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Exchange Rate Volatility and Its Significant Impact on Nigeria's Non-Oil Exports and Economic Growth Prospects (1990-2024)

Dungrit Peter Gelle[1,*], Toryila Raphael Orshio[1], Ibrahim Victor Janar[2], Dan-Sozon Musa[2]

[1]Department of Economics, Federal University of Lafia, Lafia, Nasarawa, Nigeria

[2]Nigeria and College of Education Zing, Zing, Taraba State, Nigeria

[*]Corresponding author: Dungrit Peter Gelle, Pgelle889@gmail.com

Abstract

This study examines the effect of exchange rate volatility on non-oil export performance in Nigeria using annual data covering the period 1990 to 2024, obtained from the Central Bank of Nigeria (CBN) statistical bulletin. The Autoregressive Conditional Heteroskedasticity (ARCH) and Generalized ARCH (GARCH) models were employed, given their suitability for analyzing high-frequency and volatile macroeconomic series such as exchange rate, interest rate, and inflation rate. In the models, exchange rate, interest rate, and inflation rate were specified as independent variables, while food crop exports, cash crop exports, and solid mineral exports served as dependent variables, enabling a sectoral assessment of non-oil export performance. The empirical results indicate a positive and significant relationship between exchange rate movements and non-oil exports, confirming that volatility in the exchange rate plays a substantial role in shaping Nigeria's export outcomes. The findings underscore the need for targeted policy interventions. It is recommended that the government intensify revenue diversification efforts to enhance the capacity of the non-oil sector, while the monetary authorities focus on ensuring exchange rate stability to curb inflationary pressures that can undermine export growth and competitiveness.

Keywords

Exchange Rate Volatility, Non-Oil Exports, Food Crop Exports, Cash Crop Exports, Solid Mineral Exports, ARCH-GARCH Model, Inflation, Interest Rate, Nigeria

1. Introduction

Exchange rate plays a pivotal role in shaping the economic landscape of any nation, particularly the developing economies like Nigeria, where non-oil exports hold significant potential for diversifying the economy and reducing dependency on oil revenue. Nigeria, as one of the largest economies in Africa, faces both challenges and opportunities in its efforts to promote non-oil exports amidst fluctuating exchange rates. Thus, the relationship between exchange rate policy and the performance of non-oil exports has been a subject of extensive debate and analysis in economic literature [1].

Nigeria, endowed with abundant natural resources, has historically relied heavily on its oil exports to drive economic growth and development. However, the volatility of oil prices in the global market has exposed the vulnerability of this reliance, leading policymakers to seek alternative avenues for economic expansion. Non-oil exports present a promising prospect for diversification, offering opportunities for sustainable growth, employment generation, and enhanced resilience against external shock. Prior to the 1970s, agricultural exports were Nigeria's main sources of foreign exchange. During this period, Nigeria was a significant exporter of various commodities such as cocoa, cotton, palm oil, palm kernel, groundnuts, and rubber. In the 1950s and 1960s, the agricultural sector achieved annual output growth rates of 3% to 4% for food crops.

Additionally, non-oil exports like tin ore, columbite, and cattle hides and skins held substantial value, constituting approximately 66% of total exports until the early 1970s agricultural exports in total exports dropped dramatically from about 43% to slightly over 7%. Subsequently, from the mid-1970s onwards, the average annual growth rate of agricultural exports declined by 17%. This decline was primarily attributed by Olaleru (2019) to the positive oil price shocks of 1973-1974 and 1979, which led to substantial foreign exchange inflows from oil and a consequent neglect of the agricultural sector. Exchange rate policy, encompassing the determination of the exchange rate regime and interventions by monetary authorities, holds significant implications for the competitiveness of non-oil exports [2]. The choice between fixed, flexible, or managed exchange rate regimes, along with the frequency and magnitude of interventions in the foreign exchange market, can profoundly impact export performance.

According to World Economic Forum (2021), a stable and competitive exchange rate is crucial for fostering a conducive environment for non-oil exporters, as it affects the relative prices of exports and imports, thereby influencing the competitiveness of domestically produced goods in international markets. However, the effectiveness of exchange rate policies in promoting non-oil exports is contingent upon various factors, including the macroeconomic environment, trade policies, institutional frameworks, and structural constraints. Moreover, the interplay between exchange rate dynamics and export performance is complex, influenced by both domestic and external factors.

Exchange rate management is very important, especially for developing countries like Nigeria. This is shown by the various systems the Nigerian government and the central bank have used to control the local currency. In the 1970s, the country moved from a fixed exchange rate system to a pegged system, which continued until 1986. In 1986, as part of the conditions for joining the Structural Adjustment Programme, the Nigerian government allowed the foreign exchange market to operate more freely. This meant the currency's value was no longer fixed, but instead determined by the forces of supply and demand in the market.

With the introduction of the system, the exchange rate fell from 0.89 naira to the dollar in 1985 to 2.02 naira to the dollar in 1986. Since then, the exchange rate has been very volatile. Due to the poor performance of the floating exchange rate system and other reasons, the Independent Foreign Exchange Market (AFEM) was established in 1995 to help maintain exchange rate stability. When the AFEM was launched in 1995, the exchange rate was stable at 21.88 naira to the dollar.[3] This stability lasted until the launch of the Interbank Foreign Exchange Market (IFEM) in 1999. This change caused the exchange rate to fluctuate greatly, falling from 21.88 naira to the dollar to 92.69 naira to the dollar. In 2000, the exchange rate fell further to 102 naira to the dollar. The naira exchange rate against the dollar continued to fluctuate, falling from 132 naira to the dollar to 128 naira to the dollar between 2005 and 2006. In 2002, the Dutch auction system (DAS) was reinstated. This move aimed to help conserve foreign exchange reserves, reduce premiums in parallel markets, and make the naira's exchange rate more reasonable. However, these efforts were unsuccessful, and the naira's exchange rate remained volatile during this period.

In 2006, the Central Bank of Nigeria launched the Wholesale Dutch Auction System (WDAS) to increase the openness of the foreign exchange market and narrow the gap between the official and black market rates. However, in 2013, the system was transformed into the Retail Dutch Auction System (RDAS). RDAS aims to make it easier for ordinary citizens to obtain foreign exchange directly from the central bank through commercial banks.

