

Exchange Rate and Price Volatility in Nigeria: Implications on Macroeconomic Stability

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Abstract

This research centered on exchange rate and price volatility in Nigeria. Exchange rate and price volatility are becoming serious concern in the Nigerian economy because of their rapid changes and high volatile trend leading to macroeconomic instability. We aimed to empirically investigate volatility of exchange rate and general price level in Nigeria and their effects on macroeconomic stability. The ARCH and GARCH models are employed to check for volatility clustering. The impulse response and forecast error decomposition were derived from VAR to measure interrelationships among the macroeconomic variables which include, parallel market exchange rate (BEXR), consumer price index (CPI) and changes in the gross domestic product (GDP). Results showed presence of volatility clustering in the exchange rate and general price level in Nigeria. The implications are low saving and low investment and diminishing real income leading to vicious circle of poverty. Findings also revealed no significant output responses to both parallel market exchange rate and the general price level. As a result, the two variables might be inefficient policy instruments to stimulate output growth. However, for the import dependent Nigerian economy, the two variables cannot be totally isolated in policy making. Therefore, they surely must be stabilized to achieve stable macroeconomic environment. This requires that the distribution line of foreign exchange from official to parallel market must be thoroughly checked. Import substitution industrialization hinge on commercial production of goods and services within the domestic economy reduces pressure on foreign goods demand, exchange rate demand and consequently enhances stabilization of the entire macroeconomic framework.

Keywords: Exchange Rate, Price Index, Parallel Market, GARCH, VAR JEL Classification Codes: E32, E37, E44, E58

1. Introduction

In an attempt to find feasible solution to stabilize the Nigerian macroeconomic framework, a lot of researchers offered probable solutions which appear not yielding expected outcome when applied. Maintaining a reliable and developed financial system requires stability of exchange rate and general price level. Exchange rate is a key price variable in an

economy and performs dual role of maintaining international competitiveness, and serving as nominal anchor for domestic prices (Mordi, 2006). It is a very important price which governments take very active interest in (Obadan, 2006). This might be one of the reasons why the Nigerian highest monetary authority, the Central Bank of Nigeria (CBN), top-most objective is to maintain price and exchange rate stability

with a view to contribute to the development of Nigeria.

In some of the critical research carried out in the past, (Yinusa & Akinlo, 2008; Adeoye & Saibu, 2014) discussed the implication of exchange rate volatility in the economy. While Yinusa and Akinlo found that currency substitution badly induced volatility of exchange rate, Adeoye and Saibu, on the other hand, established that depreciation of nominal value of macroeconomic variables such as inflation rate, reserves, interest rate and money supply lead to volatility of exchange rate. However, in some recent literature on Nigeria, it appears volatility of oil price and unstable general price levels are the principle causes of volatility in exchange rate (Igbinovia & Ogiemudia 2021; Nuhu 2021). In addition, Onubogu, and Dipeolu (2020) and Ajibade and Ayinde, Abdoulaye (2020) listed factors that induced high prices, particularly, food prices, which include crude oil price, inflation rate and exchange rate among others. Therefore, it appears general price level and exchange rate are crucial factors in macroeconomic stabilization and these two deserve urgent attention which previous authors might have overlooked. As a result, when suggestions were offered and probably practiced, they made no significant positive economic effect.

Moreover, in the previous studies, unlike Clarida and Gali (1994), Echenbaum and Evans (1999), Adebisi and Ogunleye (2009), most authors (Tomori, 2019; Adeoye, 2019; Musa & Ifarajimi, 2022) did not examine the episodic factors in the exchange rate and price movement. Identifying structural breaks allow clearer understanding of trend in historical changes of a variable. It eases the challenges associated with comparing prevailing economic financial activities with a period of relative stability and another period of instability. To buttress the robustness of the empirical study, while it appears many previous analyses were done with yearly aggregate data, monthly data would be obtained for this study and it is anticipated that it produces improved outcomes. Therefore, the paper investigates the volatility of exchange rate and price in Nigeria and their implications on macroeconomic stability in Nigeria from January 2010 to March, 2021.

2. Review of Relevant Literature

2.1 Conceptual Review

Macroeconomic variables are aggregate economic indicators such as interest rate, exchange rate, money supply, gross domestic products and export. Others are investment, national savings, inflation rate and import. The price level is an important

macroeconomic variable being monitored by the CBN. This is imperative because of its relativity to exchange rate and value of domestic currency, income and welfare of the populace. Generally, price is the value of quantity of a commodity or service offered by one party to another. Price gives specific worth of a value embedded in good or service. Unlike the olden days of trade by barter, specific price enhances trade and exchange and make both easy to perform within domestic economy and across international boundaries. The general price level refers to the average price of commodities (composite consumer price index) recorded over time. Changes in the average general price level simply means inflation rate. However, it is deflation or recession if the changes are negative and recurring. Stable price and exchange rate are both crucial to macroeconomic stability.

The concept of exchange rate may implicitly refer to price of imported goods. It may also point to financial and economic prestige of a country. Exchange rate and price can be likened with each other and both can influence consumption, investment decision and the macroeconomic planning

Mordi (2006) stated that exchange rate serves as nominal anchor for domestic prices, and as a result, it can be defined as the price of one currency vis-à-vis another

and is the number of units of a currency required to buy another currency. It means that exchange rate performs dual purpose functions, as a price and as a medium of exchange to acquire foreign goods via foreign currency. For an import dependent country like Nigeria, exchange rate is very crucial for business transaction and generally, price stability. The duty of maintaining stable exchange rate is vested in monetary authority who ensures close watch on the trend in the world and domestic economy in order to set a target for equilibrium rate. Often in a developing country with considerable level of economic openness, when the economy faces shocks and seemingly inefficient management of exchange rate, there might be volatility leading to volatility clustering if not tackled on time.

