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AN INVESTIGATION INTO THE SYMMETRIC RELATIONSHIP BETWEEN COMMODITY PRICE VOLATILITY AND FISCAL BALANCE IN NIGERIA

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Abstract

This study investigated symmetric relationship between commodity price volatility and fiscal balance in Nigeria within the sample period of 1992-2022, using time series data. The data were analysed using Exponential Generalized Autoregressive Conditional Heteroskedasticity (EGARCH) as a volatility estimator, Autoregressive Distributive Lag (ARDL), Toda-Yamamoto (YM) to run the analysis. The ARDL bound test results revealed that; there is long-run equilibrium relationship between commodity price volatility and fiscal balance in Nigeria from 1992-2022. The error correction mechanism for ARDL indicated that it is negative and statistically significance at 5% level of significance in correcting the short run disequilibrium. The Toda-Yamamoto causality revealed that there is no causality relation from commodity price volatility and fiscal balance in Nigeria and statistically insignificant at 5% level of significance. The study thus concludes on the basis of these findings that, commodity price volatility is a key factor of influencing the volatility on fiscal balance in Nigeria. The study recommended that the situation of commodity price volatility in relationship with fiscal balance in Nigeria is negative, that is a rise in commodity price will bring about negative fiscal balance. The implication is that commodity price volatility is more attached to government expenditure than government revenue. This situation further justifies the position of Nigeria as import dependent economy.

Keywords: Commodity price volatility, real interest rate, inflation, real exchange rate