When there is a shortage of foreign exchange in the market, its price rises sharply, just like any other commodity. This rise affects other important economic factors, especially for non-oil exporters. Furthermore, exchange rate volatility makes it more difficult for Nigerian exporters to manage their export operations. This is because many of the raw materials and technologies needed to produce export products rely on imports, and these costs are often high and unpredictable. Against this backdrop, this study explores how exchange rate policy affects Nigeria's non-oil exports.

At independence in 1960, non - oil exports accounted for well over half of the Nigerian Gross Domestic Product (GDP) as well as the major source of export earnings. The Nigeria’s wide range of climate variations allows it to produce a variety of food and cash crops as well hub for mineral deposits. The staple food crops include cassava, yams, corn, coco-yams, cowpeas, beans, sweet potatoes, millet, plantains, bananas, rice, sorghum and varieties of fruits and vegetables. The leading cash crops are cocoa, citrus, cotton, groundnuts, palm oil, benniseed and rubber.

The leading mineral deposit includes gold and lithium among others. They were also, Nigeria’s major exports in 1960s and 1970s until petroleum surpassed them in the 1970s. Chief among the export destinations for Nigerian non -oil exports are Britain, the United States, Canada, France and Germany [4].

However, with the discovering oil and the consequent oil boom, the contribution of non-oil export earning has not only declined drastically but Nigeria which was net exporter non-oil goods becomes the major importers of these goods. This has made the Nigerian economy vulnerable to external shocks and fluctuations in exchange rate. Since the discovery and commercial export of crude oil in the late 1970s, Nigeria's economy has been a monoculture economy reliant on oil as its primary source of foreign exchange earnings. Subsequently, this has led to volatility in the exchange rate and several policies to maintain a stable exchange rate. For instance, from 2019-2020 the Central Bank of Nigeria (CBN) implemented managed float exchange rate system by intervening regularly in the foreign exchange market to stabilize the naira. Therefore, the official exchange rate in 2019 stood at ₦360 per USD and dropped to about ₦380 per USD by 2020 due to the impact of the COVID-19 pandemic.

Again, 2021-2022 CBN implemented a more flexible exchange rate regime to converge the official and parallel market rates. This policy shift was part of broader efforts to attract foreign investment and improve transparency in the forex market. Despite these measures, the naira depreciated significantly, with the official rate moving from ₦381 per USD in 2021 to about ₦454 per USD in 2022. The parallel market rate saw even sharper declines due to persistent dollar shortages and speculative activities. Furthermore, in June 2023, CBN implemented a major devaluation of the naira, shifting the official exchange rate from ₦463 to ₦623 per USD as part of strategies to unify the multiple exchange rates and curb the widespread currency speculation. However, the naira continued to weaken, trading between ₦800 and ₦1,000 per USD in the latter half of 2023 [5].

Despite the severity of the situation, most existing studies such as those by Okorontah & Ossai (2020), Aina & Adekunle (2021), Adegboye & Fapohunda (2023), and Emeh & Ndubuisi (2023) have primarily focused on analyzing exchange rate volatility and interventions by the Central Bank of Nigeria (CBN). However, these studies often overlook the crucial link between exchange rate fluctuations and the performance of non-oil exports in Nigeria.

The study aims to investigate the impact of exchange rate dynamics on Nigeria's export performance by specifically examining how exchange rate volatility influences food crop exports, assessing its effect on cash crop exports, and evaluating the relationship between exchange rate movements and solid mineral exports.

2. Literature Review

Exchange rate is the price at which a unit of country's currency is exchanged for another country's currency at any point in time. The exchange rate is one of the most critical prices in any economy that participates in international trade and investment flows. Exchange rate represents the relative value of one currency in terms of another currency. The price at which the Nigerian N1 is exchanged for $1 is exchange rate. Hausmann & Hidalgo (2021) states that exchange rate policies are fundamental to the economic strategy of any country engaged in international trade and investment. These policies influence how a country's currency is valued in comparison to other currencies, thereby affecting the cost of imports and exports, the balance of payments, inflation rates, and overall economic stability.

Non-oil exports serve as the lifeblood of many economies, constituting a pivotal component in diversifying revenue streams and reducing dependence on volatile commodity markets. This concept embodies the notion of exporting goods and services excluding those derived from petroleum or its by-products. In essence, it represents a strategic shift towards fostering sustainable economic growth and development. Non-oil exports refers to the essence of economic resilience and sustainability, steering countries away from overreliance on volatile commodities such as oil and mitigating the adverse impacts of price fluctuations in global markets. Hartley & Zou (2021) stated that non-oil exports encompass a wide array of goods and services traded internationally, excluding petroleum-based products, and encompassing everything from agricultural produce to manufactured goods, technological innovations, and specialized services [6].

2.1 Theoretical Framework

This study is anchored on Export-Led Growth Model (ELG). This is found most appropriate because it postulates the relationship between exchange rate policy and non-oil exports. It also, advocates for promoting non -oil industries that produce goods for export which is the key driver of economic growth. Similarly, it posits that increasing the volume of non-oil exports can increase a country's advantages in international trade. Thus, it highlights the significance of international trade as a primary engine for growth, leveraging comparative advantages, increasing market size, and stabilizing exchange rate. Key postulations of the ELG model include the enhancement of productivity through exposure to international markets, the attraction of foreign investments via well managed exchange rate and the stimulation of technological advancement due to increased competition and innovation.

In the context of Nigeria, the application of the ELG model is particularly pertinent given the country's historical reliance on oil exports. To diversify its economy, Nigeria has been aiming to boost its non-oil exports. A critical aspect of this strategy involves an exchange rate policy, which directly influences the competitiveness of non-oil exports. An effective exchange rate policy can enhance the international competitiveness of a country's non -oil exports by making them relatively cheaper in the global market. For Nigeria, a competitive and stable exchange rate is essential to reduce the cost of non-oil exports, thereby making them more attractive to foreign buyers.

