2]. Gone are those days when Nigerian currency was stronger than the American dollar. In 1985, $US1 was equivalent to 89 Kobo (CBN, 1985), as at December 2018, an American dollar was equal to 365 Naira. This implies that in the last 33 years the exchange rate in Nigeria has been depreciated by approximately 40,911% (Akinwolere, 2021) [5]. This scenario over the past 3 decades, has made the Nigerian government to made several attempts to restore the lost glory of the Nigerian currency, but reverse has always been the case.

Nevertheless, the existing research such as Ogun (2010) [15], Adegbite and Aderinto (2017) [1] and other scholars, emphasizes the influence of currency fluctuations on the competitiveness of exports and the expenses associated with imports. Therefore, the aim of this study is to fill these gaps by offering empirical observations on the fluctuations in exchange rates in the Nigerian economy. Therefore, the objectives of the study are to; determine the effects of naira exchange rate volatility in the terms of US Dollar, British Pound and Europe Euro on balance of trade in Nigeria.

## 2. Literature Review

### 2.1 Concept of Exchange Rate Volatility and Balance of trade

According to Kanu and Nwadiubu (2020) [12], exchange rate volatility refers to the tendency for foreign currencies to appreciate or depreciate, thus affecting the profitability of foreign exchange trades. Volatility is the measurement of the amount that these rate change and the frequency of such changes. There are many instances of exchange rate volatility, including business dealings between parties in two different countries and international investments.

According to Agbaeze, Alamba and Ejelonu (2023) [3] increase or decrease in real exchange rate indicates strength and weakness of currency in relation to foreign currency and it is a standard for illustrating the competitiveness of domestic industries in the world market. When there is deviation of this rate over a period of time from the benchmark, then there is exchange rate volatility. It also indicates that misalignment of exchange rate has occurred where there is multiplicity of markets parallel with the official market. Currency instability and volatility could only exist during flexible exchange rate regime where cross-country exchange rate is determined by the forces of demand and supply.

Balance of trade is the difference between the monetary value of goods and services sold to other countries and that purchased from other countries. Simply put, it is the difference between a country's exports and imports for a given period of time (Merovci & Sekiraca, 2014) [13]. The trade balance is the largest component in determining a country's current account. A trade surplus or positive trade balance occurs when the country's exports exceed its imports while a trade deficit or negative trade balance is when the reverse is the case.

### 2.2 The Purchasing Power Parity (PPP) Theory of Exchange Rate

The Purchasing Power Parity (PPP) expresses that, a unit of any given cash ought to have the capacity to purchase a similar amount of merchandise in all nations. Numerous market analysts trust that the PPP depicts the powers that decide trade rates over the long haul. Appropriately, the ostensible swapping scale between the coinages of two nations must mirror the diverse costs level in those nations. PPP, which forms a strong building block of the theory of exchange rate determination, maintains that there exists a proportional relationship between the exchange rate of the currencies of two countries and their relative inflation rates. The PPP theory can be formulated in two forms: in absolute forms. The absolute form of PPP asserts that the equilibrium exchange rate equalizes the general purchasing power of a given income in terms of relative price levels. It thus, relates the level of exchange rate to relative prices levels. The relative form argues that changes in exchange rate measured from a base period reflect changes in relative price levels.

The theoretical basis of the study is the PPP theory. This is because, it dealt with the problem of exchange rate variation which is an important explanatory variable used in the study to determine balanced of trade in Nigeria. Thus, the domestic currency must be strong in relation to the foreign currency for favourable trade which in turn serves as a necessity to achieving a target rate of growth.

### 2.3 Empirical Review of Exchange Rate Volatility and Balance of Trade

Mutiu and Oyedepo (2023) [14] assessed the symmetric and asymmetric effects of exchange rate volatility on trade flows in Nigeria. The study employs quarterly data that covers the period of 1995Q1 to 2020Q4. The paper applies both linear ARDL and non-linear ARDL (NARDL) models. The results from linear ARDL model showed that, exchange rate volatility has only significant short-run effect on export while it has both short-run and long run effects on the imports. The findings from the non-linear ARDL suggest that exchange rate volatility has neither short run nor long run asymmetric effects on exports. However, the non-linear ARDL model reveals short run and long run asymmetric effects of exchange rate volatility on imports.