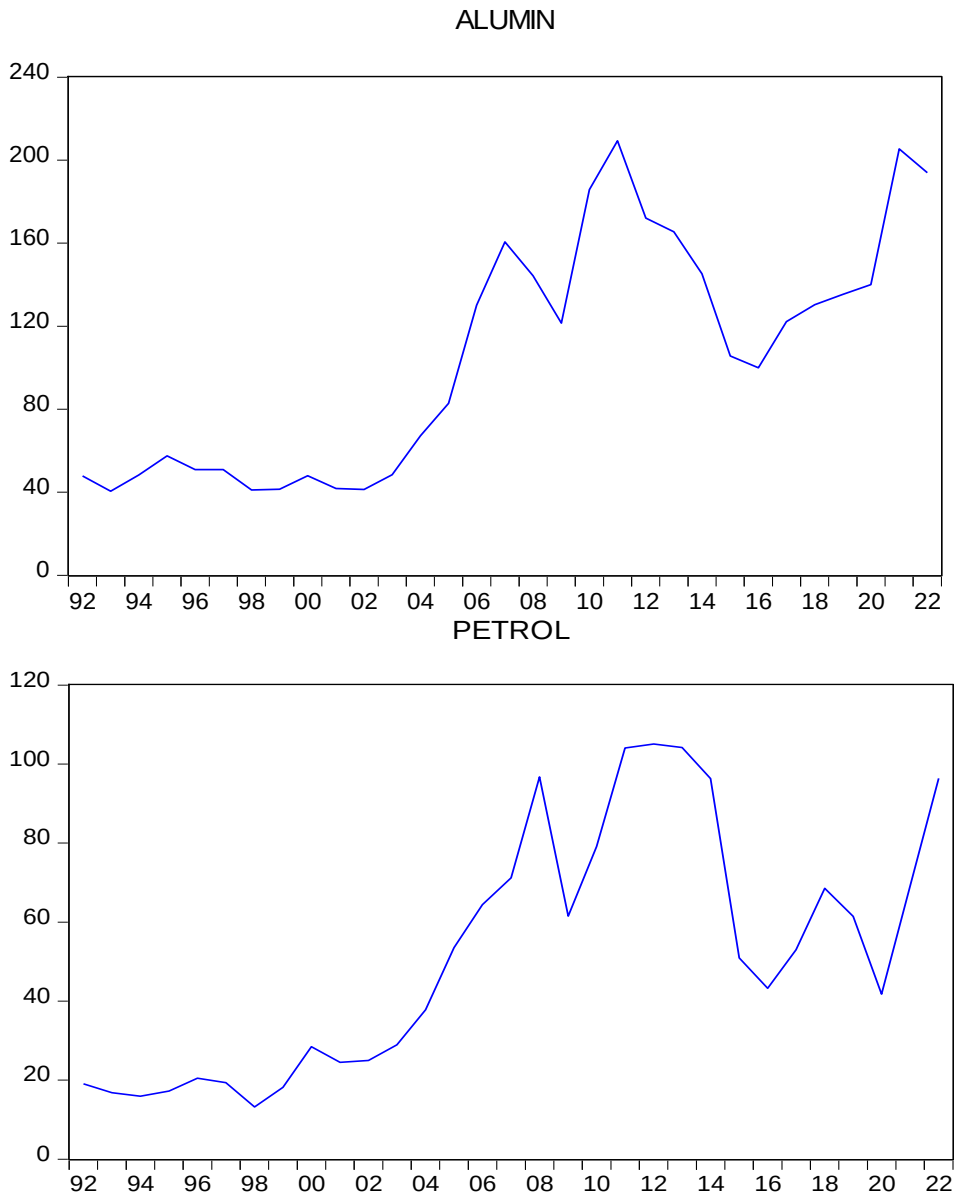
Introduction

The relationship between commodity price volatility and fiscal balance remains a subject of considerable controversy in both academic and policy circles. High and volatile commodity prices were a significant global issue over 2007 and into 2008. While the escalating financial crisis over the second half of 2008, and the precipitous decline in commodity prices that accompanied it took much of the attention away from the issue for a period, the prices of some commodities have now returned to around their mid-2008 peaks (Adeosun & Fagbemi, 2019). In most African countries such as, developments in the commodity sector significantly determine growth trajectory (Adeosun & Fagbemi, 2019). The nexus between commodity prices volatility and fiscal balance is both strong and complex (Adeosun & Fagbemi, 2019). Commodity prices offer substantial economic incentives that induce decisions relating to public expenditure, employment, consumption, resource allocation and trade. Hence, commodity price movements often shape development outcomes of Sub-Saharan African (SSA) countries (Angola, Benin, Botswana, Cameroon, Nigeria and Niger) (Adeosun & Fagbemi, 2019). Although a given commodity price change may not affect all countries in a uniform way, volatile commodity prices can undermine efforts towards attaining sustainable fiscal balance. In particular, the gains of commodity windfalls during boom times are by far outweighed by the adverse effects caused by price volatility and low-price periods, which seem to be longer than boom times. Van der Ploeg and Poelhekke (2009), postulate that, in resource-

rich countries, volatility in world commodity prices exacerbates poor economic performance. Thus, countries are prone to the vagaries of volatility and terms-of-trade shocks that hamper their capacities to introduce and implement policies that can lead to structural transformation; improving fiscal balance may be hindered. Policy inconsistence due to commodity price fluctuations can cause pressure on SSA countries' balance of payments. Thus, these external stress and volatility may trigger fiscal imbalance.

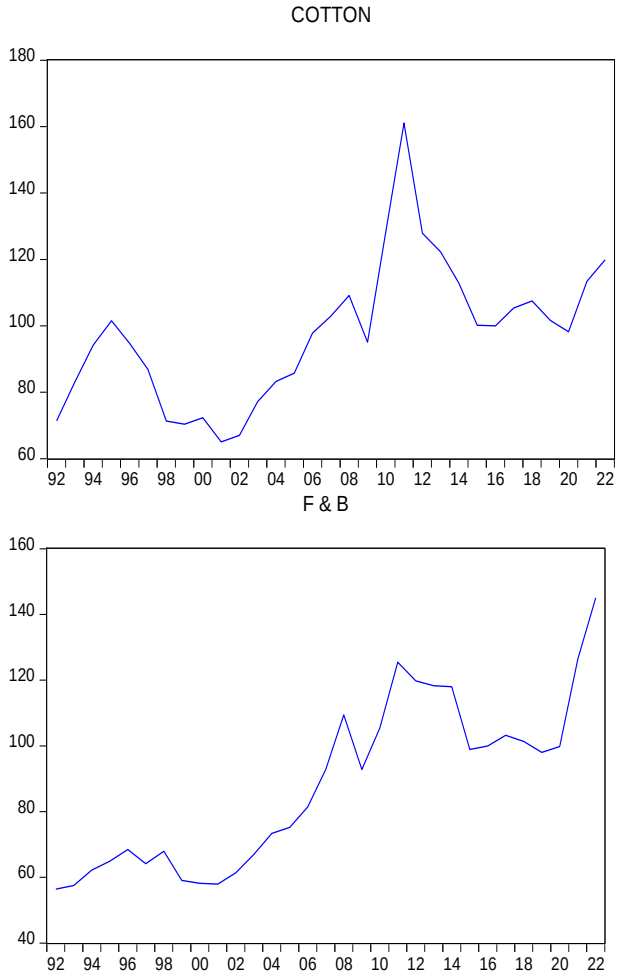
The issue of commodity price volatility in Nigeria has been a history of commodity struggle where crude oil usually takes predominance over the commodity complex such as metal, oil precious metal and agro products, among others. According to Adeosun and Fagbemi (2019), the pattern of economic volatility is complex in Nigeria. At the macroeconomic level, the high volatility recorded in real growth rates, inflation, government revenues, terms of trade and real exchange rate closely reflect the movements of oil prices. Ao and Chen (2020) noted that the vagaries of the commodity price market has resulted in a significant decline in the earnings, because of the exogenously determined price of crude oil which has led to shocks in earnings of stakeholders in the international commodity market and the nation. The price spikes are also associated with increased price volatility in commodity prices. Increasing volatility has been a concern for most agricultural producers and for other agents along the food chain as it renders planning very difficult for all market participants. Price volatility can have a long run impact on the incomes of many producers and the trading positions of countries and can make planning on production more difficult. As argued by Mukherjee and Goswani (2017), higher volatility results in an overall welfare loss, though some may benefit from higher volatility (Farmers). Sudden changes and long run trend movements in agricultural commodity prices present serious challenges to market participants and especially to commodity dependent and net food importing developing countries. At the national level, food importing countries face balance of payment pressure as the cost of food imports rise.