2.2 Empirical Literature

Ebenezer and Toluwalope (2025) did a study on how exchange rates affect industrial output in Nigeria, with a focus on different sectors. They looked at how changes in the interbank and effective exchange rates influence output in various manufacturing sub-sectors. They used the eGARCH (1,1) model to study volatility using monthly data from 2010 to 2023, and ARDL estimation with quarterly data from 2010 Q1 to 2023 Q4. Their findings show that volatility in the interbank rate has a stronger impact than volatility in the effective rate. In the short term, interbank rate volatility hurts the textile, electronics, and wood products sectors, while effective rate volatility negatively affects textiles, chemicals, and oil refining [7]. However, in the long run, interbank rate volatility helps boost oil refining and vehicle assembly, and also supports output in electrical and electronics, textiles, and vehicle assembly. The study suggests that policies should be designed specifically for each sector to address how volatility affects them differently. They also point out that their analysis ends just as major currency reforms (2024-2025) start, and they didn't consider how these changes might interact with the performance of non-oil exports more broadly.

Fausat et al. (2024) published a study titled "Exchange Rate Volatility and Manufacturing Exports in Nigeria: 1986-2020." The main goal was to look at how exchange rate fluctuations affect manufacturing exports. They used EGARCH to measure volatility and VECM to analyze its effects. The findings showed that exchange rate volatility has a short-term positive impact on manufacturing exports, but inflation has a long-term negative effect. The researchers suggest improving loan services and infrastructure for manufacturing exporters. However, there's still a lack of understanding about the impact of the FX reforms from 2021 to 2025 [8].

Sekyen, Kumshin, and Bakle (2024) conducted a study examining the relationship between exchange rate volatility and manufacturing exports in Nigeria. They used quarterly data up to 2021 and applied an ARDL model to assess both short-term and long-term impacts of exchange rate fluctuations on manufacturing exports. Their findings indicate a positive and statistically significant long-term effect. The researchers suggest implementing policies to reduce the difference between the official and parallel foreign exchange markets and make it simpler for manufacturers to access the official exchange rate when importing raw materials.

In 2023, Dele el looked into what causes changes in the value of the Nigerian currency and how that relates to the country's exports that don't depend on oil. They used data from 1982 to 2017, which is a period of 36 years. To analyze the situation, they used several methods like descriptive statistics, co-integration analysis using ARDL and Bounds testing, and ARCH/GARCH(1,1) models to measure volatility. They also checked for stationarity with ADF and PP tests. Their findings showed that changes in the currency value, interest rates set by banks, inflation, and the volume of foreign exchange trading all have a positive effect on non-oil exports. However, GDP, the money supply (M2), and government spending had negative but not significant effects. Out of all the factors, the most important ones were changes in the currency value and inflation, as shown by their ARCH and ARDL models. They suggested that Nigeria should focus on keeping the currency stable to support its non-oil export businesses [9].

Okeke and Chinanuife (2022) did a study looking at how exchange rate policies affected non-oil exports in Nigeria between 1981 and 2020. They used the autoregressive distributed lag model to analyze the effect of these policies on export activities. Their results showed that exchange rate policies have a positive effect on non-oil exports. This is important for Nigeria's economy. Based on this, they suggested that better policies should be put in place to make the financial sector more efficient. They believe these policies can encourage more investment in non-oil exports. The study also recommended policies to improve the efficiency of the financial sector to further boost investments in non-oil exports.

Innocent el at. (2022) did a study on how exchange rate changes in Nigeria affected exports from 2005Q1 to 2020Q4. They used several models like ARCH, GARCH, TARCH, and EGARCH to measure how much the exchange rate was changing. Then they used the ARDL bounds testing method to see both the short-term and long-term impacts. Their results showed that while exchange rate changes have a negative effect on exports, this effect wasn't very strong. They suggest that policies should focus on making the exchange rate more stable and helping exporters.

Chimere et al. (2020) used the augmented mean group method to look at how exchange rate policies affect non-oil exports in some West African countries. They carefully studied the details of this relationship. Their findings showed that the effect of exchange rate policies on non-oil exports varied a lot from one country to another.

This difference showed that policies need to be more flexible and consider the specific situations of each country. In short, the study suggests that a one-size-fits-all approach to economic policies isn't effective. Instead, there should be more customized strategies that take into account the unique needs and challenges of each nation. This way, policymakers can better support long-term economic growth and development in the West African region [10].

Muyambari (2017) looked into how exchange rate policies affect non-oil exports in Botswana, South Africa, and Mauritius from 1976 to 2014. Using advanced autoregressive and distributed lag (ARDL) models, the study shows how these policies had different effects in each country. The results suggest that financial reforms should be customized to each nation's specific situation to make policies more effective in boosting non-oil exports. For all three countries, the study suggests improving their financial systems in a way that makes them more stable and supportive of long-term growth in non-oil exports. By matching policies to the unique features of each economy, government officials can better manage exchange rates and improve the competitiveness of their exports, leading to greater economic success [11].

Sakyi, Boachie, and Immurana (2016) looked at how exchange rate policies affected non-oil exports in Ghana using autoregressive distributed lag models. Their detailed study found that in the short term, there were mixed results, but over the long term, there wasn't a clear positive effect. Based on this, they suggested that big changes are needed in the financial sector. They recommended a balanced approach that includes both fiscal and monetary policies [12]. This call for major reforms aligns with the need to strengthen the economic structure, making it more resilient and flexible in the face of changing global conditions. By fixing existing problems and putting in place smart strategies, Ghana could improve the effectiveness of its exchange rate policies, which in turn could help the non-oil export industry grow and become more successful in the long run [13].

Chukwedo and Chukunonso (2015) studied how exchange rate policies affect non-oil exports in Nigeria. They used data from 1970 to 2013 and applied the Gregor-Hansen Endogenous Structural Break method along with tests for unit roots, co-integration, and Granger causality. Their detailed analysis revealed a strong one-way relationship between exchange rate policies and non-oil exports. This suggests that how exchange rates are managed has a major impact on the performance of non-oil exports, which is an important part of Nigeria's economy. Based on their findings, they suggested important actions, especially focusing on bringing credit and thrift societies, cooperatives, and rural savings groups into the formal financial system. They believed this integration would help increase savings, creating a better environment for investment in non-oil export activities [14].

