Exchange Rate Volatility and Export Performance in Nigeria: A Generalized Autoregressive Conditional Heteroskedasticity (GARCH) Analysis

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Abstract
Prior to the Structural Adjustment programme (SAP) in 1986, the Federal Government subsidized the exchange rate. To that extent, the Nigerian exchange rate was relatively stable to other major currencies of the world. However, after the floating exchange rate regime post SAP, Nigeria has witnessed fluctuating exchange rate and this has caused volatility which has hampered the export performances. Bearing in mind the Sustainable Development Goal eight of economic growth, the purpose of this paper was to investigate the level of exchange rate volatility on Nigeria's export performance. The dependent variable was agricultural export volume and the independent variables were exchange rate volatility, inflation, with gross domestic product per capita. The secondary dataset was from 1986 till 2020 and was culled from CBN statistical bulletin. Econometric analysis used included the augmented dickey-fuller estimation, the generalized autoregressive conditional heteroskedasticity (GARCH), Johansen Co-integration, and granger causality. Findings from the unit root showed that all the variables were stationary at first difference. The ARCH/GARCH result revealed that the previous year's export information (that is ARCH) could influence current year's exchange rate volatility. Also, the GARCH displayed that past export would affect the present exchange rate volatility. Furthermore, the Johansen cointegration showed that all the independent variables had a long-

run effect on export, and finally, there existed a causal relationship between exchange rates volatility and exports. Finally, it was recommended that there should be diversification of the Nigeria's exports base from crude oil to agricultural and service exports.

Keywords: *Exchange Rate Volatility, Export, Inflation, GARCH, Gross Domestic Product Per Capita*

1.0 Introduction

Exchange rate volatility is simply all risks related to exchange rate fluctuations of a country. It exposes the risks involved in the fluctuating nature of every rates of exchange. As Nigeria embraced floating exchange rate since 1986, as against the former fixated rate regime, different rates at different timeframes came with attached risks associated with it (Duru, et al, 2022). According to Olamide, Ebenezer, & Andrew (2021), some macroeconomic factors like inflation, and also growth and development of the economy which by themselves are volatile have effects on exchange rate volatility.

The agricultural sector has been vital to the Nigerian economy as it provides food for the growing population, raw materials for industrial production, savings and tax revenue to support development of the economy, and to earn more foreign exchange (or save foreign exchange when primary products are imported) (Njoroge, 2020). However, since the emergence of the oil sector in the late sixties, agriculture export impact on the Nigerian economy has been on the downward trend especially in the area of its contribution to GDP. By 2016, the growth in the agricultural sector declined to 3.9 per cent from the 5.1 growth rate in 2015 (Njoroge, 2020). Also according to Njoroge (2020), despite the introduction of various programmes by the government to boost agricultural export like the Anchor Borrowers' Programme in 2015, oil exportation still dominate the Nigerian economy as against agricultural export.

The management of Nigerian exchange rates had led to experiencing important movements in past years. During early sixties, the country pegged the naira against Great Britain pounds up till when the devaluation of the pound occurred in 1967. Naira then was now pegged against United State dollar until the early seventies when the devaluation of dollar occurred, Nigeria then left the dollar and went again to the Great Britain pound till 1973, when naira was pegged to the dollar again up till date (Inam and Oscar, 2017). During these periods till date, several problems arose, for example, issue of naira devaluation became eminent even though external reserve rose sharply from 10 billion naira in 2014 to 13.4 billion naira for year 2015 (Gidigbi and Akanegbu, 2017). However, fluctuations (frequent increase and reduction) in OPEC price of oil also negatively led to fluctuations in revenue from foreign exchange, and this introduced problems like increase in importation, depletion of the external reserves, and increase in external debts (Revelli & Ndongo, 2020).

Also, by 1986, the structural adjustment programme (SAP) was introduced and exchange rates were liberalized and became floating or market-defined (Isibor, 2018). This shift commenced with establishing a second-tier market for foreign exchange. First-tier exchange rate was still rigid and was used by the federal government for specific transactions. However, the second-tier foreign exchange was ascertained through bids and was used for all transactions. In 1987, both markets were combined to produce the unified exchange rate of ₦3.74 to a dollar which was approved (Isibor, 2018). Combining the two markets created a large market of foreign exchange where rates were decided by bids through invisible hands of supply and demand. However, the

invisible hands of demand and supply has made the exchange rate fluctuated at various time-period despite the fact that the Central Bank of Nigeria (CBN) had power to interfere to secure stability in the market functions, the fluctuations still continued till date.