In their views, Obadan (2006), Mordi (2006), Adebisi and Mordi (2012) attested to the fact that exchange rate variations means the swings or oscillations in the exchange rates for a period of time. It also refers to deviations from a target or equilibrium exchange rate. Exchange rate can be fixed or flexible, but whenever it is not, it is bound to fluctuate. In other words, floating or flexible exchange rates tends to be more volatile. The level of volatility depends on macroeconomic fundamentals (Obadan, 2006; Xie, Chen, & Hsieh, 2021).

This may include the level of financial development, the level of interaction between fiscal and monetary policies as well as the zeal of monetary authority management ability. The concept of short run and long run equilibrium also come to play in exchange rate theory. While the short run may refer to the rate established in a liberalized environment, operating through the interplay of the forces of demand and supply, the long run implicitly refers to a rate that enhances external balances and long run macroeconomic stability (Obadan, 2006; Adebisi, 2007). The purchasing power parity (PPP) is also another concept in exchange rate which researchers such as (Dornbusch (1985); Rogoff (1996); Taylor and Taylor (2004); Xie, Chen, and Hsieh, 2021) explained that the rate a country's currency exchanges for another and would be in equilibrium when their purchasing power is equal. Taylor and Taylor (2004) highlighted that our valuation of a foreign currency in terms of our own mainly depends on the relative purchasing power of the two currencies in their respective countries.

For developing countries and Nigeria specifically, exchange rate volatility has become a serious economic menace and appears to be driving prices rapidly upward, increasing poverty and causing significant macroeconomic instability. Currently,

Nigeria tends to experience more fluctuation in price and depreciation of domestic currency as there appears no fundamental policy in place to halt the wild trend of exchange rate and upward price movement. In this research, we think perhaps, measuring the volatility through ARCH and GARCH modelling may yield improved results unlike in previous studies.

2.2 Empirical Literature

Exchange rate and price volatility seem to have become economic menace in Nigeria presently. A number of studies were conducted and researchers addressed the challenges the two variables may pose to preempt possible negative economic impact. This has become imperative to forestall creating undesirable crushing economic setback capable of alienating Nigeria in the committee of nations. In the actual sense in Nigeria, the issue with exchange rate affecting the economy significantly began with deregulation policy following adoption of Structural Adjustment Programme (SAP) in 1986. With the deregulation policy, determination of oil price, interest rate and exchange rate were implicitly left to the market. Researches in that period were based on whether deregulation affected prices and exchange rate or whether exchange rate affected prices or not. Also discussed were merit and demerit of deregulation of exchange rate. Relevant

literature relative to these arguments include (Obadan, 2006; Mordi, 2006; Adebisi, 2007; Osinubi and Amaghionyeodiwe, 2009; Englama, Duke, Ogunleye and Isma'il, 2010). They also discussed management of exchange rate and various regimes such as regulation and deregulation as well as concessionary exchange rate. As a result, in the post-SAP era, exchange rate appeared to be kept relatively stable with the exception of basically external oil price shocks which caused occasional turbulence.

In the late 2000s, when the seemingly intensive deregulation of the economy began to take its toll on the Nigerian economy, series of research emerged to measure exchange rate impact on the economy with a view to offer suggestions that may improve macroeconomic framework. Researches in that period appeared to have been induced by privatization and commercialization of public enterprises as well as merger and acquisition in the financial sector. The persistent external oil price shocks was also among research topics. The frequent changes in crude oil price appeared to have resulted in frequent upward movement of domestic product prices and exchange rate and consequent rise in general price level. The resultant incidences were macroeconomic instability and further price distortion. Literature from that period till now focused on management of exchange

rate and its impact on economic growth under deregulation. They also discussed floating exchange rate and macroeconomic variable factors. Some of these literature include (Ammani, 2012; Ngerebo & Ibe, 2013; Adeoye & Saibu, 2014; Nkoro & Uko, 2016; Lawal, Somoye & Babajide, 2016). Such research also discussed floating exchange rate, optimal exchange rate system, whether retail and wholesale Dutch auction system. This again offered an insignificant solution as exchange rate trend continued upward movement and thereby driving inflation rate high.

The bottom line is that many of the post-SAP era literature focused on effect of exchange rate on macroeconomic variables and the real sector and the debate continued till the present time even as devaluation of naira continues. For instance, while Ammani (2012) examined the effect of exchange rate on the agricultural sector using cotton production as an example, Ngerebo-a and Ibe (2013) examined the effects of exchange rate on balance of payments, GDP and inflation rate. Their findings were not significantly different from Adeoye and Saibu (2014), who examined the effect on macroeconomic variables; that exchange rate actually has relationship with some macroeconomic variables such as interest rate and prices but has no significant relationship with the real sector like cotton

producing industry. They explained that more cotton were produced after SAP and more are still being produced and that this is a similar trend in the real sector.