3. Methodology

3.1 Nature and Sources of Data

The data that was employed in this study annually from 1990 to 2024 and will obtain on the variables of interest to the study such as exchange rate, food crop export, cash crop exports and solid mineral. These data will sourced via central bank or (NSB) Nigeria statistical bulletin, 2024

3.2 Definition and Measurement of Variables

Table 1. Description, definition, and measurement of key economic variables in nigeria's non-oil export analysis.

Variables	Definition of Variables	Measurement
Exchange Rate (EXR)	Exchange Rate (EXR) is the value of the Nigerian Naira against other currencies.	It is Measured in percentages
Food crops Exports (FCE)	This is the proportion of food crops export to total non - oil export.	It is Measured in percentage
Cash crops Exports (CCE)	This is seen as the proportion of cash crops export to total non - oil export	It is Measured in percentage
Inflation Rate (INF)	Inflation Rate (INF) is the rate at which the general price level of goods and services in Nigeria is increasing.	Measured in percentage
Interest Rate (INT)	Interest Rate (INT) refers to the cost of borrowing or the return on savings, expressed as a percentage.	Measured in percentage

Table 1 defines and explains five major macroeconomic variables used in analyzing Nigeria's non-oil export performance.

•Exchange Rate (EXR) - Represents the value of the Nigerian Naira against other foreign currencies, expressed as a percentage. It reflects the competitiveness of Nigerian exports in global markets.

•Food Crops Exports (FCE) - Denotes the proportion of food crop exports relative to total non-oil exports, measured as a percentage, highlighting agricultural export performance.

•Cash Crops Exports (CCE) - Refers to the proportion of cash crop exports in total non-oil exports, also measured as a percentage, showing Nigeria's export diversification within agriculture.

•Inflation Rate (INF) - Measures the rate of increase in the general price level of goods and services, providing insight into economic stability and purchasing power.

•Interest Rate (INT) - Indicates the cost of borrowing or returns on savings, influencing investment decisions and trade financing.

Overall, these variables are essential indicators for assessing Nigeria's export competitiveness, macroeconomic stability, and policy effectiveness in the non-oil sector.

3.2 Model Specification

The model specification for this study is anchored on Export-Led Growth Model that provides the implicit model thus

$$NOE_t = f\left(EXR_t, INFR_t, INT_t\right) \quad (1)$$

Where:

• *NOE* = Non -oil export decomposed into food crop export, cash crop export and solid mineral export

• *EXR* = Exchange Rate (Nominal), representing the rate of Nigerian naira against US dollars. It is the core explanatory variable

• *INFR* = Inflation Rate, measured in percentage. It serves as a control variable

• *INT* = Interest Rate, measured by measured in percentage. It act as a control variables

Transforming equation (1) into ARCH gives

$$R_t = \alpha + \delta_1 R_{t-1} + \varepsilon_t, \quad \varepsilon_t \sim IID\left(0, \sigma^2\right) \quad (2)$$

Where R is the rate of return of the series

Estimated residual is obtained from equation (2), then the squared of estimated residual is regressed on its lag as follows:

$$\hat{\varepsilon}_t^2 = \gamma_0 + \gamma_1 \hat{\varepsilon}_{t-1}^2 + v_t \quad (3)$$

Ho: $\gamma_1 = 0$, while H_1: $\gamma_1 \neq 0$

The test statistics for the null hypothesis are F-test and R^2 tests.

Generally, the mean and variance equations of ARCH (p) are specified as;

$$R_t = \alpha + \sum_{i=1}^{\rho} \varphi_i R_{t-i} + \varepsilon_t \sigma_t^2 = \lambda_0 + \sum_{i=1}^{\rho} \lambda_i \varepsilon_{t-i}^2 \quad (4)$$

Where ε_{t-i}^2 is an ARCH term, $0 \le \sum_{i=1}^{\rho} \lambda_i < 1$ for a stationary series and as $\sum_{i=1}^{\rho} \lambda_i \to 1$ it means the series exhibit slow mean reverting, while as $\sum_{i=1}^{\rho} \lambda_i \to 0$ means fast mean reverting.

The null hypothesis for the ARCH (p) is given as $\lambda_1 = \lambda_2 = \cdots \lambda_\rho = 0$ and tested using either F-test or R^2 that followed (chi-square) distribution proposed by Engle (1982). Null hypothesis (no ARCH effect) is rejected if there is ARCH effect in the model there is no ARCH effect [15].

Engle pointed out in 1995 that one problem with the ARCH model is that it is more similar to a moving average model than an autoregressive model. Therefore, when constructing macroeconomic fluctuation models, the Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model proposed by Bollerslev in 1986 is usually used. This model incorporates the lagged values of the conditional variance into the variance equation based on the ARCH framework. Therefore, the mean equation is the same as equation (3), while the variance equation is expressed as:

$$\sigma_t^2 = \lambda_0 + \sum_{i=1}^{\rho} \lambda_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \gamma_j \sigma_{t-j}^2 \quad (5)$$

For stationary series $0 \le \sum_{i=1}^{\rho} \lambda_i + \sum_{j=1}^{q} \gamma_j < 1$, the mean reverting process in the case of GARCH model is as $\sum_{i=1}^{\rho} \lambda_i + \sum_{j=1}^{q} \gamma_j \to 1$ then the model exhibits slow mean reverting, while as $\sum_{i=1}^{\rho} \lambda_i + \sum_{j=1}^{q} \gamma_j \to 0$ the model has fast mean reverting. $p \ge 0, q > 0, \lambda_0 > 0, \lambda_i \ge 0, j = 1 \cdots q, i = 1 \cdots \rho$ Thus for $q = 0$, the model reduces to ARCH (p).