Commodity price volatility does present a set of problems for inclusive growth in Nigeria. This is so because the problems of growth, pervasive instability, and persistent inequality can be exacerbated by policy. It is important also to consider the origins of high commodity price volatility. Commodity price volatility in Nigeria since the late 1992's has been tremendous. It followed an upward trend with prices of metals (Aluminium) and crude oil (Petroleum).



Source: Author's Computation using EVIEW10 (Data from 1992-2022, IMF Commodity Portal)

The two graphs showed the most pronounced increase. Although booms in commodity price could be observed previously, the magnitude of the increase, its duration and its breadth are not estimated (IMF, 2022). Price developments for agricultural products have been more subdued, even though prices for agricultural raw material (Cotton), food and beverages have been following an upward trend since late 2001.



Source: Author's Computation using EVIEW10 (Data from 1992-2022, IMF Commodity Portal)

The available evidence from literature has indicated that there exists relatively a limited number of research works that attempted to study the relationship between commodity price volatility and fiscal balance. The rest of the paper is structured as follows: literature review, methods in which the objectives of the paper could be achieved, presentation and analysis of the empirical findings and the final section concludes the paper.

Several literature provide mixed and conflicting evidence with respect to the relationship between commodity price volatility and fiscal balance in different regions and countries (Adeosun & Fagbemi, 2019; Yaya, Akinlana & Shittu (2016); Kumar, Raghavan & Vespignani, 2020; Kablan et al, 2016). Also, others provide the mixed and conflicting evidence in the causal relationship between commodity price volatility and fiscal balance, (see Adeosun & Fagbemi, 2019; Manasseh, Ogbuabor, Obinna, 2016; Ogundipe, 2020; Bukas & Triantafyllou, 2020; Zyra & Shevchuk, 2018). Kumar, Raghavan and Vespignani, (2020) investigated the impact of commodity price volatility on the governments' fiscal balance, using the dynamic panel data models for 108 countries. The study found that governments' fiscal balance deteriorates with commodity price volatility. A one standard deviation increase in commodity price volatility leads to a reduction of approximately 0.04 units in the fiscal balance as a percentage of gross domestic products. Then the negative impact of commodity price volatility on fiscal balance can be mitigated with lower real interest rate.

Adeosun and Fagbemi (2019) examined the asymmetric relationship between commodity price and fiscal performance in Nigeria, using the Non-linear Autoregressive Distributed Lag (NARDL) cointegration technique and found out that there is a positive significant impact associated with primary commodity price (cocoa) on fiscal policy design and economic development in both long run and short run. Ndlovu (2019) investigated the nexus between commodity price volatility, stock market performance, and economic growth in these emerging economies of Brazil, Russia, India, China, and South Africa (the BRICS) predicated on two hypotheses. First, the study hypothesised that in modern integrated financial systems, commodity price volatility predisposes stock market performance to be non-linearly related to economic growth. The second hypothesis was that financial crises are inescapable feature of modern financial systems using non-linearities, fractality, and entropy behaviour using the spectral causality approach, univariate GARCH, EGARCH, FIGARCH, DCC-GARCH, and Markov Regime Switching (MRS) – GARCH. The study found that first, spectral causality tests signalled dynamic non-linearities in the relationship between the three commodity future prices and the BRICS stock indices. Second, the predominantly non-linear relationship between commodity prices and stock prices was reflected in the nexus between the national output proxies and the indices of the five main commodity classes. Third, spectral causality analysis revealed that the causal structures between commodity prices and national output proxies were non-linear and dynamic. Fourth, the Nyblom parameter stability tests revealed evidence of structural breaks in the data that was analysed. The DCC-GARCH model uncovered strong evidence of contagion, spill-overs, and interdependence.

Kablan, Ftiti and Guesmi (2016) examined the interdependence between the credit and commodity price cycles among African commodity exporters. The study used an evolutionary co-spectral analysis that sets a time varying dynamic correlation measure. The study revealed that persistent commodity price shocks exert a greater impact on real economy than transitory fluctuations. Similar patterns can be derived for different types of commodities. During downswings, coherence is high for beverages and agricultural raw materials. In contrast, coherence for metals and oil is high during upswings. Periods of high coherence correspond to periods of financial pressure. Manasseh, Ogbuabor, Obinna (2016) examined volatility and commodity price dynamics in Nigeria, using time series data, this was estimated with the generalized autoregressive conditional heteroskedasticity (GARCH) and exponential GARCH, while granger causality test was used to examine the causality direction between domestic commodity prices and spot price of commodity derivatives. The result shows that 30% of volatility in the spot international commodity market can be explained by volatility in domestic and international export commodity prices, while international oil spot prices explain 7% volatility in prices of goods consumed locally and export commodity price index explains 16% of spot price of international commodity between 2000 and 2013 in Nigeria. Inflation and exchange rate are shown to be significantly related to spot price volatility which accounts for its volatility also.