Variations in movement of exchange rate, coupled with the performance in international trade especially in increased exports in Nigeria suggests a link between both variables. Latief & Lefen (2018) opined that volatility in exchange rate can stimulate inflation plus economic growth and development problems. Also, such volatility could push up import and frustrate government plans to boost export like export trade liberalization.

Despite various efforts by the Nigeria government to maintain a stable exchange rate, the naira has depreciated through the years to date (Modebe, Okoye & Ado, 2017). This is quite obvious in the case of the value of the Naira (₦), which was ₦1 to $1 in 1981, rose to an average of ₦100 to $1 in year 2000 (Modebe, Okoye & Ado, 2017) and sky rocketed to over ₦128 to $1 in 2003. In 2004, the exchange rate further depreciated to ₦135.50 to $1, thereafter, the exchange rate appreciated to ₦132.15 to $1 in 2005 and later ₦118.57 to $1 in 2008. Towards the end of 2008, the naira depreciated to ₦150.0124 to $1 and remained the same till 2009. In August of 2013, the exchange rate of Naira to one US dollar was ₦160.14756 to $1 (or ₦160.15 to $1) (Modebe, Okoye & Ado, 2017). Nigeria's exchange rate to dollar as at 2015 drastically declined from N160.15 to $1 in 2013 to N198.05 to $1 by December, 2015. As at December 2016 and 2017 Nigeria recorded an all-time high rate of N300.757 and N358 to $1 respectively (Duru, et al, 2022). This high level of depreciation had ripple effects on the prices of goods and services nation-wide (inflation). This decline in the value of the Naira coincided with the period of inflationary growth in Nigeria, and has been an unwholesome development that has led to a drastic decline in the living standard of the average Nigerian. This has affected the sustainability of economic growth. Generally, where a country's currency is characterized by a persistent fall in its value, there will be a rise in the nominal value of her exchange rate to the rest of the World.

To measure inflation there are three approaches. These are the Gross National Product (GNP) implicit deflator, the Consumer Price Index (CPI) and the Wholesale or Producer Price Index (WPI or PPI). The period to period changes in these two latter approaches (CPI and WPI) are regarded as direct measures of inflation. There is no single one of the three measures of inflation that rather uniquely best measures inflation.

Galloping inflation is one of the main threats to the stability and prosperity of a large number of market economies. It has impeded most economies due to its undesirable effects (Revelli & Ndongo, 2020). Although, there is no clear cut relationship between export growth and inflation (Revelli & Ndongo, 2020), some evidences suggested that moderate inflation helps in increasing economic growth. However, the overall weight of evidence so far clearly indicated that inflation is inimical to economic growth (Okoroafor & Adeniji, 2017; Olamide, Ebenezer, & Andrew, 2021). The problem of inflation surely is not a new one. It has been a major challenge in the development process of many economies over the years.

According to Yakub, et al (2019), monetary and fiscal policies have been formulated by the regulatory authorities in Nigeria overtime to solve the issues of volatility in exchange rate but the problem still persists. Moreover, previous studies like Wong (2017) have examined the problem of exchange rate volatility in developed economies and fewer studies like Ehikioya (2019) on developing economies especially Nigeria. However, both studies found the issue of exchange rate volatility challenging against economic growth.

Also, while studies like Uduakobong and Williams (2018) found a negative relationship between

exchange rate volatility and economic growth, other studies like Yakub, et al (2019) found a positive relationship. This conflicting view made the researcher carry out this investigation in order to confirm the extent of relationship between exchange rate volatility and this time around export performances in order to cater for the literature gap.

In spite of the conflicting results of studies like Alagbe, Yusuf, & Oluwaseyi, (2017), Uduakobong & Williams (2018) and Yakub, et al (2019), the problem of exchange rate volatility still persists in Nigeria. Whether the persistent issue was caused by unsuitable actions previous literature already investigated is what the paper wants to deal with, and thus show empirical proof of effects of exchange rate volatility on export with other variables which include Nigerian sustainable economic growth (GDP per capita) and inflation. The research would buttress why paying particular attention to Nigeria would bring different results than former researches done on the topic especially the works of developing countries in Africa. The research would also add to current studies by showing how export performance is influenced by not only exchange rate volatility but also sustainable economic growth and inflation. Also, most of the reviewed studies examined exchange rate volatility and how it affected economic growth (Ehikioya, 2019) and non-oil export drive (Uduakobong & Williams, 2018), however, the research would examine its impact, alongside inflation, and sustainable economic growth, on export performance.