Also considered in this study is the GARCH-in-Mean (GARCH-M) model which allows the conditional mean to depend on its own conditional variance. Therefore, the GARCH-M model has the following form:

$$R_t = \alpha + \sum_{i=1}^{\rho} \varphi_i R_{t-i} + \varepsilon_t + \theta \sigma_t^2 \quad (6)$$

The null and alternative hypotheses of the GARCH-M (1 1) model are H_0: θ=0 and H_1: θ≠0, respectively. The GARCH-M term is statistically significant when the null hypothesis (H_0) is rejected, and the model provides useful volatility information (i.e., it improves the estimation of the GARCH model). A major limitation of the aforementioned ARCH and GARCH models is their symmetry [16]. To capture leverage effects, we consider asymmetric volatility models. First, Zakoian (1994) proposed the threshold GARCH (TGARCH) model, which captures asymmetry by introducing a multiplicative dummy variable into the variance equation to test whether there is a statistically significant difference when the shock is negative. The conditional variance equation is set as follows:

$$\sigma_t^2 = \lambda_0 + \sum_{i=1}^{\rho} \lambda_i \varepsilon_{t-i}^2 + \sum_{j=1}^{q} \gamma_j \sigma_{t-j}^2 + \Phi \varepsilon_{t-1}^2 d_{t-1} \quad (7)$$

Where the dummy variable $d_{t-1} = \begin{cases} 1 \text{ if } \varepsilon_{i-1} < 0 \\ 0 \text{ if } \varepsilon_{i-1} \ge 0 \end{cases}$.

Another model considered in this study is the exponential GARCH (EGARCH) model proposed by Nelson in 1991. This model helps to explain asymmetric effects (also known as leverage effects) that ARCH and GARCH models cannot capture.

$$\ln\left(\sigma_t^2\right) = \lambda_0 + \lambda_1 \left| \sqrt{\varepsilon_{t-1}^2 / \sigma_{t-1}^2} \right| + \varnothing \sqrt{\varepsilon_{t-1}^2 / \sigma_{t-1}^2} + \theta \ln\left(\sigma_{t-1}^2\right) \quad (8)$$

If asymmetric effects exist $\varnothing < (>) 0$ this means that a negative (positive) shock of equal magnitude can exacerbate market volatility more than a positive (negative) shock; and if $\varnothing = 0$, there is no asymmetric effect. The Schwarz Information Criterion (SIC) given below is used to select the best model. $SIC(g) = \log(\hat{\varepsilon}'\hat{\varepsilon}/n) + g \log n / n$. The Schwarz information criterion is preferred because it imposes the most severe penalty on the loss of model degrees of freedom.

It is expected that based on apriori functional relationship between dependent and independent variables, the expected relationship between EXR, INF, and INT is expected to be positive. Hence $\beta_1, \beta_2, \beta_3, \beta_4 > 11$.

3.2 Justification of the Model

The model suggests that the variance of the residuals at time it depends on the square of error terms from past periods hence the variance is not constant. Engle suggested that it is better to simultaneously model the mean and the variance of a series when we suspect that the conditional variance is not constant.

3.3 Preliminary Test

3.3.1 Unit Root Test

The unit root test is employed to determine the stationarity of the time series data. Stationarity is crucial because non-stationary data can lead to unreliable and spurious results in statistical analyses, particularly in regression models. Non-stationary data can produce misleading correlations and trends, obscuring the true relationships between variables [17]. Therefore, ensuring that the data used in econometric models is stationary is essential for producing valid and reliable results. In this study, the Augmented Dickey-Fuller (ADF) test is employed to check for the presence of unit roots in the time series data for exchange rates and non-oil exports. The ADF test is an extension of the Dickey-Fuller test, which includes lagged differences of the variable to account for higher-order autocorrelation. This extension makes the ADF test more robust and reliable for testing stationarity in time series data. The ADF test can be expressed as follows:

$$\Delta\gamma_t - \alpha + \beta_t + \gamma y_t - \mathrm{I} + \sum_{i_1}^{q} \delta_i \Delta y_{t-i} + \varepsilon_t \quad (10)$$

3.3.2 Co-integration Test

After establishing the stationarity of the series, the next step is to test for co-integration to determine if there exists a long-run equilibrium relationship between exchange rate policies and non-oil exports. The Johansen co-integration test is used for this purpose. This test is robust and widely used in econometric analysis when dealing with multiple time series data. It helps to identify the presence of co-integrating vectors that signify a long-term equilibrium relationship among the variables [18]. The Johansen test involves estimating the following vector autoregressive (VAR) model:

$$\gamma_t - \alpha + \Pi \mathrm{Y}_{t-1} + \sum_{i_1}^{q-1} \Gamma_i \mathrm{Y}_{i-1} + \varepsilon_t \quad (11)$$

4. Presentation and Discussion of Results

Table 2. Descriptive statistic.

Statistics	EXR	GEXR	FCE	GFCE	CCE	GCCE
Mean	138.2	0.01	0.00	21.6	42.6	0.02
Median	132.4	0.00	0.00	22.00	26.3	0.06
Maximum	1376.8	230.9	0.10	26.1	145.3	19.2
Minimum	66.1	-231.0	-0.10	17.2	10.3	-39.5
Std. Dev.	26.0	6.1	0.01	2.60	31.2	2.50
Skewness	33.4	-0.1	0.70	-0.01	0.97	-0.78
Kurtosis	1579.0	1285.8	9.20	1.60	2.6	18.20
Jarque-Bera	32.1	26.0	98.10	9.48	35.03	35.03
Probability	0.00	0.00	0.00	0.01	0.00	0.00
Sum	44.2	32.4	0.	52.51	39.40	12.56
Sum Sq. Dev.	21.0	11.1	0.09	82.12	75.00	75.00
Observations	37	37	37	37	37	37

Table 2 presents the descriptive statistics for six major variables - Exchange Rate (EXR), Growth of Exchange Rate (GEXR), Food Crops Exports (FCE), Growth of Food Crops Exports (GFCE), Cash Crops Exports (CCE), and Growth of Cash Crops Exports (GCCE) - based on 37 annual observations.