In some of the recent literature, the focus seemed to be on economic integration and level of openness. Some of these are Barguelli (2018) and Boubakri, Guillaumin and Silanine (2019). While Barguelli's (2018) findings emphasized the need for a country's substantial financial integration to enhance relative, stable and real exchange rate and macroeconomic framework, Boubakri, Guillaumin and Silanine (2019) on the other hand, established that flexible exchange rate regimes and extreme financial openness would aggravate volatility of exchange rate and prevent economic stability. Other recent literature have multifarious outcomes which also focused on effect of exchange rate on food prices, oil prices and inflation. Some in these category are Ajibade et al (2020) and Nuhu (2021). They found that while exchange rate drives food prices, equivalently, oil price shock also drives exchange rate. In another review on volatility of exchange rate, Ahmadi and Manera (2021) findings for developing countries and emerging economies revealed volatility clustering common mostly as a result of oil price shocks. They suggested that government policy on macroeconomic

planning in such region with oil endowment should understand the fundamental causes of its disparities and the state of the economy. Given these diverse research findings, one may conclude that oil price shocks and monetary policy making play key role in volatility of both exchange rate and the general price level in Nigeria.

As an innovation in this research, the parallel market rate and its interaction with the consumer price index and aggregate economic performance are examined. There appears a new development in the Nigerian foreign exchange market in recent time which sends signals to prices and output. It seems the parallel market rate is becoming obvious and has a noticeable impact. For the Nigerian economy, there must be a peculiarity about the parallel market foreign exchange activities demanding a thorough examination. In most literature, the official rate is often preferred to parallel market rate may be as a result of unavailability of reliable data. Nevertheless, for over a decade the CBN has been presenting a reliable data on the parallel market (as a variable) thereby enhancing reliable and researchable thesis on the subject. The parallel market (Bureau de change) appears a large market in Nigeria where foreign exchange transactions take place significantly. This may be the result of the fact that Nigeria has a large informal

sector with non-negligible volume of economic transactions.

2.3 Trend in Macroeconomic Policy Instruments in Nigeria

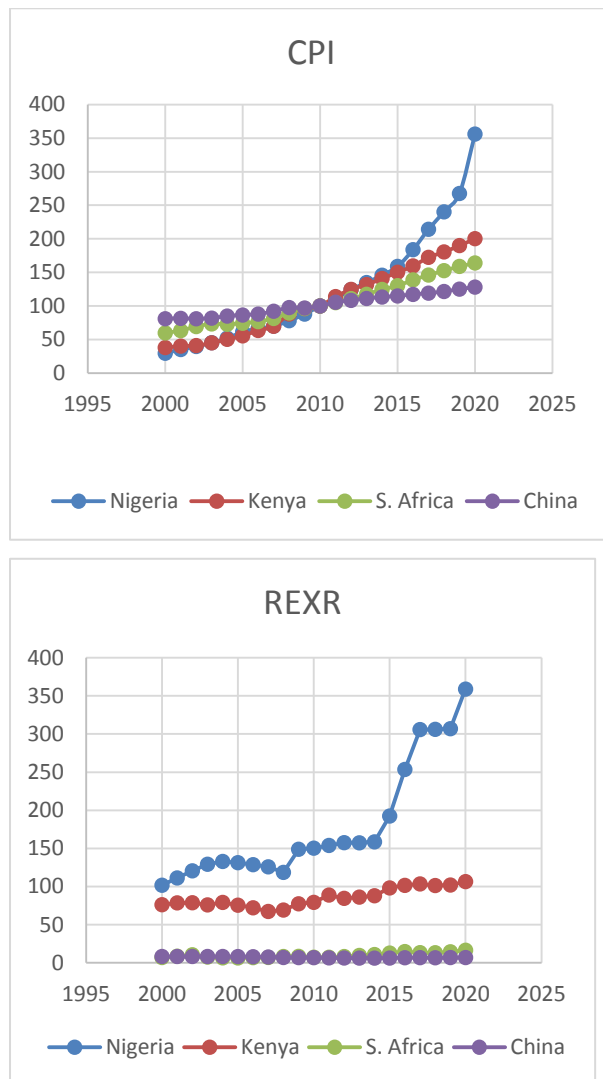


Figure (a): Annual Consumer Price Index (CPI) of Figure (b): Real Effective Exchange Rate (REXR) of

Developing and Emerging Economies, (2010=100) Developing and Emerging Economies

Source: Author's Computation Based on WDI Data

The consumer price index (CPI) and real effective exchange rate (REXR) of developing countries and emerging economies are illustrated in Figures A and B. It can be seen from Figure (a) that although, CPI for selected countries showed

upward trend from year 2010, but the Nigeria's CPI, rised rapidly and higher than other countries in whatsoever, period one might signify. Meanwhile, in Figure b, while REXR appeared relatively stable in other countries, including sub-Saharan

Kenya, but in Nigeria, the variables rapidly shot upward from year 2015 and raised to about 370 naira to 1 US dollar in 2020. The episodic rise in exchange rate and the sudden acceleration from 2015 to 2020 might be a clear indication of improper management of macroeconomic policy framework in Nigeria. Meanwhile, the parallel market, where average citizens perform daily foreign exchange transaction, is higher than the “real effective rate”. Looking at Kenya, although exchange rate is relatively higher than emerging economies

like South Africa and China, but stability of the variable is attainable. Therefore, it means a comparatively stable Kenyan macroeconomic outlook, based on key economic indicators like exchange rate and price movement, might attract more foreign investors while Nigeria’s seemingly unstable economy remains unattractive. Exchange rate trend in Nigeria from 2010 clearly indicates how volatile the market rate has been, and probably the major driver of prices and economic instability.