2.1 Conceptual Framework of Nominal Exchange Rate

The nominal exchange rate measures the value of one currency in terms of another. The nominal exchange rate shows the rate of exchange, operating in the present moment in the foreign exchange market. Adeniyi & Olasunkanmi (2019) opined that the nominal exchange rate should reflect the purchasing power of one currency against another. Their proposal was that a purchasing power exchange rate existed between any two countries, and it is measured by the reciprocal of one country's price level against another. Isibor (2018) opined that the condition for free trade is that the Nominal Exchange Rate (NER) between two countries should be equal to the ratio of the price levels in the two countries. This approach assumes that equilibrium real exchange rates remain constant over time and therefore, the nominal exchange rate movement tends to offset relative price movements. According to Obiekwe & Osubuohien (2016), it was stated that the NER is determined by an official sanction in a fixed rate regime and also in a floating rate regime, by demand and supply for both currencies in a foreign exchange market. It is insignificant about the purchasing power of that currency because it measures the exchange value in only numerical terms. In Nigeria, it is quoted as so many units of Naira per unit of foreign currency (e.g. U.S. dollar). The nominal exchange rate determines the cost of imports and the level of revenue to exporters and it is also used for policy purposes to compensate for movements in differential rate of inflation.

2.1.1 The Structure of the Nigerian Foreign Exchange Market

Nigeria's foreign exchange market is made up of three major segments, the official, autonomous (made up of inter-bank and bureau de exchange) and the parallel markets. The various segments of the markets evolved overtime owing to developments in the economy (Alagidede & Ibrahim, 2017). The operations of the official foreign exchange market have metamorphosed over the years, particularly since the introduction of the exchange and trade liberalization policy in 1986, the official market was unified in 1987 when the exchange rate for public sector transactions was aligned with the commercial exchange rate.

The inter-bank market for free funds or privately sourced foreign exchange was at the early stage dominant as foreign exchange was centralized in the CBN under the 1962 Exchange Control Act. According to Uduakobong & Williams (2017), this is a market where banks extend credit facilities among themselves to meet very short- term liquidity obligations ranging from overnight borrowing up to one year. The market is characterized with rapid transmission of information on rates to all the participants, though dominated by few market leaders who influenced the borrowing rate. However, the market became vibrant with the introduction of Second – Tier Foreign Exchange Market (SFEM) and the permission granted banks by the CBN to affect foreign exchange dealings among themselves. The sharp practices which emanated from the system in form of round tripping of funds led to persistent instability in the exchange rate.

Consequently, the official foreign exchange market and the inter-bank market were merged in 1989 into an enlarged inter-bank foreign exchange market (IFEM). The bureau de change was established with the abolition of the inter-bank market in the same year to accord access to small users of foreign exchange market. Exchange rates in the bureau de change were market determined. In 1995, the official market evolved from a single to a dual exchange rate system in which a fixed exchange rate was applied for priority public sector transaction, while a market-based exchange rate was used for private sector transactions through the Autonomous Foreign Exchange Market (AFEM) segments.

With the introduction of AFEM in 1995, Yakub, Sani, Obiezue, & Aliyu, (2019) observed that the banks were once more allowed to engage in inter-bank dealings with only privately sourced foreign exchange. However, the operations of the AFEM failed to meet the objectives for which it was set up. For instance, the inter-bank market, which was supposed to source its funds privately, relied on the CBN. In effect, the CBN continued to fund the various foreign exchange market transactions. As demand pressure continued to rise from this arrangement which has led to the depreciation of the naira at the foreign exchange market, some reforms were introduced. By January 1999, the fixed official rate for priority sector transactions were conducted at the AFEM market-based rate (Okoroafor & Adeniji, 2017). Later in the same year the AFEM was replaced by the inter-bank foreign exchange market through the active participation of other players, such as, banks, oil companies, non-bank financial institutions, parastatals, bureau de change and private companies. The CBN was therefore, not expected to act as the major supplier of foreign exchange but as a participant who would only intervene in the buying and selling of foreign exchange as and when necessary.

The parallel market for foreign exchange has been in existence from the exchange control era (Isibor, 2018). Since the market-based reforms, the widening disparity in exchange rates has further strengthened the existence of the parallel market, owing largely to the windfall gains arising there from. The parallel market is a residual market as it accommodates spill over demands from other sources (Isibor, 2018). It has been established that scarcity in the official source and bureaucratic procedures necessitated the growth and development of the parallel market. In any foreign exchange management framework, whether in developed or developing economies, speculations, arbitrage, hedging and portfolio switching are important elements in gauging the health and development of the foreign exchange market and by extension, the financial system.