Ogundipe (2020) investigated the effect of commodity price volatility on real GDP, using a longitudinal data covering fifty-three African commodity-dependent countries for the period 1970–2017 using the system generalized method of moments (SGMM) estimation technique. The results from the estimation procedure indicated a negative contemporaneous relationship between commodity price volatility and growth. However, the intervention of policy instruments such as contrasting openness degree signals short-run relief for commodity export-dependent economies, as trade policy

mitigates the adverse effect of commodity price volatility on growth. Żyra and Shevchuk (2018) investigated the commodity price effects upon GDP growth and nominal effective exchange rate (NEER) dynamics in several Central and Eastern European (CEE) countries (the Czech Republic, Hungary, Poland and Romania), using Generalized Autoregressive Conditional Heteroscedasticity (GARCH) and Autoregressive Conditional Heteroscedasticity (ARCH) models. The study found that an increase in the world commodity price index is a factor behind a uniform exchange rate appreciation across all countries, with acceleration in output growth in the Czech Republic and Hungary. Except for the Czech Republic, higher commodity price volatility is associated with exchange rate depreciation, while being neutral with respect to output growth.

Bakas and Triantafyllou (2020) investigated the impact of economic uncertainty related to global pandemics on the volatility of the broad commodity price index as well as on the sub-indexes of crude oil and gold, using Vector Autoregressive (VAR) model. The results show that uncertainty related to pandemics have a strong negative impact on the volatility of commodity markets and especially on crude oil market, while the effect on gold market is positive but less significant. Hällgren and Ljungdahl (2022**)** investigated the possible ways of managing commodity price volatility from a purchasing perspective and how the applicability of tools depends on company specific circumstances. Covid-19 has created large disruptions in global supply chains and led to increased price volatility for virtually all commodities, using primary data (questioner and interview study, including five companies and three suppliers). The research has been divided into the three sections: Covid-19 implications, aspects affecting the purchasing approach, and tools available for managing commodity price volatility. The study revealed that the companies are actively managing commodity price volatility but lack background work of explicitly analysing the exposure to risk from commodity price volatility and creating risk objectives accordingly. The most effective and commonly used tool was escalator clauses, which enables adjusting purchasing price as the commodity price fluctuates. Other common tools were switching supplier, staggering contracts, and passing price, but additional tools were also analysed and discussed. The study concluded that there does not exist a best practice for managing commodity price volatility and that the applicability of tools depends on company specific circumstances.

Mukherjee and Goswami (2017) investigated the volatility of four commodity futures (potato, metal, crude oil, and gold) with three types of contracts (near a month, next near a month, and far month). As volatility estimators, they used simple standard deviations. Such methodology could result in bias estimation as the return of commodity futures is more complicated than the simple difference between buying and selling prices. Nonetheless, they consider that Samuelson's hypothesis does not hold for these commodities on the Indian futures market. Samuelson's hypothesis states that volatility of commodity future increases with lower maturity of it.

Purpose of the Study

Therefore, the broad objectives of this paper were to:

1. examine the relationship between commodity price volatility and fiscal, and
2. offer policy recommendations based on the findings of the study.

Methods

The study employed a secondary data which is annual time series in nature. Data for the study include Fiscal Balance from World Bank (WB, 2022), Commodity Prices is from International Monetary Fund (IMF, 2022), through these commodities prices we can

construct the data of commodity price volatility using EGARCH model and Capital Growth, Real Exchange Rate, Inflation and Real Interest Rate are from World Bank (WB, 2022).

Table 3.1: Sources of the Variables

Variables	Sources
Fiscal Balance	World Bank
Commodity Price Volatility	IMF
Capital Growth	World Bank
Real Exchange Rate	World Bank
Inflation	World Bank
Real Interest Rate	World Bank

Source: author's compilation. WB (World Bank), IMF (International Monetary Fund, Commodity Data Portal, 2022. Will be use EGARCH, to construct the volatility of commodities prices)

Model Specification

The study is built essentially from determinants of commodity price volatility captured by the Keynesian model. This study adopted and modified the model specified by Adeoson and Fagbemi, 2019; Manasseh et al (2016); Kumar et al, (2020), which determined the relationship between commodity price volatility and fiscal balance in Nigeria 1992-2022. The variables in the model are fiscal balance, commodity price volatility, and capital growth, real exchange rate, inflation, and real interest rate.