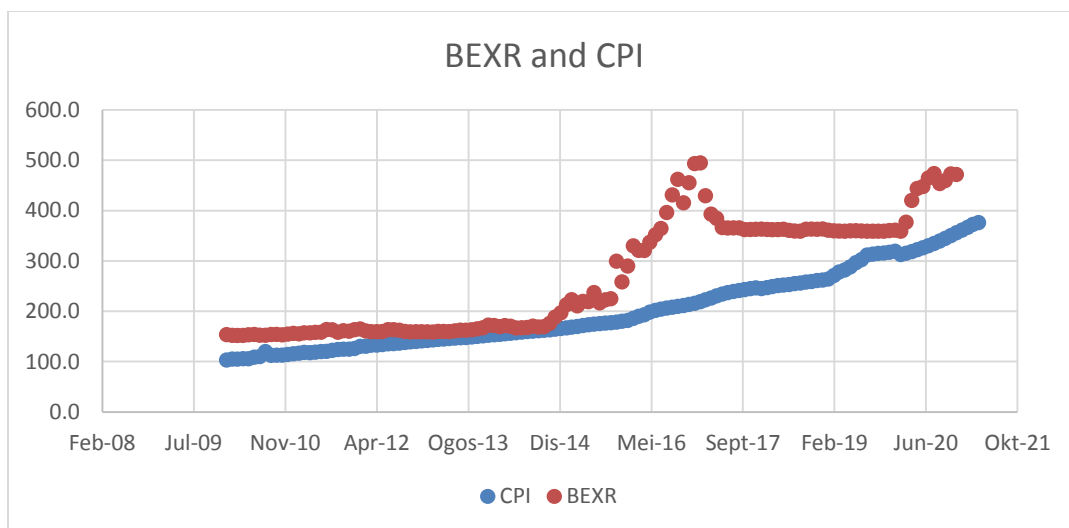


Figure c: Exchange rate trend at the bureau de change

Source: Author’s Illustration Aided by CBN Statistical Bulletin, 2020

Figure C showed exchange rate and price trend. While it appeared exchange rate is relatively stable from 2010 to 2014 and third quarter of 2016 to first quarter of 2020, general price level continued to display upward trend. Nevertheless, whether

exchange rate was stable or volatility, prices were high in either episode, it means that exchange rate might be a key factor, but might not be the only principle determinant of price movement in Nigeria.

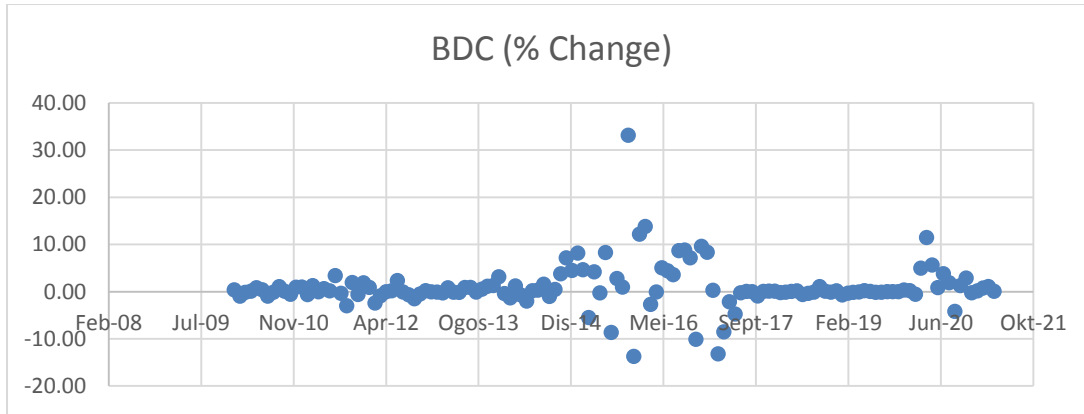


Figure d: Scatter plot of monthly percentage change in exchange rate at the Bureau de change, Nigeria

Source: Author's Illustration Aided by CBN Statistical Bulletin, 2020

Examining a scatter plot for the parallel market denoted by (BDC), Figure d, we noticed instability or high volatility between 2014 and 2016 and low volatility between 2017 to early 2020. This was eventually followed again by period of high volatility in early 2020 to mid-2021. However, before

these periods, we noticed a period of low volatility from year 2010 to early 2014. Theoretically, the implication of volatility clustering is to lay foundation implicitly for future economic instability. This might be the case currently experienced in Nigeria and it demands urgent attention.

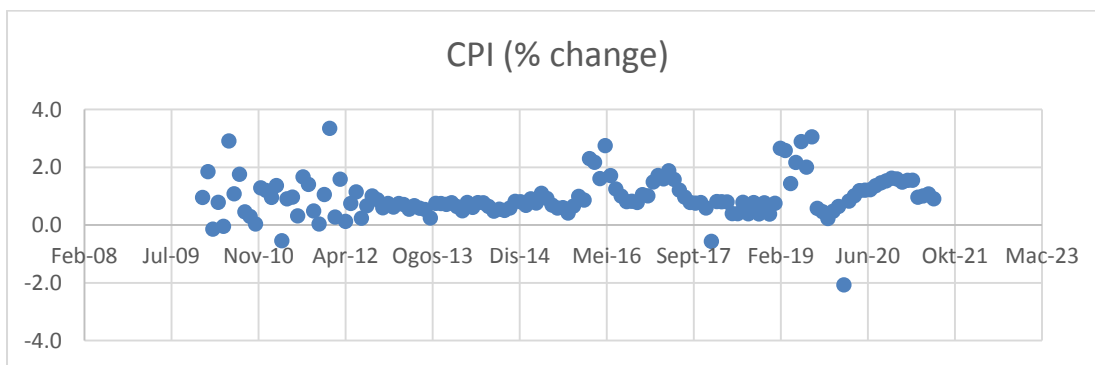


Figure e: Scatter plot of Monthly percentage change in in consumer price index, Nigeria.