Gbaka, Abachi, Obute, Kpoghul and Sokpo (2023) [11] investigated the impact of the persistent exchange rate volatility on trade flows in Nigeria, for the period of 1970-202 using Two Stage Least Squares method. Result of the trade flows equation confirms a negative and insignificant impact of exchange rate volatility on trade flows in Nigeria. Further findings from the EGARCH model indicated that, exchange rate volatility in Nigeria has been high, persistent and asymmetric with positive leverage and high clustering effect over the study period.

Oyegun (2022) [16] explored the relationship between exchange rate volatility and trade balance in Nigeria using annual time series from 1981 to 2020. Exchange rate volatility was measured using GARCH (1,1) variance series derived from the real effective exchange series. Error correction models were adopted for the analyses and estimated by the ordinary least squares technique. The findings revealed that exchange rate volatility positively impacts on the balance of trade account, imports and exports in Nigeria with about a very close magnitude. In addition, inflation was very responsive in reducing trade account balance, imports and exports. Although it reduced exports more than it reduced imports. On the other hand, interest rate did not impact on balance of trade and imports but showed a positive impact on exports in Nigeria.

Xu, Bahmani-Oskooee and Karamelikli (2022) [17] investigate the asymmetric effects of exchange rate uncertainty on China's bilateral trade with its trading partners. The results show more evidence supporting the asymmetric effects of exchange rate volatility on China's bilateral trade with most trading partners. Also, Bahmani-Oskooee and Harvey (2021) [7] examined the symmetric or asymmetric effects of exchange rate volatility on commodity trade between the US and Mexico considering 95 exporting and 89 importing industries. The findings show evidence of asymmetric effects in majority of the exporting and importing industries.

Bahmani-Oskooee & Baek (2021) [6] evaluates the asymmetric effects of exchange rate volatility on trade flows for the Korea- U.S commodity trade. They find significant long-run asymmetric effects of exchange rate volatility in Korea and the U.S exporting and importing industries. Similarly, Bahmani-Oskooee and Saha (2021) [8] examine the asymmetric effects of exchange rate volatility on trade flows between India and each of its 14 trading partners. The findings indicate that the asymmetric effects of exchange rate volatility are partner specific. Generally, the results

suggest that increase in exchange rate volatility has significant effects on export and imports but decrease in volatility has no effects.

Also, Chien, Setyowati and Cheng (2020) [9] examine the asymmetric effects of exchange rate volatility on bilateral trade flows between Taiwan and Indonesia for 19 export and import industries. The findings reveal that the long run asymmetric effects of exchange rate volatility has much higher impacts on Taiwan export to Indonesia than imports from Indonesia. However, the short run asymmetric effects cause unstable change on exports and imports industries.

Aderemi, Ogunleye, Abalaba and Owolabi (2020) [2] examined the effect of exchange rate volatility on trade balance in Nigeria using ARDL model. It was discovered from the study that exchange rate volatility has a significant negative impact on Nigerian exports. This negative impact could be attributable to the lack of competitiveness of locally made products in the world market. However, there is a positive relationship between exchange rate volatility and import, though this is not consistent with economic theory. This result could be linked with the overdependence of the country on foreign goods. Therefore, exchange rate volatility has a negative impact on trade balance in Nigeria.

Dickson and Ukavwe (2013) [10] applied the error correction and GARCH model to investigate the impact of exchange rate fluctuations on trade volatility in Nigeria, using annual time series data from 1970 to 2010. The study found that exchange rate volatility does not significantly explain volatility in import, but was found to be statistically significant and positive in accounting for volatility in export.

## 3. Methodology

Quarterly time series data on the subject matter covering the study period of 1994 to 2022 was collected from Statistical Bulletin and Statement of Accounts of the Central Bank of Nigeria as well as the annual abstracts of statistics (various issues) published by the National Bureau of Statistics (NBS). The techniques adopted include; the unit root test, to ascertain the stationarity of the variables; the Johansen cointegration test to ascertain the long run equilibrium relationship amongst the variables; vector error correction model (VECM) to determine the short run relationship between the dependent and independent variables; and Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model to capture the volatility of exchange rates.