The present study specified the following model in a functional form:

$$FB = f(CPV, CAP, REXR, INF, RIR) - - - - - - (3.1)$$

This functional form specified the equation 3.1 into econometric form:

$$FB_t = \beta_0 + \beta_1 CPV_t + \beta_2 CAP_t + \beta_3 REXR_t + \beta_4 INF_t + \beta_5 RIR_t + \varepsilon_t - - - - - - - (3.2)$$

Taking the natural log of equation 3.2 yields;

$$LogFB_t = \beta_0 + \beta_1 LogCPV_t + \beta_2 LogCAP_t + \beta_3 LogREXR_t + \beta_4 INF_t + \beta_5 RIR_t + \varepsilon_t - - (3.3)$$

Where: FB_t is Fiscal Balance, CPV_t is Commodity Price Volatility, CPG_t is Capital Growth, $REXR_t$ is Real Exchange Rate, INF_t is Inflation, RIR_t is Real Interest Rate, $\beta_0$is Constant Parameter, β_s is Coefficient of the Independent Variables, μ: Error Term, μ_t is Stochastic Disturbance Term.β_1**to** β_5**> 0**

Estimation Procedure

Unit root test

The study applied the traditional unit root tests of augmented Dickey- Fuller (ADF), and Phillips Perron to test the stationarity of the variables of the study.

ARDL Approach to Co-integration

The study employed Autoregressive Distributed Lag (ARDL) model proposed by Pesaran and Shin (1999) to examine the long run relationship between commodity price volatility, inflation, capital growth, real interest rate, real exchange rate and fiscal balance. The model examined the long run relationship irrespective of whether the variables are stationary in levels, differences or fractionally integrated (Pesaran et al, 20001). To take care of short-term deviations while determining the long run co-integration, an error correction representation is included in the ARDL model (Pesaran et al, 2001). The model

also provides efficient and unbiased even if the sample size employed is small (Narayan, 2005). The model was specified as follows:

$$\Delta FB_t = \beta_0 + \beta_1 FB_{t-i} + \beta_2 CPV_{t-i} + \beta_3 CPG_{t-i} + \beta_4 REXR_{t-i} + \beta_5 INF_{t-i} + \beta_6 RIR_{t-i} + \sum_{i=0}^{p} \beta_7 \Delta FB_{t-i} + \sum_{i=0}^{p} \beta_8 \Delta CPV_{t-i} + \sum_{i=0}^{p} \beta_9 \Delta CPG_{t-i} + \sum_{i=0}^{p} \beta_{10} \Delta REXR_{t-i} + \sum_{i=0}^{p} \beta_{11} INF_{t-i} + \sum_{i=0}^{p} \beta_{12} RIR_{t-i} + ECM + \mu_t \quad (3.4)$$

Where: $InFB$ is Log of Fiscal Balance, $InCPV$ is Log of Commodity Price Volatility, $InCPG$ is Log of Capital Growth, $InREXR$ is Log of Real Exchange Rate, INF is Inflation, RIR is Real Interest Rate, β_0 is the dript component, Δ is the first difference operator.

The variables remain as previously described, Δ stands for the difference (or change) in respective variables and (-) is the lag sign. To satisfy the long-run relationship, ARDL bound test requires a null hypothesis for no co-integration H_0: $\beta_1 = \beta_2 = \beta_3 = \beta_4 = \beta_5 = \beta_6$ 0; for equations.

Toda-Yamamoto Model

Toda-Yamamoto is a VAR Granger Causality/Block Exogeneity Wald Tests model developed by Toda and Yamamoto (1995). This method estimates a VAR model of (m + dmax) where m stands for the lag order selected using available information criteria (like AIC or SIC) and dmax denotes the maximum order of integration of the series (Toda & Yamamoto, 1995).

Therefore, the Toda-Yamamoto causality testing model is specified:

$$FB_t = \omega_0 + \sum_{i=0}^{m} \emptyset_{1,i} FB_{t-i} + \sum_{i=m+1}^{m+dmax} \emptyset_{2,i} FB_{t-i} + \sum_{i=0}^{m} \xi_{1,i} CPV_{t-i} + \sum_{i=m+1}^{m+dmax} \xi_{2,i} CPV_{t-i} + \mu_{1,t} \quad (3.5)$$

$$CPV_t = \gamma_0 + \sum_{i=0}^{m} \xi_{1,i} CPV_{t-i} + \sum_{i=m+1}^{m+dmax} \xi_{2,i} CPV_{t-i} + \sum_{i=0}^{m} \emptyset_{1,i} FB_{t-i} + \sum_{i=m+1}^{m+dmax} \emptyset_{2,i} FB_{t-i} + \mu_{2,t} \quad (3.6)$$

Where the series are defined in Eq. (3.5) above, From Eq. (3.6), Granger causality from CPV_t to FB_t implies $\emptyset_{1,i} \neq 0 \forall_i$similarly in Eq. (3.6), FB_t Granger causes CPV_t, if $\emptyset_{1,i} \neq 0 \forall_i$The model is estimated using seemingly unrelated regression (SUR) (see, Rambaldi & Doran, 1996).