Source: Author's Illustration Aided by CBN Statistical Bulletin, 2020.

The distortion in general price level is illustrated in scatter plot in Figure e. It is difficult to fit a straight line for the graph. This emphasizes how difficult it might be to predict price in Nigeria. It is believed by

average Nigerians that price moves with exchange rate and that whenever exchange rate rises, price also rises. Equivalent notion is established in the trend shown in Figure c. However, in this research, we assumed there

are other key macroeconomic or stochastic variables responsible for price rapid movement in Nigeria. For the stochastic variable, the recent outbreak of Covid-19, which negatively affected the economies of the whole world, might be a principle factor. With the outbreak, it appears the economies of developing countries are hard-hit by the shock more than the industrial countries.

3. Methodology

The trend analysis in section two depicted some elements of volatility of exchange rate and price which need to be tested empirically. The empirical methods for testing volatility clustering were undertaken. These include the autoregressive conditional heteroscedasticity (ARCH) and the generalized autoregressive conditional heteroscedasticity (GARCH) models developed by Engle (1982) and popularized by Engle and Bollerslev (1986). ARCH and GARCH models capture volatility clustering although GARCH might perform better than ARCH model. The process include testing for ARCH effect to ascertain the volatile condition of exchange rate and price in Nigeria. If the alternative hypotheses (of the presence of ARCH effect) for the two variables: monthly exchange rate at the parallel market (BEXR) and the monthly change in consumer price index are accepted, then we proceed to testing for GARCH effect.

In addition, responses of output change to the two variables would be examined. This requires the vector auto-regression model (VAR) developed by Sims (1980), Sims (1986) and Sims, Stock and Watson (1990). The method permits measurement of interrelationship among variables and concurrent estimation of the variables. The impulse response function and forecast error decomposition obtainable in VAR make possible the measurement of shocks from one variable to another and variable responsible for errors in another variable in a particular period. Time series data used for the regression analysis were obtained from the CBN Statistical Bulletin, 2010-2020. However, some data used for some graphical illustrations were obtained from the World Bank World Development Indicators (WDI).

Model Specification

The ARCH and GARCH models are specified in this section. A simple VAR model is also presented to obtain impulse response function and the forecast error (variance) decomposition. These methods have been employed by Oyinlola and Egwaikhide (2011), Ajibade et al (2020) and Nuhu (2021). Following the objective of this study, the following variables shall be employed: exchange rate at the parallel market represented by the bureau de change (BREX), consumer price index (CPI) and

changes in Nigerian national output (GDP). Monthly data obtained from the CBN Statistical Bulletin, 2020 was presented for the regression analysis. Except for the variables employed in empirical analysis, the methodology and estimation techniques used by the authors stated above were equivalent. The empirical model set by Oyinlola and Egwaikhide (2011) gave a brief highlight of the authors' work, a vector error correction model (VECM) stated in equation (1) below: (detail check in Oyinlola & Egwaikhide, 2011).

$$\Delta y_t = \alpha \beta' y_{t-1} + \sum \Gamma_i \Delta y_{t-i} + \pi + \zeta_t = 1, \dots, T \quad (1)$$

Where y_t is a vector of endogenous variables which include domestic price, exchange rate, money, income and world export price. α is parameters measured by the speed at which the variables in the system adjust to their long run equilibrium values. β' vectors are estimates of the long run co-integrating relationships between the variables in the model. π is the drift parameter and ζ_t the error term. The long run equation is stated thereafter. While VECM as assumed in Oyinlola and Egwaikhide's work would produce improved result over VAR, in the current article, since co-integration test was not achieved, unrestricted VAR was adopted to obtain impulse response and forecast error decomposition. Moreover, testing volatility

clustering with monthly data from January, 2010 to December 2020, in the Nigerian market is the major objective. Estimation exclude testing for long run effect. Therefore, the ARCH and GARCH were adopted to measure the volatility clustering among the macroeconomic variables of interest (BEXR and CPI). GDP was introduced in VAR estimation. The BREX was rarely used in previous studies which might be due to dearth in reliable data availability. Nevertheless, VAR (impulse responses) suggest to a degree what might happen in both short run and the long run as a result of innovations or shocks.

For this study, model specification begins with the ARCH mean equation and extended to GARCH having achieved ARCH effect.

The Mean Equation

Generally, the ARCH model is usually preceded by the mean equation

$$\chi_t = \Psi Z'_t + \varepsilon_t \quad (2)$$

Equation (2) represents the mean equation for the conditional mean of χ_t given Z'_t where χ_t is a dependent variable and Z'_t is a set of regressors, Ψ is a parameter and ε_t denotes shocks or innovations. Note that:

$$\varepsilon_t = \varrho^t \phi_t \quad (3)$$

Where $\phi_t \sim NIID(0,1)$

The equation for the conditional variance of ϱ^t is given as:

$$\varrho_t^2 = \gamma_0 + \delta \varrho_{t-1}^2 + e_t \quad (4)$$

$$\gamma_0 > 0; \delta \geq 0 \quad 5$$

Equation (4) represents the ARCH(1) effect where null hypothesis, ($h_0 = 0$) and alternative hypothesis ($h_1 \neq 0$), which signify homoscedasticity or heteroscedasticity respectively. In equation (5), the GARCH (1,1) model is stated:

$$\sigma_t^2 = \gamma_0 + \delta \sigma_{t-1}^2 + \delta \varepsilon_{t-1}^2 \quad (5)$$

Equation (5) depicts the variance of two models are equal (γ_0 and $\delta \varepsilon_{t-1}^2$) where the variance of the error term (ε_{t-1}) is predicted using the variance value of the error term in year $t-1$.