The findings from the descriptive statistics revealed that all the variables and their return series during the period understudy have large variations between the minimum and maximum values. This large variation between the maximum and the minimum values is clear evidence of significant variations in the trend of the series during the period under investigation. The implication of this finding is that the effect of exchange rate on food crop export (FCE) as well as cash crop export (CCE) in Nigeria is very high. It also, suggests the presence of volatility in the series especially exchange rate and food crop export in Nigeria. Furthermore, observations of the sequence distributions show that all variables are positively skewed, meaning they have long right tails. However, except for returns, all return sequences are positive, while returns are negatively skewed, indicating they have long left tails [19]. In terms of kurtosis, all return sequences are leptokurtic, meaning their tails are thicker than those of a normal distribution. On the other hand, all non-return sequences are flat-kurtotic, meaning their tails are thinner than those of a normal distribution. The results of the skewness statistics are supported by the Jarque-Bera test, which shows that all sequences do not follow a normal distribution. Therefore, given this nonnormality and the other statistical methods included in the ARCH and GARCH models (such as the Student's t test, the generalized error distribution, the fixed-degree-of-freedom Student's t distribution, and the fixed-degree-of-freedom generalized error distribution), these models are best suited for this study.

4.1 Test for ARCH Effect

The test for ARCH effect as specified in equation 3.1 was carried by employing the ARCH LM test proposed by Engle (1982). The result is presented on table 3.

Table 3. Result of ARCH (1) effect test.

Test	GFCE	GEXR	GCCE	GSME
F-test	84.5***	265.6***	293.0***	47.00***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)
nR^2	83.5***	245.1***	82.5***	39.7***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)

Source: Author's computation, 2025 Note: *** and ** designate 1 & 5 % significant level respectively.

Table 3 show the results of statistical tests (F-test and nR^2 test) used to assess the significance and goodness of fit of econometric models (such as regression models) in assessing the relationship between explanatory and dependent variables. The variables in the table include GFCE, GEXR, GCCE, and GSME, representing different economic indicators (such as food export growth, exchange rate growth, cash crop export growth, and manufacturing export growth).

The F-test and nR^2 test results in Table 4 both indicate that all variables exhibit the ARCH effect of a first-order autoregressive process at the 1% significance level. This means that we do not need to test for higher-order lags, as the first-order test alone is sufficient to estimate the volatility model in this paper.

To achieve objective one which to investigate the effect of exchange rate on food crops export in Nigeria, ARCH effects of all the variables return series were employed. This was accompanied by the estimation of the GARCH (p,q) equation and other extensions stated in chapter three. However, ARCH(q) was not analyzed based on theory as GARCH (p,q) model with lesser values of p and q provides a better goodness of fit than ARCH(q) model with larger values for q. The results are presented on the tables depicting estimation of exchange rate without food crop export growth rate and estimation of exchange rate with food crop export growth rate [20].

Table 4. Result of exchange rate volatility without food crop export.

Variables	GARCH(1 1)	GARCH - M	TGARH	EGARCH
Mean Equation				
Constant γ	0.120	-13.172	0.130	0.140***
	(0.236)	(14.894)	(0.208)	(0.008)
GEXRATE(-1) λ	-0.120	-0.220	-0.045	-0.998***
	(0.121)	(0.140)	(0.282)	(0.004)
@SQRT(GARCH) α		4.026		
		(4.455)		
Variance Equation				
Constant Υ_0	32.020***	30.768***	32.660***	1.078***
	(0.291)	(5.083)	(0.475)	(0.004)
ARCH(1) Υ_1	0.381	0.378	0.255	8.221***
	(0.330)	(0.590)	(0.216)	(0.003)
GARCH(1)β	-0.021***	-0.160	-0.003***	0.026***
	(0.005)	(0.173)	(0.0007)	(0.005)
TRESHOLD(1) υ			4.073	
			(4.252)	
ASYMMETRY(1) λ				-8.215***
				(0.002)
Diagnostic Test				
SIC	6.0000	6.0000	6.0000	6.0000
ARCH LM Test				
F-test	0.003	0.003	0.009	0.0003
	(0.960)	(0.960)	(0.920)	(0.920)
nR^2	0.003	0.003	0.009	0.0003
	[0.960]	(0.950)	(0.920)	(0.920)

Source: Author's computation, 2025 Note: *** and ** designate 1 & 5 % significant level respectively.

Table 4 list All models (GARCH, TGARCH, EGARCH) indicate significant volatility clustering in the Nigerian exchange rate. The EGARCH model shows the strongest barbell effect (negative shocks are more likely to cause increased volatility). The results suggest that, even without considering food exports, the exchange rate exhibits high volatility and sensitivity to negative economic events.

The study analysed exchange rate volatility by applying GARCH (1,1) model and its numerous proponents. The findings from the result revealed that the coefficient of GARCH (1,1) is -0.002 and it is statistically significant at 1% level of significance suggesting the presence of GARCH effect. Also, the sum of the coefficient of ARCH and GARCH is largely below one suggesting speedy mean reverting of exchange rate. This simply implies that when there is

occurrence of shocks, exchange rate speedily reverts to its mean. However, the GARCH-M adds no meaningful information to the volatility of the exchange rate as the value of the coefficient of GARCH-M term which is 4.026 is statistically insignificant at both 1% and 5% respectively. Furthermore, the value of the SIC (6.000) reveals that GARCH (1,1) model provides a better good fit than the GARCH-M(1,1).

In addition, the value of the coefficient of TGARCH (1,1) which is 4.073 reveals that the threshold asymmetric term is not statistically significant in the determining the asymmetry effect in the unpredictability of exchange rates in Nigeria. Nevertheless, the EGARCH with negative asymmetric coefficient value of-8.215 suggests that positive shock accelerates the volatility of exchange rate more than negative shocks with the same degree. In summary, however, while the value of the coefficient of TGARCH and GARCH indicates that the variance process in exchange volatility is mean reverting, the value of the coefficient of EGACH suggests otherwise as it shows that the shocks that leads to volatility surge in exchange rate is likely to be permanent in Nigeria. Finally, the value of SIC (6.0000) of the EGARCH which is the least suggest that EGARCH is the best technique for modelling exchange rate volatility in Nigeria

Table 5. Result of exchange rate volatility and food crop export.