2.1.2 Exchange Rate Fluctuations

It is well-known in literature that getting the exchange rate right or maintaining relative stability is important for both internal and external balance and consequently growth in the economy. Exchange rate is the most important price variable in an economy and performs the twin role of maintaining international competitiveness and serving as nominal anchor to domestic price (Asinya & Takon, 2016). Swing in the exchange rates over a period of time or deviation from an equilibrium exchange rate is referred to exchange rate fluctuation. The exchange rate is subjected to variations when it is not fixed, thus floating exchange rate tends to be more volatile. Economic essentials affect the level of fluctuation and the extent to which exchange rate stability is maintained. Favorable economic circumstances and outcome which in turn appreciate the currency and maintain stability is caused by strong fundamentals. Omankhanlen, Ilori, & Isibor (2021) stated that movements in the exchange rate have ripple effects on other economic variables such as inflation rate, unemployment, money supply. These facts underscore the importance of exchange rate to the economic well-being of every country that opens its doors to international trade in goods and services. Fluctuation of real exchange rate around its equilibrium could cause negative or positive impacts on growth depending on the direction of these movements. Ayodele (2017) ascertained that highly fluctuated exchange rate has negative impacts on economic growth, moderately volatile exchange rate has positive impacts on growth, while overvalued exchange on the other hand rate reduces growth.

2.1.3 Concept of Inflation

Inflation can be described as persistent rise in the general price level of goods and services over a period of time (Isibor, 2018). Changes in price level are usually measured monthly, quarterly and annually. Inflation is by and large simply a monetary phenomenon that arises from a more rapid increase in money supply than in total output in an economy (Ufoeze, Okuma, Nwakoby, & Alajekwu, 2018). This point was further stressed by proponents of the quantity theory of money who opined that changes in the general level of general prices are determined primarily by changes in the quantity of money in circulation (Njoroge, 2020).

According to Revelli & Ndongo (2020), an increase in the price level of goods and services can only be considered as inflation if such price increments are constant, enduring and sustained. For example, short term hike in prices due to scarcity or hoarding. Therefore, the price change should be permanent and the inflationary pressure must be far reaching instead of occurring in only one or a few products. This is because in a growing and changing economy, some product prices must increase as others fall in response to changes in the demand and supply of these goods and services. If price stability is to be achieved in any economy, then individual prices of goods, services, and wages must be free to fluctuate in such a way that the general price level remains relatively unchanged (Isibor, Felicia, Maria, Godswill, & Chisom, 2018).

Olamide, Ebenezer, & Andrew (2021) provided an alternative definition to inflation, choosing rather to describe inflation as a continuous and sustained fall in the value of money. They concluded that inflation is the erosion of the value of money through a sustained increase in the general price level, as a result of an unnecessary expansion in the quantity of money in circulation.

There are three major types of inflation according to neo-Keynesians. The first is the demand-pull inflation, which occurs when aggregate demand is in excess of available supply (capacity). This phenomenon is also known as the Phillips curve inflation. The Phillips curve inflation

showed that output gap can result from an increase in government purchases, increase in foreign price level, or increase in money supply (Olamide, Ebenezer, & Andrew, 2021).

The second is known as cost-push inflation. It occurs in the event of a sudden decrease in aggregate supply of goods and services, owing to an increase in the cost of producing a single unit of a commodity especially when there are no suitable alternatives. This type of inflation is becoming more common today than before, as evident in the rising price of housing, energy and food. It is often reflected in price/wage spirals in firms, whereby workers try to keep up their wages with the change in the price level and employers pass on the burden of higher costs to consumers through increase in prices. The third type, referred to, as structural inflation, is built-in inflation, usually induced by changes in monetary policy (Olamide, Ebenezer, & Andrew, 2021).

2.1.4 Nigerian Export

The import substitution industrialization strategy was created after independence in mid-1960 to late 1970 (Duru, et al, 2022). This strategy was created in order to encourage local production and sale of goods in the country. For this reason, the country will no longer see the need to import certain goods or services because they will available in the country. The objective of this strategy was to discourage importation of goods and foreign dependence through increased local production which would increase foreign exchange saving, create satisfactory balance of payment, improve technological development and also create employment opportunity (Duru, Eze, et al, 2022).