For variables for this study to replicate ARCH model, equation (6) is presented below:

$$\chi_t = \beta_1 \text{BREX}'_t + \beta_2 \text{CPI}'_{t_t} \varepsilon_t \quad (6)$$

where χ_t is a dependent variable and BREX'_t and CPI'_t are set of regressors, β_1 and β_2 are parameters and ε_t denotes shocks or innovations. The ε_t in equation (6) is the variable of concern, the error term. In addition, in ARCH and GARCH as well as any other variance measurement method like TGARCH and EGARCH, the modelled is on the

conditional variance. In other words, the concern is on the degree of variance in the market, for instance; the ε_t in equation (2) becomes " $\varepsilon_t = \varrho^t \phi_t$ " as stated in equation (3).

To capture the impulse response function, we state equation (7) as an auto regressive linear equation to be estimated as unrestricted VAR and obtained the impulse responses.

$$y_t = \theta_0 + x_t[L]y_{t-1} + \varepsilon_t \quad (7)$$

Where x_t is an exogenous variable, $\theta[L]$ is a matrix polynomial in the lag operator of variables, y_{t-1} is the lag value of exogenous variable, ε_t is the vector of estimated shocks for each of the monetary policy variables. We assumed ε_t is serially uncorrelated. The VAR specification in the context of this article, expressed in multivariate AR (1) to examine the contemporaneous impact of shocks, is specified as followed:

$$\text{GDP}_t = \vartheta_0 + \sum \text{GDP}_{t-i} + \sum \text{BEXR}_{t-i} + \sum \text{CPI}_{t-i} + \varepsilon \quad (8)$$

$$\text{BEXR}_t = \vartheta_0 + \sum \text{BEXR}_{t-i} + \sum \text{GDP}_{t-i} + \sum \text{CPI}_{t-i} + \epsilon \quad (9)$$

$$\text{CPI}_t = \vartheta_0 + \sum \text{CPI}_{t-i} + \sum \text{BEXR}_{t-i} + \sum \text{GDP}_{t-i} + \mu \quad (10)$$

4. Empirical Results

This section presents results of the empirical testing of ARCH and GARCH effects.

4.1 Volatility Measures in Nigeria

Table 4.1. ARCH Effect Variance Equation

Dependent Variable = RETURNSONBEXR

Variance Equation				
C	0.00142	6.65E-05	21.47717	0.0000
	8			
RESID(-1)^2	0.17147	0.115297	1.487277	0.1369
	8			

Source: Author's computation with e-views 10, based on data from the CBN

The variance equation of the ARCH model was presented in Table 4.1. It can be observed that the coefficient of the variance equation is positive, representing evidence of volatility of exchange rate in Nigeria and in particular, the parallel market where small scale dealers and their customers can easily obtain foreign currency. Table 4.2 contains heteroscedasticity test for the model.

Table 4.2. Heteroscedasticity Test on Return on BEXR

Test: ARCH				
F-statistic	7.251129	Prob. F(1,128)		0.0080
Obs*R-squared	6.969604	Prob. Chi-Square(1)		0.0083

Source: Author's work based on data from the CBN

The test result showed rejection of null hypothesis of no ARCH effect because the Prob. Chi-Square (1) is equal to 0.0083, significant at 1%. We then proceed to GARCH effect which is expected to generate further result for a more reliable suggestion.

Table 4.3. Variance Equation for the GARCH Effect

Variance Equation				
C	0.000146	3.80E-05	3.830253	0.0001
RESID(-1)^2	0.148782	0.0306	4.862122	0.0000
GARCH(-1)	0.598782	0.0651	9.193123	0.0000

Source: Author's work based on data from the CBN

The GARCH model result was presented in Table 4.3. The result revealed a clearer outcome of BEXR volatility measure. The coefficient of GARCH model was larger than the ARCH model which further explains volatility clustering in the parallel market. The sum of the two coefficients (residual and GARCH (1) model) is equal to 0.74756, indicating a long run volatility in the market.

Table 4.4. Heteroscedasticity Test (GARCH Effect) RETURNSONBEXR

Heteroscedasticity Test: ARCH			
F-statistic	0.170610	Prob. F(1,127)	0.6803
Obs*R-squared	0.173064	Prob. Chi-Square(1)	0.6774

Source: Author's work based on data from the CBN

In testing for heteroscedasticity, the null hypothesis of no heteroscedasticity is accepted. It means the GARCH model truly states the volatile nature of the market. Therefore, there is a need for the Nigerian monetary authority to check this economic challenges to prevent further potential damage to the macro economy.

Table 4.5 GARCH Variance Equation on Returns on CPI

Variance Equation				
C	2.91E-06	6.85E-07	4.250064	0.0000
RESID(-1)^2	0.178612	0.058741	3.040682	0.0024
GARCH(-1)	0.757021	0.042789	17.69178	0.0000

Source: Author's work based on data from the CBN

Table 4.5 displayed the GARCH variance equation where the coefficient results are improvement over ARCH effect. The consumer price index in Nigeria appears to be adversely affected by the exchange rate volatility. We also empirically established volatility clustering in general price level in Nigeria. The heteroscedasticity test shows evidence of minimum variance for the model set.