Variables	GARCH(1 1)	GARCH - M	TGARH	EGARCH
Mean Equation				
Constant γ	0.0005	0.04	9.520	0.000344***
	(0.007)	(0.175)	(0.006)	(1.551)
GEXRATE(-1) λ	-0.488***	-0.390	-0.478***	-1.158***
	(0.104)	(0.095)	(0.081)	(0.009)
@SQRT(GARCH) α		0.005		
		(0.037)		
Variance Equation				
Constant Υ_0	0.003***	0.006***	0.003***	-4.718***
	(0.0005)	(0.0002)	(0.0005)	(0.025)
ARCH(1) Υ_1	0.134	0.097*	0.086	3.896***
	(0.091)	(0.054)	(0.074)	(0.035)
GARCH(1) β	0.586***	0.394***	0.585***	0.276***
	(0.008)	(0.009)	(0.081)	(0.003)
TRESHOLD(1) υ			0.027	
			(0.167)	
ASYMMETRY(1) λ				-1.674***
				(0.003)
GFCE	-0.032***	-0.047***	-0.032***	-78.121***
	(0.0002)	(0.007)	(0.004)	(0.003)
Diagnostic Test				
SIC	-2.903	-2.66	-2.904	-4.572
ARCH LM Test				
F-test	0.0180	0.173	0.050	0.002
	(0.893)	(0.678)	(0.822)	(0.967)
nR^2	0.018	0.173	0.051	0.002
	(0.893)	(0.678)	(0.823)	(0.967)

Source: Author's computation, 2025 Note: *** and ** designate 1 & 5 % significant level respectively and GFCE denotes the growth rate of food crop exports.

Table 5 reveals the positive role of agricultural exports in financial stability and recommends that governments promote the diversification of food exports to alleviate exchange rate instability and enhance economic resilience.

The result shows the estimations of GARCH (1,1) and GARCH-M(1,1) models for exchange rate volatility and its effect on food crop export in Nigeria. The findings from all the the models suggest that exchange rate volatility has ARCH and GARCH effects on food crop exports in Nigeria. The coefficients of food crop exports are negative and statistically significant at 1% level of significance in all the models. The implication of this finding is that exchange rate volatility does not only affect food crop export, but food crop exports is one of the major determining factors of exchange rate volatility in Nigeria. Therefore, negative shocks in food crop export leads to surge in exchange rate volatility in the country. This is principally due to the central role food crop export and import play in exchange rate management.

Furthermore, while the summation of the coefficients ARCH and GARCH models is more than one for EGARCH model, they are less than one for all other models. Thus, the EGARCH model suggests that the series variance process is not mean reverting, indicating that the effect of exchange rate volatility on food crop exports is permanent. However, the EGARCH asymmetry coefficient value of -1.674 is negative and statistically significant at 1% level of significance, suggesting that negative shocks in food crop export reduces the volatility of exchange rate in Nigeria unlike the positive shocks of the same degree.

Finally, considering the SIC outcomes in all the models, indicates that the EGARCH gives the best fit for the exchange rate volatility and food crop export estimation in Nigeria.

To achieve objective two which is to investigate the effect of exchange rate on cash crop exports in Nigeria, the ARCH model with its numerous extensions were employed and the result is presented on table 6.

Table 6. Result of exchange volatility and cash crop exports.

Variables	GARCH(1 1)	GARCH - M	TGARH	EGARCH
Mean Equation				
Constant γ	-0.0006	-0.008***	-0.0007	-0.004*
	(0.002)	(0.002)	(0.003)	(0.002)
GEXRATE(-1) λ	-0.224*	-0.274***	0.085	0.074
	(0.003)	(0.001)	(0.002)	(0.093)
@SQRT(GARCH) α		0.417***		
		(0.003)		
	6.134***	5.230***	0.002***	-1.409***
Variance Equation	(0.002)	(0.004)	(0.002)	(0.004)
Constant Υ_0	0.091*	0.061***	0.071	0.186*
	(0.005)	(0.003)	(0.080)	(0.001)
ARCH(1) Υ_1	0.823***	0.873***	0.630***	0.814***
	(0.006)	(0.004)	(0.005)	(0.005)
GARCH(1) β				
			0.576**	
TRESHOLD(1) υ			(0.003)	
				-0.657***
ASYMMETRY(1) λ				(0.002)
GCCE (β)	-0.008***	-0.002***	-0.010***	-4.473***
	(0.002)	(0.003)	(0.003)	(0.004)
Diagnostic Test				
SIC	-4.455	-4.523	-4.434	-4.588
ARCH LM Test				
F-test	2.464	3.268*	0.089	0.006
	(0.119)	(0.007)	(0.766)	(0.938)
nR^2	2.454	3.232*	0.091	0.006
	(0.117)	(0.003)	(0.763)	(0.937)

Source: Author's computation, 2025, Note: ***and* indicate 1%, and 10% level of significance and GCCE denote Growth rate of cash crop export respectively.

Table 6 list exports of cash crops have played a positive role in stabilizing the Nigerian exchange rate. The study indicates that strengthening agricultural export policies and promoting the export of agricultural products will help reduce currency depreciation pressure and improve foreign exchange market stability.

The findings demonstrate how exchange rate fluctuations affect Nigerian cash crop exports in both symmetric and asymmetric models. The results indicate that exchange rate fluctuations have a persistent impact on cash crop exports, as reflected in both ARCH and GARCH effects. Furthermore, all models show that the impact of exchange rate changes on Nigerian cash crop exports is a slow process, requiring a period of time to recover. This is because the sum of the ARCH and GARCH effects in the GARCH(1,1) and GARCH-M(1,1) models are 0.823 and 0.873, respectively, while the corresponding values for the TGARCH(1,1) and EGARCH(1,1) models are 0.830 and 0.814, respectively. Although these values are all less than 1, they are very close to 1, indicating that the impact of exchange rate fluctuations on Nigerian cash crop exports is highly persistent in all models.