Commodity Price Volatility Generation

Kumar et al (2020), Mukherjee and Goswoni (2017) used standard deviation to construct the data of commodity price volatility, but using standard deviation to construct the volatility has the following limitation; It doesn't give the full range of the data, it can be hard to calculate. Despite those challenges we can use exponential generalized autoregressive conditional heteroskedasticity (EGARCH) model to construct the data of commodity price volatility in this study. The Exponential Generalized Autoregressive Conditional Heteroskedasticity EGARCH which captures asymmetric properties of

volatility was proposed to address three major deficiencies of GARCH model. They are (i) parameter restrictions that ensures conditional variance positivity; (ii) non-sensitivity to asymmetric response of volatility to shock and (iii) difficulty in measuring persistence in a strongly stationary series. The log of the conditional variance in the EGARCH model signifies that the leverage effect is exponential and not quadratic. The specification of volatility in terms of its logarithmic transformation implies the non-restrictions on the parameters to guarantee the positivity of the variance (M'Jose, 2010). Therefore, it is important to note that the commodity price volatility listed in the model as core variable will be generated using (EGARCH) from price of 10 most traded commodities (IMF commodity portal, 2022).

The conditional variance of EGARCH (p, q) model is specified as:

$$\boldsymbol{log}\,(\sigma_t^2) = \beta_0 + \sum_{i=1}^{q}\beta_i\left|\frac{\mu_{t-1}}{\sigma_{t-i}}\right| + \sum_{i=1}^{q}\gamma_i\frac{\mu_{t-1}}{\sigma_{t-i}} + \sum_{i=1}^{q}a_i\log(\sigma_{t-j}^2) - - - - - - - (3.7)$$

In this model, good news implies that μ_{t-1} is positive with total effects $(1+\gamma_i)|\mu_{t-1}|$ and bad news implies μ_{t-1} is negative with total effect $(1-\gamma_i)|\mu_{t-1}|$ when $\gamma_i < 0$, bad news would have higher impact on volatility than good news (leverage effect is present). The news impact is asymmetric if $\gamma_i \neq 0$. The EGARCH model is covariance stationary when $\sum_{i=1}^{q}a_j < 1$.

Results

Descriptive Statistics

Before going to the econometric estimation, it is worthy to have a look at descriptive statistics of the variables. In the descriptive statistics, the data are supposed to be in their raw form without any transformation. The result is presented in Table 4.1. This is essential due to these statistics summarize the statistical properties of the series of the model.

Table 4.1: Result of Descriptive Statistics

	CPV	INF	CPG	REXR	RIR	FB
Mean	20579.81	16.81159	1.975491	111.6559	2.717136	26.61489
Median	14854.26	10.13103	2.675391	100.6310	5.685580	24.58445
Maximum	50445.57	75.40165	40.38866	273.0096	18.18000	46.04300
Minimum	5299.221	0.686099	-23.74670	49.77635	-31.45257	12.69530
Std. Dev	14305.24	15.91740	12.45878	48.89651	10.11752	10.47327
Observation	31	31	31	31	31	31

Source: Author's Computation using EVIEW10

Table 4.1 presents the descriptive statistics results. The standard deviations analysis revealed higher volatility in CPV, followed by REXR and INF while, CPG, FB and RIR recorded lowest volatility.

Unit Root Test Result

A summary of unit root test results regarding order of integration based on different unit root criteria is given in Table 2.

Table 4.2 Augmented Dickey Fuller (ADF) Unit Root Test Result

Variables	ADF Statistics	5% Critical Value	Prob. Value	Status	Order of Integration
LEVEL VARIABLES					
LFB	-4.295429	-2.963972	0.0021	Stationary	I(0)

LCPV	-0.889058	-2.963972	0.7777	Not Stationary	I(0)
INF	-8.053921	-2.976263	0.0000	Stationary	I(0)
LCPG	-2.946756	-2.971853	0.0527	Not Stationary	I(0)
LREXR	-2.909023	-2.963972	0.1061	Not Stationary	I(0)
RIR	-6.154137	-2.976263	0.0000	Stationary	I(0)
FIRST DIFFERENCED VARIABLES					
LFB	-5.455679	-2.976263	0.0001	Stationary	I(1)
LCPV	-5.247276	-2.967767	0.0002	Stationary	I(1)
INF	-3.703777	-2.981038	0.0102	Stationary	I(1)
LCPG	-3.914796	-2.986225	0.0064	Stationary	I(1)
LREXR	-3.548452	-2.976263	0.0142	Stationary	I(1)
RIR	-5.967485	-2.976263	0.0000	Stationary	I(1)

Source: Author's Computation using EVIEW10

From the ADF unit root test results in table 4.2, FB, INF and RIR are stationary at level I(0), while CPV, CPG AND REXR are stationary at first difference I(1). Therefore all the variables are combination of both I(0) and I(1) and none of them is of I(2). Thus, the variables are qualified to run for ARDL approaches to co-integration.