In order to speed up the implementation of the import substitution strategy and ensure its success, the federal government used protective measures such as imposition of low tariff on importation of intermediate and capital goods, high tariff on importation of finished and consumer goods as well as restrictions on the importation of some consumer goods. The federal government also utilized fiscal and monetary measures such as giving tax holidays to industries, income tax relief, and depreciation allowance for investment in equipment and provision of intermediate material for manufacturing (Isibor, 2018). Added to the above steps taken by the government to ensure the success of the import substitution strategy was the creation of the Nigerian industrial development bank in 1963. This development bank in partnership with the international finance corporation provided loans to Nigerian registered industries (Okoroafor & Adeniji, 2017).

Also, the federal government made efforts in convincing domestic and foreign investors to open factories or local plant. This led to the establishment of industries such as textiles, wearing apparels, paints, tyres and tube, cement, grain grinding factories, etc. (CBN, 2020). However, the federal government also took part in setting up industries. Some of the industries set up include Ngalaku cement company, Ikot Ekpene sunshine batteries, Calabar cement factory, Nitrogenous fertilizer projects, Warri refineries, Ajaokute steel limited, and so on.

However, Isibor (2018) stated that the import substitution industrialization strategy did not encourage industrial growth because the country concentrated more on producing consumer goods than technologically innovative goods which help to sustain industrialization. Machines, raw materials, spare parts and equipment used for production in local industries were imported. The sector's dependence on imported inputs made the country exposed to economic instabilities. They relied on foreign exchange received from oil export to purchase materials. The 1983 international market oil downfall affected the economy because there was deficient foreign

exchange to pay for the imported raw materials. The oil revenue which generated close to 90% of foreign coinage fell from $25.4 billion in 1980 to below $6 billion in 1986 (Isibor, 2018). These greatly affected industries as there were insufficient raw materials, spare parts which then led to them shutting down their factories. Therefore, from studies like Isibor (2018) and Duru, Eze, Saleh, Uzoechina, Ebenyi, & Chukwuka, (2022), the import substitution strategy failed in Nigeria, that is, instead of reducing importation, it increased importation thereby nullifying the objective of discouraging the country's dependence on foreign countries.

2.2 Theoretical Framework

Monetary Transmission Mechanism Theory

The issue of how monetary policy affects economic output is a vital one in macroeconomics. This theory denotes how monetary policies activities impact productive sectors (Njoroge, 2020). The theory was propounded by Mishkin (1995) and it showed how monetary policy affects variables like total employment, and aggregate net export. Monetary policy may respond by raising interest rates to fight inflation which may backfire by increasing the cost of borrowing for investors (Akin, Ikpefan, & Isibor, 2019). It may also lower interest rate which may weaken the exchange rate which could discourage exportation while driving importation in any country. Monetary policy could influence economic growth by impacting effects of interest rate, exchange rate, and asset prices (Isibor, Ojo, & Ikpefan, 2018).

2.3 Empirical Literature Review

Njoroge (2020) investigated the effect of exchange rate volatility on exports using the panel gravity model approach. Using quarterly secondary data from 2000 first quarter till last quarter 2018, the researcher found a positive but insignificant relationship between both variables.

Morina, et al (2020) in their study on how exchange rate volatility impacts the economic growth of Central and Eastern European (CEE) countries found exchange rate volatility to be negatively significant in having an effect on the economic growth of the CEE nations. The study used the Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) analysis.

Adeniyi & Olasunkanmi (2019) studied the impact of exchange rate volatility on Nigerian economic growth using a data series from 1986 till 2016. They found a negative and significant effect between the variables. They also found exchange rate volatility to have a causal effect on GDP. Ehikioya (2019) examined the impact of exchange rate volatility on the Nigerian economic growth. Using the Generalized Auto-Regressive Conditional Heteroskedasticity (GARCH) technique, the researcher found exchange rate volatility to be an important component in determining both short- and long-run macroeconomic objectives of economic growth as it was positively significant.

Bahmani – Oskooee and Kovyryalova (2018) studied volatility of exchange rates on openness in Nigeria by employing cointegration with data from 1971 till 2013. Analysis from the study disclosed that exchange rate volatility had short-run effect on exports.

Alagidede & Ibrahim (2017) investigated the causes and effects of exchange rate volatility on economic growth of Ghana. Using the Error Correction Model, the study found exchange rate volatility to have a long run positive effect on Ghanaian economic growth.

Modebe, Okoye and Ado (2017) studied impacts of exchange rates movements on Nigerian production sector employing VECM. Findings showed that rates for exchange, interest, inflation, and trade openness had long-run significant effects on production capacity utilization.