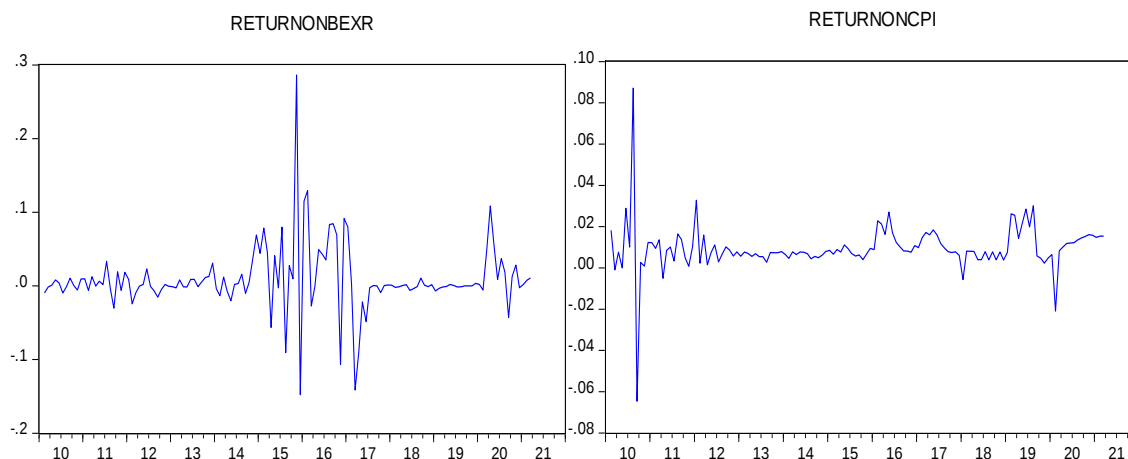


Figure (f): Returns on REXR

Figure (g): Returns on (CPI)

Source: Author's Computation Via E-views 10, Based on CBN Statistical Bulletin, 2020-2021

The volatility of the general price level and parallel market (bureau-de-change) were displayed in Figure (f) and Figure (g). They showed evidence of volatility clustering within the year (monthly observations) under review. There is evidence of volatility clustering in returns on parallel market exchange rate. It began with period of low volatility from January 2010 to March 2014. This was followed by period of high volatility from second half of 2014 to last quarter of 2016 and followed by another period of low volatility from January 2017

to October and November 2019. This again was followed by another period of high volatility till 2021. Volatility clustering was also depicted in the CPI. It started with period of high volatility to low volatility till the last quarter of 2018 after which a period of high volatility followed. All these clearly illustrate how unstable the Nigerian macro-economy is, reflecting a probable poor macroeconomic management. We signify that the unpredictable price and volatile exchange rate can increase risk and uncertainty and consequent reduction in investment demand and discourages prospective investors.

4.2. Impulse Response Function

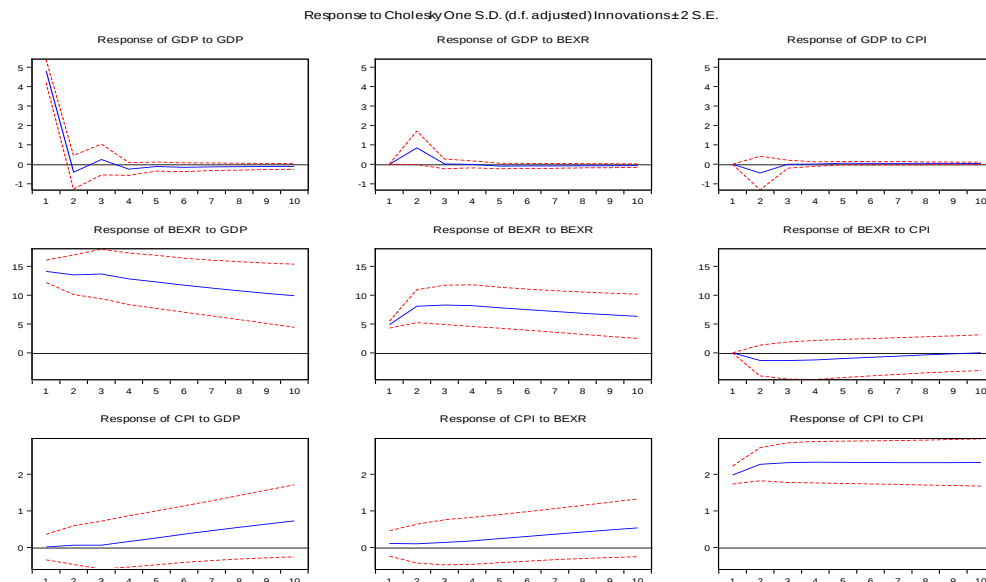


Figure (h): Impulse response function

Source: Author's Computation Based on data from CBN Statistical Bulletin, 2020-2021

It is noticeable from figure (h) that at the beginning of the period, GDP showed response to shocks (from BEXR and CPI) but as from the third period, it showed no response any more. One may conclude that exchange rate and price policies do not have

significant effect on annual output changes in the long run. The variance decomposition is presented in Table 4.6, which allows us to determine factors responsible for variation in each variable

4.2.1 Variance Decomposition

Table 4.6. Variance Decomposition (BEXR)

Period	S.E.	GDP	BEXR	CPI
1	14.9683	89.3087	10.6912	0.0000
2	21.7767	80.7843	18.8477	0.3678
3	27.0620	77.8858	21.6307	0.4834
4	31.0748	76.1432	23.3356	0.5210
5	34.3426	75.1978	24.2931	0.5090
6	37.0681	74.5819	24.9382	0.4799
7	39.3986	74.1660	25.3892	0.4446
8	41.4201	73.8629	25.7274	0.4096
9	43.1946	73.6324	25.9894	0.3780
10	44.7667	73.4490	26.1989	0.3520