ARDL Bound Test for Co-integration

Bounds Test for cointegration was performed to check the presence of long-run relationship among the variables. The null hypothesis is that there is no long-run relationship

Table 4.3 Bound Test for Cointegration

Test Statistic	Significance	Bound Critical Values		
		I(0)	I(1)	K
F-statistic	10%	3.8	3.8	2
9.204715	5%	4.6	4.6	
	2.5%	5.39	5.39	
	1%	6.44	6.44	

Source: Author's computation using Eviews10

The result of the bound test of co-integration is reported in table 4.3, the result shows that the value of F-statistics is 9.204715 is higher than lower and upper bound of critical value at 5% level of significance. Therefore, the variables have long-run equilibrium relationship. The long-run ARDL bound test result values indicate that there is long run equilibrium relationship among the variables (commodity price volatility, inflation, capital growth, real exchange rate, real interest rate and fiscal balance) in Nigeria. The findings are in line with Kumar et al (2020); Ayodele, Tunde and Anyamaobi (2018).

ARDL Long-run Results

Table 4.4: ARDL Long-run Results

Conditional Error Correction Regression				
Variable	Coefficient	Std. Error	t-Statistic	Prob.

C	1.860533	1.331664	1.397149	0.1757
*LOGFB(-1)**	-0.893264	0.242793	-3.679113	0.0012
LOGCPV	-0.241170	0.141088	-1.709353	0.1008
INF	0.040979	0.142347	0.287878	0.7760
LOGCPG	0.105332	0.088404	1.191493	0.2456
LOGREXR	-0.074422	0.276658	-0.269004	0.7903
RIR	0.243394	0.151434	1.607256	0.1216

Source: Author's computation using EVIEWS10

Table 4.4 shows the result of the ARDL long run result, the commodity price volatility and real exchange rate, they have a negative relationship with fiscal balance and statistically insignificance at 5 level of significance. This shows that increase in commodity price volatility and real interest rate leads to decrease in fiscal balance in Nigeria. The findings are in line with Adeosun and Fagbemi (2019). Then the inflation, capital growth and real interest rate variables have a positive relationship with fiscal balance but is statistically insignificance at 5% level of significance, this means that increase in inflation, capital growth and real interest rate will lead to increase in fiscal balance in Nigeria. The findings are in line with Kumar et al (2020).

ARDL Short-run Results

The presence of co-integrating equations showed the results of the ARDL Long-run Bound test, the error correction modeling was carried out to examine the short-run dynamic and long-run equilibrium reconciling the short run behavior (or value) of an economic variable with its long-run behavior (or value) of an economic important thermo of Granger representation theorem states that the relationship between the two can be expressed as error correction mechanism.

Table 4.5: Error Correction Mechanism (ECM)

ECM Regression				
Case 2: Restricted Constant and No Trend				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LOGCPV)	-0.241170	0.095010	-2.538365	0.0184
D(INF)	0.040979	0.080794	0.507195	0.6168
D(LOGCPG)	0.105332	0.086475	1.218068	0.2355
D(LOGREXR)	-0.074422	0.196782	-0.378197	0.7088
D(RIR)	0.243394	0.111915	2.174815	0.0402
*CointEq(-1)**	-0.893264	0.203806	-4.382903	0.0002

Source: Author's Computation using EVIEW10.

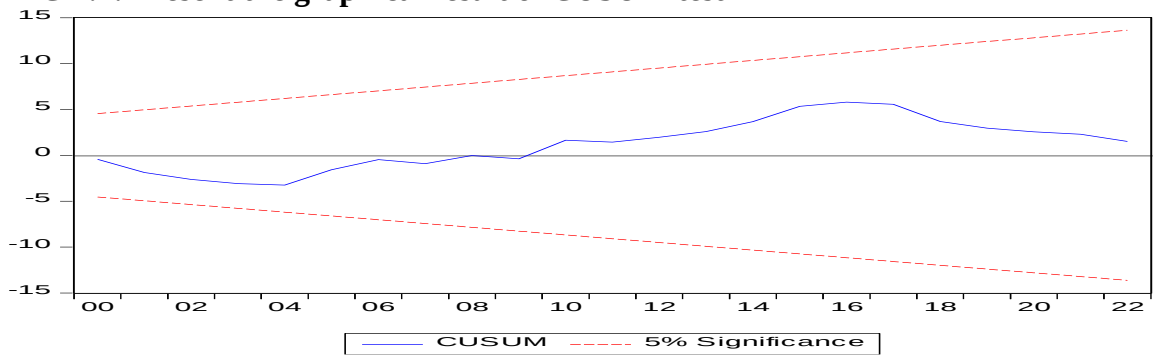
The table 4.5 above, the error correction mechanism (ECM) showed 89% of the short-term disequilibrium has been corrected by fiscal balance in year. The coefficient of fiscal balance (FB) is correctly signed as negative (-0.89) less than 1 and statistically significant at 5% level of significance, this shows a high of speed of adjustment, this means there is disequilibrium from short run back to the long run. The diagnostic tests of the results to confirm whether the model is stable, robust and efficient, and can give a good forecast. The Jarque-Bera (normality test) developed by Jaque and Bera (1980) to test for the normality distribution of the residuals.