Barguellil, Ben-Salha, & Zmami (2018), while examining exchange rate volatility and economic growth in sub-Saharan African (SSA) countries, opined that exchange rate volatility had a negative but long run impact on economic growth of the SSA nations. They used cointegration analysis for their study. Okoroafor & Adeniji (2017) studied the link between currency devaluation, exchange rate volatility, and macroeconomic variables responses in Nigeria. Using a dataset from 1986 till 2016 and analyzing the data with the vector error correction model, they found a positive long run and significant relationship between currency devaluation and inflation. They also found a long run and negative relationship between exchange rate volatility and economic growth.

Ayodele (2017) linked volatility on exchange rate and trade openness from 1990 to 2014 with GARCH. The findings revealed that exchange rate volatility and inflation had significant effect on oil exportation. Katusiime, Agbola, & Shamsuddin (2016) investigated exchange rate volatility and its linkage with the Ugandan economic growth. Using quarterly data from 2006 till 2013 and the Auto-regressive Distributive lag test (ARDL), they found that in the short-run, exchange rate volatility exerted a negative impact on Ugandan GDP but had a positive effect on Ugandan exports in the long run. Asinya & Takon (2016) examined the nexus between exchange rate volatility and Nigerian government fiscal policies. Government policy of the early 1980 brought about naira depreciation which was to encouraged exports. The study used GARCH with data from 1980 till 2012 and found a short-run significant relationship in the model between depreciation of the naira and exchange rate volatility.

2.4 Gaps in Literature

Most of the reviewed studies like Ehikioya (2019) and Morina, Hysa, Ergün, Panait, & Voica (2020) used economic growth as the endogenous variable of their studies while this study would make use of export performance as its endogenous variable with sustainable economic growth, inflation, and exchange rate volatility as exogenous variables. This was due to the theoretical framework which explained how monetary policy variables like inflation and exchange rate affects variables like total employment, and aggregate net export. Also, sustainable economic growth was made an exogenous variable because of its direct impact on export growth. As production grows, the economy expands or grow, many of the produced goods or services would be exported to other countries, hence, it would directly impact export performance. Secondly, empirical research supplied little on the subject of this research as most of them focused on impacts of exchange rates volatility on economic growth.

3.1 Methods

Secondary-sourced data culled from Central Bank of Nigeria (CBN) bulletin (2020) and for periods 1986 to 2020 was used for analysis. The Augmented-Dickey Fuller examined the data stationarity at levels and first difference. The Generalized Autoregressive Conditional Heteroskedasticity model analyzed the volatility of exchange rates against export. Also, Johansen Co-integration was utilized to check whether an equilibrium impact existed among the variables in the long-run.

3.2 Model Specification

While adopting and modifying the model from the study of (Duru, et al (2022), the model shall be estimated using the Generalized Autoregressive Conditional Heteroskedasticity to link

volatility of exchange rate against export. According to Engle (1982), GARCH examines the mean and variance equations of a model in order to establish the presence or absence of volatility. The simple GARCH mean equation model is:

$LEXP_t = \lambda_0 + \lambda_1 EXR_t + u_t$ (1)

Where:

EXR_t = Exchange rate in time t

$LEXP_t$ = Agricultural Export log in time t

λ_0, λ_1 = Slope of the function

u_t = error term

The variance equation is:

$LEXP_t^2 = \alpha + \beta EXR^2_{t-1} + U_t$ (2)

The second model to be analyzed in the study is

$LEXP_t = \beta_0 + \beta_1 EXR_{t-1} + \beta_2 LGDPpc_t + \beta_3 INF_t + U_t$ (3)

Where: $LEXP_t$ = Agricultural Export log in time t

EXRt = Exchange rate at period t

$LGDPpc_t$ = log of gross domestic product per capita at period t

INF_t = Inflation at t-time

U_t = Error term

4.0 Analysis and Interpretation

4.1 Result of Augmented Dickey Fuller (ADF) Unit Root at 5%, 1st difference, Trend and Intercept

When the ADF value is higher than 5% test values, the variables are declared stationary and vice versa. The ADF test is preferred because it corrects for increased space of serial or auto-correlation. Hence, before investigating any time-series data, stationarity analysis must be carried out in order that bias and spurious results are nullified. Also, stationary data have constant mean, variance and autocorrelation for periods of time, meaning the error term does not vary with time. However, for non-stationary data, its variance is infinite and rarely crosses the mean. So any shock in any variable may not get to the right mean degree.

From the result in table 1 below, the ADF test statistics was more than the test critical values proving the stationarity of all the variables (inflation (INF), exchange rate volatility (EXR), sustainable growth of the economy (LGDPpc), with export (LEXP)) were stationary at 1st difference, 5% significant level.