Finally, the threshold value of coefficient of TGARCH which is 0.576 is statistically significant indicating not only the importance of asymmetry in estimating the effect of exchange rate volatility on cash crop export but that positive shocks in exchange rate has more profound effect on cash crop export than the negative shock of the same magnitude.

The findings from the results of the diagnostic tests of ARCH effect establish that all the models except GARCH-M(1,1) wholly captured the ARCH effect of exchange rate volatility and cash crop export in Nigeria.

To achieve objective three which is to investigate the effect of exchange rate on solid mineral exports in Nigeria, the ARCH model with its numerous extensions were also employed and the result is presented on table 7.

Table 7. Result of exchange rate volatility on solid mineral export in nigeria.

Variables	GARCH(1 1)	GARCH - M	TGARH	EGARCH
Mean Equation				
Constant γ	0.002	0.045*	-0.002***	-0.002***
	(0.002)	(0.002)	(0.005)	(0.002)
GRGDP(-1) λ	0.758***	0.707***	0.815***	0.751***
	(0.009)	(0.009)	(0.004)	(0.002)
@SQRT(GARCH) α		0.006*		
		(0.003)		
Variance Equation				
Constant Υ_0	0.005***	0.004	3.962***	-6.475***
	(0.004)	(0.708)	(0.001)	(0.004)
ARCH(1) Υ_1	0.698***	0.686**	0.588***	0.941***
	(0.002)	(0.002)	(0.008)	(0.001)
GARCH(1) β	-0.098	-0.021	0.733***	0.230***
	(0.133)	(0.090)	(0.002)	(0.005)
TRESHOLD(1) υ			-0.203*	
			(0.001)	
ASYMMETRY(1) λ				-0.030
				(0.105)
GSME	0.008***	0.002***	-0.002***	3.2905***
	(0.006)	(0.005)	(0.002)	(0.002)
Diagnostic Test				
SIC	-4.500	-4.550	-4.944	-4.641
ARCH LM Test				
F-test	0.008	0.012	0.154	0.237
	(0.978)	(0.915)	(0.696)	(0.628)
nR^2	0.008	0.0117	0.155	0.239
	(0.978)	(0.914)	(0.694)	(0.626)

Source: Author's computation. Note: ***, **and * indicate 1%, 5%and 10% level of significance respectively and GSME denotes growth rate of solid mineral exports

Table 7 shows the estimates of GARCH (1,1) and GARCH-M(1,1) effect of exchange rate volatility on solid mineral export in Nigeria. The findings from the result indicates that the ARCH coefficients are statistically significant suggesting the existence of the ARCH effects of exchange rate volatility effect on solid mineral exports. Further, the finding from the results of GARCH (1,1) and GARCH-M(1,1) suggests that the effect of volatility of exchange rate on solid mineral exports in Nigeria is mean reverting. This is because the sum of the value of the coefficients of ARCH and GARCH estimates is less than one. The implication of this finding is that the effect of the shocks of exchange rate volatility on solid mineral exports is temporarily.

Moreover, the coefficient of the growth rate of solid mineral exports (GSME) is statistically significant in all the models. This implies the central role the growth rate of solid mineral exports plays in exchange rate volatility in Nigeria.

Similarly, threshold asymmetric term has the coefficient value of 0.203 that is statistically significant implying that negative shocks of exchange rate reduce the volatility of solid mineral export than positive shocks of the same degree.

4.2 Discussion of Findings

To investigate the effect of exchange rate volatility on food crop export in Nigeria, the ARCH model with its numerous extensions were employed. The findings from the ARCH model with its numerous extensions shows that the effect of exchange rate on cash crop export in Nigeria is a slow mean reverting process. Also, that positive shock accelerates the volatility of exchange rate on food crop export more than negative shocks with the same degree. These findings confirm the findings of Audu and Okumoko (2013) Adeniyi et al. (2015), Okeke and Chinanuife (2022) who found that exchange rate policies wield a positive impact on non-oil exports

To determine the effect of exchange rate volatility on cash crop exports, the ARCH model with its numerous extensions were also employed. The findings from the results show that the positive shocks in the exchange rate have a more profound effect on cash crop exports than the negative shock of the same magnitude. Also, that there is evidence of high degree of persistence of the effect of exchange rate volatility on cash crop exports in Nigeria. This finding also buttresses the findings of Chimere et al. (2020) Muyambari (2017), who found that exchange rate management is pivotal in managing the volatility of non - oil export in South Africa.

To investigate the effect of exchange rate on solid mineral export in Nigeria was further achieved using ARCH model with its numerous extensions. The study found that the effect of the shocks of exchange rate volatility on solid mineral exports is temporarily, it is also mean reverting and that the negative shocks of exchange rate reduce the volatility of

solid mineral export than positive shocks of the same degree. This finding contradicts the findings of Asare (2013) who found the effect of exchange rate volatility on non -oil exports to be permanent.

5. Conclusion and Recommendations

The study concludes that exchange rate volatility exerts heterogeneous effects on different categories of Nigeria's non-oil exports, with notable variations in both the magnitude and persistence of these impacts. This heterogeneity underscores that no single policy approach can effectively address all segments of the export economy.

The evidence shows that in some sectors, such as cash crops, positive shocks often associated with exchange rate depreciation produce significant and long-lasting disruptions. These shocks increase uncertainty, reduce exporters' ability to plan, and can erode competitiveness if cost structures are heavily dependent on imported inputs. The persistence of these effects indicates structural vulnerabilities within these sectors, where recovery from currency instability is slow and market confidence takes time to rebuild.

However, the paper recommends that the government should design and implement sector-specific trade and exchange rate policies that recognize the varying sensitivities of different non-oil export categories, ensuring that supportive fiscal measures and infrastructure investments are targeted where volatility has the most persistent effects. The Central Bank of Nigeria should adopt a proactive exchange rate management framework that includes stabilizing interventions, transparent forex market operations, and the provision of affordable hedging instruments to help exporters mitigate the adverse effects of currency fluctuations and also the Export promotion bodies such as the Nigerian Export Promotion Council should intensify capacity-building programs for exporters, focusing on currency risk management, market diversification, and product value addition, while also facilitating greater access to international markets through trade fairs and export linkage platforms.

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