### 3.1 Model Specification

The model is proposed with intention to applying vector auto regressive VECM and GARCH methodological framework. The study examined exchange rate in US dollar, British Pound and Euro as the independent variables and balance of trade as dependent variable. Therefore, the vector auto regressive model to analyse the dynamic interaction between the independent and dependent variables are accordingly specified based on the structural model below:

$$BOT = f(USD, PSD, Euro) \quad (1)$$

$$BOTT = a_0 + a_1USD + a_2PSD + a_3Euro + u \quad (2)$$

Where;

BOT= Export, USD= Naira-Dollar Exchange Rate, PSD= Naira-Pound Starlings Exchange Rate, Euro= Naira-Euro Exchange Rate, $a_0$ = Constant/Intercept parameters, $a_1$-$a_3$= Slope parameters, U=Error Term

### 3.2 Model Specification Based on VECM

$$\Delta BOT_t = \alpha_1 + \sum_{i=1}^{p} \beta_{11}\Delta BOT_{t-1} + \beta_{12}\Delta USD_t + \sum_{i=1}^{p} \beta_{12}\Delta USD_{t-1} + \beta_{13}\Delta PSD_t + \sum_{i=1}^{p} \beta_{13}\Delta PSD_{t-1} + \beta_{14}\Delta Euro_t + \sum_{i=1}^{p} \beta_{14}\Delta Euro_{t-1} + \varepsilon_{1t} \quad (3)$$

## 4. Results and Discussion

**Table 1:** GARCH (1,1) Result for the Estimated Model

| Variable | Coefficient | Std. Error | z-Statistic | Prob. |
|---|---|---|---|---|
| LOG(USD) | -272360.6 | 610660.9 | -0.446010 | 0.0455 |
| LOG(PSD) | 2137386. | 593814.8 | 3.599415 | 0.0003 |
| LOG(EURO) | -2024812. | 862506.6 | -2.347590 | 0.0189 |
| Variance Equation | | | | |
| C | 5.66E+11 | 4.59E+11 | 1.234900 | 0.0216 |
| RESID(-1)^2 | 0.353636 | 0.329619 | 1.072863 | 0.0283 |
| GARCH(-1) | 0.130657 | 0.710137 | 0.183988 | 0.0454 |
| R-squared | 0.695035 | Durbin-Watson stat | | 1.321266 |
| Adjusted R-squared | 0.679018 | Akaike info criterion | | 30.44437 |

**Source:** Researcher's Computation from E- view 10

From Table 1, the variance equation showed the presence of GARCH effect since all the GARCH parameter is significant and in the mean equation, the GARCH parameter is also significant as depicted by the probability value of 0.045 which is lower than 0.05 (5percent level of significance). This showed that, volatility exists in exchange rate from 1994Q1 to 2022Q4. From the variance equations above, exchange rate volatility was extracted.

**Table 2:** Results of ADF Unit Root Test for the Estimated Model

| Variables | Unit Root Test @ Level | | Unit Root Test @ First difference | | Order of integration |
|---|---|---|---|---|---|
| | ADF Statistics | 5%Critical Value | ADF Statistics | 5% Critical Value | |
| BOT | -2.035788 | -2.886959 | -10.58303 | -2.886959 | I(1) |
| USD | 0.410284 | -2.886959 | -11.29058 | -2.886959 | 1(1) |
| PSD | 0.321206 | -2.886959 | -11.24594 | -2.886959 | 1(1) |
| Euro | -0.009164 | -2.886959 | -11.15440 | -2.886959 | 1(1) |

**Source:** Researcher's Computation from E- view 10

The result of the unit root test in Table 2 showed that none of the variables was stationary at level as a result of the fact that, the ADF statistic value is less than the critical value at 5percent. However, the non-stationary variables were differenced once and became stationary at first differences; 1(1). Given that all the variables were integrated of order one, the study conducted the Johansen co-integration test to determine the long run relationship amongst the variables in the estimated model.