Table 1: Unit root

Variable	ADF values	5% test critical Values	Stationarity	Remarks
LEXP	-5.999028	-2.967767	Stationary at 1st difference	I(1)
EXCR	-3.332404	-2.967767	Stationary at 1st difference	I(1)
LGDPpc	-4.169285	-2.967767	Stationary at 1st difference	I(1)

INF	-7.041454	-2.967767	Stationary at 1st difference	I(1)

Source: Researcher's computation (2022)

4.2 GARCH Result

From table 2, using the mean equation part which was the Autoregressive Conditional Heteroskedasticity (ARCH), the ARCH was significant and the probability values of all the independent variables (EXCR, INF, LGDPPC) were all statistically significant at 5% to mean that previous year's export information (that is ARCH) can influence current year's exchange rate volatility.

Examining the variance equation part which was the Generalized Autoregressive Conditional Heteroskedasticity (GARCH), it was also significant statistically at 5% with value of 0.0441 to state that past export would affect the present exchange rate volatility. Put together, present export performances are impacted by its ARCH (mean equation) and GARCH (variance equation) factors or shocks.

Exchange rate (EXCR) was also significant statistically at 5%; this means that volatility in exchange rate or outside shock could influence volatility in export performance. Therefore, government policies that would stabilize the exchange rate would be needed to stabilize export.

Table 2: ARCH and GARCH Result

Mean Equation (ARCH)

GARCH = C(4) + C(5)*RESID(-1)^2 + C(6)*GARCH(-1)				
Variable	Coefficient	Std. Error	z-Statistic	Prob.
EXCR	-15.21815	1.100032	-13.83427	0.0000
INF	2.643914	0.381084	6.937877	0.0000
LGDPPC	46.34245	2.807110	16.50895	0.0000
Variance Equation (GARCH)				
C	123.7100	110.0928	1.123689	0.2611
RESID(-1)^2	2.872509	1.229382	2.336547	0.0195
GARCH(-1)	-0.208111	0.103845	-2.004062	0.0441
R-squared	0.473810	Mean dependent var		141.0504
Adjusted R-squared	0.436225	S.D. dependent var		129.3985
S.E. of regression	97.15880	Akaike info criterion		9.824560
Sum squared resid	264315.3	Schwarz criterion		10.10211
Log likelihood	-146.2807	Hannan-Quinn criter.		9.915033
Durbin-Watson stat	2.188429			

Source: Eviews 9 (2022)

Heteroskedasticity Test: Autoregressive Conditional Heteroskedasticity (ARCH)

From table 3, the rule of thumb is that if the Prob. Chi-Square (1) is more than 5 percent, the null hypothesis cannot be rejected. The null hypothesis is that there is no heteroskedasticity in the model. From the table, the study observed that the Prob. Chi-Square (1) was more than 0.05 (0.6876), therefore the null hypothesis should not be rejected and it is stated that there is no heteroskedasticity in the model.

Table 3: Heteroskedasticity Test: ARCH

Heteroskedasticity Test: ARCH			
F-statistic	0.151696	Prob. F(1,28)	0.6999
Obs*R-squared	0.161655	Prob. Chi-Square(1)	0.6876

Source: Eviews 9 (2021)

4.3 Johansen Co integration

The main thought of co-integration is that two or more variables will have long-run equilibrium relationship when their linear combination is stationary (that is meets at any equilibrium for some periods). The reason for this analysis is to ascertain if the variables have long-run relationship or not. The paper tests the presence of long-run equilibrium relationship between the endogenous variable and the exogenous variables employing Johansen co-integration. The co integration test becomes essential when the variables are observed to be first-difference stationary or I(1). When the Trace and Max Eigen statistics surpasses the critical value at 5% level of significance or when probability values of the Trace statistics or Max Eigen value is less 0.05, then there is presence of cointegration and vice versa. The Johansen Cointegration was used to study the long run association between export performance and volatility of exchange rate, inflation, and gross domestic product.

The null hypothesis was:

H_0: $\gamma = 0$ (No presence of long-run effect)

Studying the result below, trace statistics cointegration result provided evidence of two cointegrating equations. This is because all the two probability values (prob.) are significant at 5% establishing a long-run relationship between the endogenous and exogenous variables in the model. The Max-Eigen statistics also established two cointegration equation as all its two probability figures (prob.) are statistically significant at 5 per cent. Therefore, table 4 provided co integrating relationship between export and exchange rates volatility, inflation, and gross domestic product.