Table 4.6: Diagnostic Test Result

Tests	F- statistics	Obs*R-squared	Prob.
Jaque Bera	-------	-------	0.817938
Serial Correlation	0.011280	0.032195	0.9888
Heteroskedasticity	1.274169	7.484104	0.3076
RAMSEY RESET	0.000532	-------	0.9818

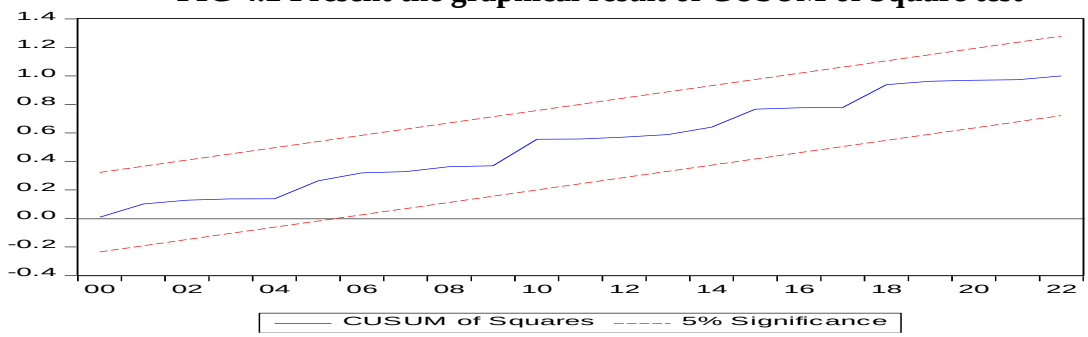
Source: Author's Computation using EVIEW10.

FIG 4.1: Present the graphical result of CUSUM test



Source: Author's Computation using Eview10.

FIG 4.2 Present the graphical result of CUSUM of Square test



Source: Author's Computation using EVIEW10.

The results of diagnostics tests have been presented in table 4.8 which showed that the error terms are normally distributed. Similarly, the model is well specified based on the Ramsey rest test, and free from serial correlation heteroscedasticity problem. Stability of both the short and long run parameters were checked using CUSUM and CUSUMsq and the result is presented in Figs. 4.1 and 4.2. They revealed that the plots are within the 5% critical bounds and justify the stability of the models during the study period.

Toda-Yamamoto Test Result

The Toda-Yamamoto causality was carried out to test the causal relationship among fiscal balance and commodity price volatility. The result is presented in table 4.7.

Table 4.7: Toda-Yamamoto Causality Test
VAR Granger Causality/Block Exogeneity Wald Tests

Dependent variable: LOGFB

Excluded	Chi-sq	df	Prob.
LOGCPV	2.335161	2	0.3111

Dependent variable: LOGCPV

Excluded	Chi-sq	df	Prob.
LOGFB	3.532634	2	0.1710

Source: Author's computation using Eviews10

Based on the results of the Toda-Yamamoto test, fiscal balance (FB) does not granger causes commodity price volatility (CPV) at 5% level of significance, therefore we accept the null hypothesis and reject the alternative, this means there is no causal relationship between fiscal balance and commodity price volatility in Nigeria, this finding is in line with Nlovu (2019). Commodity price volatility (CPV) does not granger causes fiscal balance (FB) at 5% level of significance, therefore we reject the null hypothesis and accept the alternative, this means there is no causal relationship between commodity price volatility and fiscal balance in Nigeria, the finding is in lines with Manasseh, Ogbuabor, and Obinna (2016); Boubakri, Guillaumin and Silanineusing (2021).

Conclusion

The study concludes that there is a long-run and symmetric relationship between commodity price volatility and fiscal balance in Nigeria. Commodity price fluctuations—covering maize, rice, food and beverages, vegetable oil, soybean, cotton, natural gas, petroleum, aluminium, and silver exert both positive and negative impacts on fiscal balance. However, the effect is largely negative, as rising commodity prices increase government expenditure more than revenue, reflecting Nigeria's dependence on imports. Unlike countries with diversified export bases that benefit from higher revenues during commodity booms, Nigeria faces rising import bills, which weaken fiscal balance and exert negative pressure on fiscal behavior.

Recommendations

1. The Abuja Commodity Derivatives Market should be activated to provide a platform for hedging against commodity price risks in both the short and long term.
2. Commodity reserves should be properly maintained to regulate prices in the spot and futures markets, thereby stabilizing returns for government and investors.
3. Nigeria's export base should be diversified to reduce overdependence on imports and enhance fiscal resilience during commodity price fluctuations.
4. Fiscal policies should be strengthened to prioritize revenue generation from local production and export-oriented industries, rather than excessive reliance on imports.

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