**Table 3:** Johansen Co-integration Test Result for the Estimated Model

| Hypothesized No. of CE(s) | Eigen Value | Trace Statistic | 0.05 Critical Value | Prob.** |
|---|---|---|---|---|
| None * | 0.220478 | 52.24891 | 47.85613 | 0.0183 |
| At most 1 | 0.146109 | 24.85070 | 29.79707 | 0.1669 |
| At most 2 | 0.054041 | 7.476056 | 15.49471 | 0.5230 |
| At most 3 | 0.012331 | 1.364854 | 3.841466 | 0.2427 |

**Source:** Researcher's Computation from E- view 10

The result of the Johansen co-integration test for the estimated BOT model as presented on Table 3 indicated that, there exists one (1) co-integrating equations in the trace statistic test. This implies that the variables are co-integrated (i.e they adjust to short run dynamics and long run equilibrium). In other words, there is existence of a long-run equilibrium relationship among balance of trade (BOT), US dollar exchange rate (UDS), British Pound exchange rate (PSD) and European Euro exchange rate (Euro) at 5% significance level. Since the series are co-integrated, then, the balance of trade model was estimated using the unrestricted VAR model approach.

**Table 4:** Vector Error Correction Model Estimates for the Model

| Variable | D(BOT) | D(LOG(USD) | D(LOG(PSD) | D(LOG(EURO) |
|---|---|---|---|---|
| ECM(-1) | -0.004140 | -4.26E-09 | -1.56E-10 | -1.13E-10 |
| | (0.00668) | (9.6E-10) | (4.7E-10) | (5.4E-10) |
| D(BOT(-1) | 0.001871 | 6.53E-10 | -6.91E-10 | -9.69E-10 |
| | (0.04951) | (1.4E-08) | (7.0E-09) | (8.0E-09) |
| D(LOG(USD(-1) | 62353.85 | 0.057351 | -0.001761 | -0.003795 |
| | (0.01109.) | (0.11548) | (0.05638) | (0.06425) |
| D(LOG(PSD(-1) | -72382.65 | -0.081717 | -0.007008 | -0.007716 |
| | (2405111) | (0.34671) | (0.16925) | (0.19290) |
| D(LOG(EURO(-1) | 43151.97 | -0.045804 | -0.052332 | -0.071069 |
| | (2006641) | (0.28927) | (0.14121) | (0.16094) |
| C | -208.3223 | 0.026623 | 0.016037 | 0.021480 |
| | (87362.2) | (0.01259) | (0.00615) | (0.00701) |
| R-squared | 0.603543 | 0.156187 | 0.005901 | 0.007133 |
| Adj. R-squared | 0.542590 | 0.117121 | -0.040122 | -0.038833 |
| F-statistic | 0.046796 | 3.998074 | 0.128219 | 0.155179 |

**Source:** Researcher's Computation from E- view 10

The essence of the VECM is to test for the effect or impact of the independent variables on the dependent variable. Based on the estimated VECM result on Table 4, the coefficient of the ECM(-1) appeared with the correct sign (negative) and significant at 5percent level of significant. Thus, the past disequilibrium or equilibrium will adjust to long run equilibrium at a speed of about 0.414percent. Similarly, the adjusted R-Squared value of about 54percent showed that the estimated balance of trade model is good fit. Thus, the variation in the balance of trade explained by exchange rate in terms of the US dollar, British Pound and European Euro is 54%.

Meanwhile, in order to validate the short run estimated VECM model, it is expected that, the past value of the dependent variable (BOT) must be significant. Thus, based on the result on the table above, the coefficient of the past value of BOT is significant at 5percent. This implies that, the past value of BOT has feedback effect on its self, which is a robustness test and desirable condition to validate the genuity of the estimated equation.

Based on the coefficient of the independent variable, lag one value of exchange rate in term of US Dollar (USD) has positive sign and significant impact on BOT at 5percent significant level. This implies that, the variable USD has significant positive feedback on balance of trade (BOT) in Nigeria during the period of study. Thus, exchange rate in terms of the US dollar has the tendency to sustained positive balance of trade in Nigeria during the period of study.

The lag one value of exchange rate in term of British pound sterling (PSD) has negative sign and statistically not significant at 5percent significant level. This implies that, the variable PSD do not have endogenous impact on balance of trade (BOT) in Nigeria during the period of study. Thus, exchange rate in terms of British pound sterling is not a good predictor of balance of trade, meaning that it has no tendency to sustained positive balance of trade in Nigeria during the period of study.