Table 4: Cointegration result based on trace and max-eigen statistics

Hypothesized No. of CE(s)	**Eigen Value**	**Trace Statistics**	**0.05 Critical Value**	**Prob. ****	**Hypothesized No. of CE(s)**	**Max-Eigen Statistics**	**0.05 Critical Value**	**Prob. ****
None *	0.660975	55.85501	47.85613	0.0074	None *	29.20542	27.58434	0.0307
At most 1 *	0.425405	26.64958	29.79707	0.0105	At most 1 *	14.96040	21.13162	0.0217
At most 2	0.307204	11.68918	15.49471	0.1724	At most 2	9.909531	14.26460	0.2179
At most 3	0.063788	1.779650	3.841466	0.1822	At most 3	1.779650	3.841466	0.1822

Source: Researcher's computation (2022)

4.4 Granger Causality

This established whether a causal connection existed between export and exchange rate volatility, GDP per capita, and inflation. It also showed if the level of such causality is mono-directional (that is just one variable causes the other and no other way round) or bi-directional (that is both variables granger causes each other).

From table 5 below, for the first hypothesis, log of export (LEXP) does not granger causes exchange rate volatility (EXCR) as its probability values of 0.2307 was not statistically significant at 5% to prove this. However, exchange rate volatility (EXCR) was found to have a causal effect on log of export as its probability values of 0.0242 was significant at 5 percent significance level to prove this. This means that exchange rate volatility could cause or lead to export performance. Hence, for this, a mono-directional relationship occurs between exchange rates volatility and exports.

For the second and third hypothesis, the null hypotheses were accepted as their probability values were not significant at 5 per cent level of significance to prove this.

Table 5: Granger Causality Result

Null Hypothesis:	Obs	F-Statistic	Prob.
EXCR does not Granger Cause LEXP	30	1.34755	0.0242
LEXP does not Granger Cause EXCR		1.50332	0.2307
INF does not Granger Cause LEXP	30	1.29775	0.2646
LEXP does not Granger Cause INF		3.06604	0.0913
LGDPPC does not Granger Cause LEXP	30	2.47658	0.1272
LEXP does not Granger Cause LGDPPC		0.00574	0.9402

Source: Researcher's computation (2022)

4.5 Discussion of Result/Policy Implication

The analysis proved that first, previous year's export information can influence current year's export output and past export volatility would affect its present volatility. Also, the study found that exchange rate volatility or outside shock can transmit to export performance. This means that exchange rate volatility has an effect on export performance. The study, therefore, opined that the connection between exchange rate and export performance was a direct relationship after all since theoretically, monetary policy factors like exchange rates impact productive sectors like export.

Secondly, the connection between exports and exchange rates volatility, inflation, and GDP is a long-run relationship based on the Johansen cointegration result.

Finally, a causal relationship existed only between exchange rates volatility and exports based on its probability value of 0.0242 and which was significant at 5%. This means that exchange rate volatility can induce or have a causal effect on export performance. This means that exchange rate volatility was an important element in impacting export.

5.0 Conclusion and Policy Recommendation

5.1 Conclusion

This research investigated how agricultural export drive could be induced by volatility of exchange rates, inflation, and GDP in Nigeria. The study analysis started with stationarity test using ADF which showed presence of stationarity at first difference in the data. Also, GARCH was analyzed and confirmed the volatile nature of the current exchange rate to past exchange rate with export also. This proves that export is highly volatile to movements and shocks in exchange rate. Therefore, exchange rate that is market-determined stimulates volatility which is in line with many studies which posited that movement from government-determined exchange rate to exchange rate that is market-determined has introduced volatility plus fluctuations in the exchange rate. Furthermore, there existed a long-run effect in-between exchange rates volatility with all independent variables. Moreover, granger causality proved no causal nature among the variables. Finally, recommendations were drawn.

5.2 Recommendations

1. The government should limit the exposure of the economy to exchange rate volatility by boosting local production and reduce the country's dependence on imports.
2. There should be diversification of the Nigeria's exports base from crude oil to agricultural and service exports.
3. The Central Bank should create a future contract exchange rate market where dealers can freely participate in purchasing future contract of their foreign exchange needs early enough to reduce exchange rate risk.
4. Government should remove all excise duties on exports so as to minimize price of exported goods in order to boost foreign demand and thereby growing the Nigerian economy.
5. The Central Bank should put more efforts to improve monetary-fiscal coordination through emphasis on fiscal rules so as to keep inflation low while stabilizing it.

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