Source: Author's work based on data from the CBN

It can be noted in Table 4.6 that GDP is responsible for 73% to 89% of variation in BEXR followed by the BEXR own shocks. However, own shock determines over 90% of variation in CPI and GDP. There is a strong economic relationship between GDP and BEXR in Nigeria, increase demand for output, probably as a result of rise in population that leads to increase demand for goods and services much of which are bound to be imported goods. This in turn,

puts pressure on demand for foreign currency. In other words, the Nigerians penchant for foreign goods (manufacture goods) and services (medicals, education and shopping) would exerts upward demand on foreign currencies and this would be self-perpetuating, leading to devaluation of domestic currency. The situation then becomes a vicious circle, worsening macroeconomic framework.

Table 4.7. Variance Decomposition (CPI)

Period	S.E.	GDP	BEXR	CPI
1	1.9837	0.0036	0.3060	99.6903
2	3.0210	0.0452	0.2498	99.7049
3	3.8113	0.0570	0.2922	99.6507
4	4.4737	0.1774	0.3766	99.4458
5	5.0554	0.4072	0.5237	99.0690
6	5.5841	0.7583	0.7245	98.5171
7	6.0757	1.2144	0.9728	97.8127
8	6.5408	1.7635	1.2599	96.9765
9	6.9863	2.3912	1.5786	96.0300
10	7.4173	3.0847	1.9225	94.9927

Source: Author's work based on data from the CBN

From Table 4.7, CPI own shocks is responsible for variation in CPI, ranges between 94.99% and 99.69%. It means prices in the current period are mostly driven by prices in the previous period in Nigeria. Therefore, it follows logically that rapid movement in the current price level would accelerate prices in the next period; and obviously likely to rise faster than the growth of real national income and personal disposable income. Nonetheless, the key indicator of this repeated cycle is hyper-inflation which cripples the national

economy and forcing people into vicious circle of poverty. Nigerians seem to be experiencing hyper-inflation in the contemporary period due to rapid changes in price, defying monetary authority combating efforts.

5. Conclusions

This article examined exchange rate and price volatility in Nigeria, covering monthly data from January, 2010 to December, 2020. Our main objective was to find empirically if volatility of exchange rate and price

actually exist in the Nigerian economy and the implication it tends to portend on macroeconomic framework. The trend in price and exchange rate in Nigeria today appears unbearable for economic agents and this calls for concern. While VAR was employed to derive impulse responses and variance decomposition, ARCH and GARCH models were developed to check for volatility clustering. Evidence of volatility clustering was established in both parallel market exchange rate and the general price level. The price volatility confirms Ajibade et al. (2020) and it is equivalent to Oyinlola and Egwaikhide (2011) and Nuhu (2021) who established volatility of exchange rate, in the long run, affects domestic prices as well as inflation. This means that effect of volatility of exchange rate and prices has long been a critical issue in macroeconomic stability in Nigeria, that is, the country has long been experiencing volatility clustering in both price and exchange rate. However, the current spate of large recurring volatility clustering (year 2019, 2020 and 2021) seems abysmal and devastating for the entire economy. Household income depreciating faster than possible adjustment tendency. The result is declining expectations, low saving, low investment and increasing poverty. Macroeconomic instability is also a noticeable outcome.

Impulse response functions and variance decomposition were derived from VAR. It is aiming at finding exchange rate and price movement affect the totality of the economy measured by changes in output. Results showed that although both the parallel market rate and price level are unstable and might be inappropriate as policy instruments, but unavoidably, they must be used particularly in the Nigerian economy. In other words, efforts to make them stable is crucial to the macroeconomic framework. Moreover, it appeared from the findings that the Nigerian economy might unamenable to domestic and exchange rate pricing policies which may be due to excessive openness to external shocks the weak macroeconomic framework cannot absorb. In addition, that the output is responsible for 73% to 89% of variation in BEXR suggests a significant causal relationship between output and the parallel market. It proved that the parallel market is, indeed, the place where real economic transactions take place in Nigeria. However, since the country is habitually import dependent the household and small scale businesses always depend on the parallel market where they can obtain foreign exchange at ease for transactions.

It is suggested therefore that there must be efforts to stabilize price and exchange rate, particularly at the parallel market for the purpose of macroeconomic stability. There

must be a concerted and well-coordinated efforts focusing on reducing demand pressure on foreign exchange. Nigeria needs to improve on her production capacity, embark on import substitution industrialization to produce many of the imported goods at home. There should be national orientation towards changing of socio-economic life; Nigerians must stop or reduce considerably, the penchant for foreign products and services which include frequent oversea medical trips and education bills. These two factors as well as excessive demand for imported goods, especially among the elites, exert significant pressure on foreign exchange which usually drive exchange rate upwards. The distribution line of foreign exchange from official to parallel market must be thoroughly checked. Any fraudulent practices must be brought to book and those found guilty punished. With reference to stabilization of general price level, it appeared price control is almost impracticable in the current dispensation of liberalization, but to some extent, prices can be monitored or checked by relevant agencies. Moreover, price of a consumer good sometimes falls when supply increases, therefore, large scale production driven by government assistance, such as subsidies enhance massive production. Commercial production in the organized private sector within the domestic economy may be of great advantage. In other words, substantial

domestic production is crucial for stabilization of exchange rate and general price level in the Nigerian economy.

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