Moreover, based on the coefficient of the independent variable in the estimated model, lag one value of exchange rate in term of Euro has positive sign but not significant at 5percent significant level. This implies that, the variable Euro exchange rate has positive feedback on balance of trade (BOT) in Nigeria during the period of study. Thus, Euro exchange rate has the tendency to sustained positive balance of trade in Nigeria during the period of study.

**Table 5:** Normality Test Results for the Estimated Model

| Test Stat. | Value | Df | P-Value | Critical Value |
|---|---|---|---|---|
| Jarque-Bera | 0.07042 | (107) | 0.7907 | 0.05 |
| Chi-Square | 400.6023 | (107) | 0.3000 | 0.05 |

**Source:** Researcher's Computation from E- view 10

The normality test result in Table 5 showed that the error term is normally distributed at the 5% level of significance. This is because the probability value of the Jarque-Bera statistic in model one, model two and model three respectively are 0.7907, and this value is greater than the critical value of 5%. Meaning that, the Jarque-Bera statistic hypothesis of normally distributed residuals in the model is accepted.

**Table 6:** Stability Test Result- Ramsey Test for the Estimated Model

| Test Stat. | Value | Df | P-Value | Critical Value |
|---|---|---|---|---|
| F-Statistic | 0.854621 | (107) | 0.3573 | 0.05 |
| t-Statistic | 0.924457 | (107) | 0.3573 | 0.05 |

**Source:** Researcher's Computation from E- view 10

Ramsey reset test was carried out by regressing the forecast value of the dependent variable on the independent variables and then testing the joint significance of the coefficients on the independent variable. If these are significant, the linear model is wrongly specified. Therefore, the null hypothesis is given as; **H=0;** it therefore, means that, the powers of the fitted values has no relationship to explain the dependent variable, meaning that the model has no omitted variables. The alternative hypothesis is that, the model is suffering from an omitted variable problem.

Given the result of the Ramsey test on Table 6, the three estimated model was correctly specified since the null hypothesis of each of the estimated model is accepted at 5percent level of significance. Specifically, in the BOT model, the f-value of 0.8546 and the corresponding probability value of 0.3573 is greater than the critical value at 5%, meaning that, the null (HO) hypothesis, which states that, the powers of the fitted values have no relationship was accepted.

## 5. Conclusion and Recommendations

The study examined exchange rate volatility and balance of trade in Nigeria from 1994Q1 – 2022Q4. The specific objectives of the study are to; determine the effects of naira exchange rate volatility in the terms of US Dollar, British Pound and Europe Euro on balance of trade in Nigeria. Secondary data was collected through Central Bank of Nigeria Statistical Bulletin and the techniques adopted include; the unit root test to test the stationarity of the time series and followed by the test for cointegration to check whether or not the underlying variables have long run relationship. But the main technique of analysis is the vector error correction model (VECM), Similarly, GARCH (1, 1) (Generalized Autoregressive Conditional Heteroskedasticity) model was also used to capture the volatility of exchange rates. Based on the estimation techniques, it was reported that, there is long run association between the three exchange rate variables and the balance of trade. The short run vector error correction model showed that, the past value of balance of trade (BOT) is significant at 5percent. Also, the coefficient of the lag one value of exchange rate in term of US Dollar (USD) has positive sign and significant impact on balance of trade at 5percent significant level, meaning that, the variable USD has significant positive feedback on balance of trade (BOT) in Nigeria during the period of study. Therefore, exchange rate in terms of the US dollar has the tendency to sustained positive balance of trade in Nigeria during the period of study. The lag one value of exchange rate in term of British pound sterling (PSD) has negative sign and statistically not significant. Meaning that, the variable PSD do not have endogenous impact on balance of trade in Nigeria during the period of study. The lag one value of exchange rate in term of Euro has positive sign but not significant at 5percent significant level. Thus, Euro exchange rate has the tendency to sustained positive balance of trade in Nigeria during the period of study.

Given the findings, the following recommendation should be put in place by the government to ensure the stability of the exchange rate system: The study recommends the exchange rate and trade policies that will promote greater exchange rate stability and trade conditions that will promote domestic production in the economy. This we believe will enhance non-oil exports and reduce importation. The Nigerian government should look into reasons why there is persistent increase in petroleum prices and find solution to these problems in order to maintain price stability as consumption continues to increase. Therefore, all stakeholders must be duly considered.

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