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Granger's Causality Analysis of the Interaction Between Global Macroeconomic Variables and Commodity Price Movements in Nigeria

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Abstract: This study examines the interplay between global macroeconomic variables and commodity price movements in Nigeria, focusing on data spanning from April 1971 to July 2024. The analysis incorporates key global variables, including the Common Commodity Price Factor (CCPF), Global Factors (GF), and commodity-specific prices – copper (CP), corn (MP), and oil (OP). By employing a comprehensive econometric framework that includes correlation analysis, cointegration testing, short-term dynamics, Granger causality, impulse response functions, and variance decomposition, the study uncovers both short- and long-term dynamics in the global commodity price relationship. The results provide strong evidence of long-term cointegration between variables, with oil prices exerting a dominant influence on the Common Commodity Price Factor. Meanwhile, Granger Causality tests reveal two-way relationships between global macroeconomic indicators and commodity prices. Oil prices and global factors, in particular, significantly influence Nigeria's commodity price movements, underscoring the country's vulnerability to global shocks. Impulse response and variance analyses further highlight the evolving influence of global forces over time. The findings underscore the need for strategic policy interventions to mitigate external volatility, enhance resilience, and stabilise commodity markets. This study enhances the understanding of global economic relations and their impact on emerging markets, offering valuable insights for policymakers in resource-dependent economies, such as Nigeria.

Keywords: Interaction Global; Macroeconomic Variables; Commodity and Movements; Commodity Prices; Economic Indicators; Commodity Markets; Global Economy; Price Volatility; Market Conditions.

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1. Introduction

Nigeria's economy is deeply intertwined with global macroeconomic dynamics, particularly movements in commodity prices, including oil, copper, and maize. As a major oil exporter, fluctuations in global oil prices have far-reaching implications for Nigeria's economic stability, affecting key macroeconomic variables, including inflation, exchange rates, and GDP growth. Commodity prices are not only a reflection of global economic conditions but also serve as critical indicators of economic performance [3]. Their volatility can affect investment decisions, tax revenues, trade balances, and overall economic growth. In emerging economies like Nigeria, the commodity market plays a crucial role in mobilising savings, allocating investment funds, and supporting industrialisation [2]. However, in many of these economies, ongoing structural reforms, including

liberalisation and privatisation, have yet to materialise, thereby increasing the impact of external macroeconomic shocks on domestic markets. The interaction between commodity prices and macroeconomic variables can lead to a wide range of economic consequences, depending on the nature of the commodity, the direction of the price change, and the country's commercial position. Higher commodity prices often lead to cost-push inflation, especially in net-importing countries, whereas lower prices can result in lower inflation or even deflation in commodity-dependent economies. For exporters such as Nigeria, high commodity prices can spur economic expansion through increased profits and foreign investment, while lower prices can lead to fiscal constraints and an economic slowdown. Additionally, volatile commodity prices can lead to exchange rate fluctuations, particularly in resource-rich but non-diversified economies.

Despite growing scientific interest in commodity price volatility in Nigeria, particularly regarding oil, a significant gap remains in the overall understanding of the causal relationship between global macroeconomic variables and a broader range of commodity price movements. Previous studies, such as those by Wasseja et al. [3], Okoli et al. [9], Blanchard and Galí [4], and Gbanador [2], have examined specific aspects of this relationship, focusing mainly on oil. However, there is limited empirical research on multidirectional interactions involving other important commodities and global macroeconomic forces. This study aims to bridge this gap by applying Granger's causal analysis to examine the dynamic interactions between global macroeconomic variables and commodity price movements in Nigeria. Through this analysis, the study aims to determine the direction and strength of causation, providing policy-relevant insights for economic governance, investment planning, and risk mitigation strategies in Nigeria's commodity-based economy.

2. Literature Review

A literature review of previous studies emphasises a wide range of works that examine the relationship between macroeconomic variables and financial or economic indicators such as stock prices, oil price volatility, and economic growth. Most of these studies either focused narrowly on specific macroeconomic indicators (such as inflation, interest rates, or exchange rates) or limited their analysis to commodities, particularly crude oil. However, none of these studies examined the dynamic interaction between global macroeconomic variables and commodity price movements in Nigeria using Granger's causal analysis, which represents a serious gap that the current study seeks to address. For example, Wasseja et al. [3] examined the causal relationship between macroeconomic variables and stock prices in Kenya using the VAR framework and Granger's causal test. The variables used in the study range from inflation and exchange rates to stock prices, and from stock prices to market interest rates, with other macroeconomic variables proving to be statistically insignificant. While this study provides valuable insight into the impact of domestic macroeconomic indicators on financial markets, it is limited in scope by focusing solely on stock prices and neglecting the broader commodity market. Moreover, it is limited to the Kenyan context and does not account for global macroeconomic forces.

Similarly, the study by Okoli et al. [9] examined the impact of oil price volatility on Nigerian macroeconomic variables using the VAR model. While their work provided strong evidence of the sensitivity of domestic economic indicators to oil price shocks, it remained largely one-dimensional, focusing solely on oil as a commodity. It also did not account for any global macroeconomic factors that could collectively impact commodity price dynamics in Nigeria. Akram [6] expanded the analysis by examining the impact of oil price fluctuations and associated variables, such as the exchange rate, petrol pump prices, inflation, and the monetary policy rate, on Nigeria's economic performance. Using ARDL and Granger causality approaches, the study demonstrated that volatility in oil prices and exchange rates has both short-term and long-term effects on economic growth. However, this study was also limited to crude oil. It did not consider the interaction of multiple commodity prices, nor did it examine the impact of global economic variables, which are becoming increasingly important in a highly interconnected global economy.

Similarly, Ghosh [1] examined the impact of macroeconomic variables on stock price behaviour in Nigeria using various econometric tests. The study found that while inflation had a significant impact on stock prices in the short term, other variables, such as interest rates and the money supply, had a negligible and opposite effect in the long term. Although the study revealed a long-term correlation between stock prices and macroeconomic variables, it focused narrowly on the stock market, excluding commodity prices and global macroeconomic considerations. In all these studies, the recurring limitation is evident in their narrow range of variables – most focus on traditional macroeconomic indicators such as inflation, interest rates, and exchange rates, while ignoring broader global macroeconomic factors and their interaction with commodity prices.

Furthermore, there is a significant knowledge gap in the lack of studies that analyse the prices of multiple commodities – such as copper, maize, and oil – along with global macroeconomic variables, including the Common Commodity Price Factor (CCPF) and broader global factors (GF), especially in the Nigerian context. Thus, the current study is driven by the lack of a comprehensive analytical framework that integrates both global macroeconomic variables and commodity price movements in Nigeria using Granger's causal analysis. By incorporating variables such as global macroeconomic variables particularly the common commodity price factor (CCPF) and the global factor (GF), with a focus on the price dynamics of copper (CP), maize

(MP) and oil price (OP) in Nigeria, the study aims to fill this large gap in the literature and contribute to a better understanding of how the dynamics of the global economy affect commodity markets in a resource-dependent economy such as Nigeria.

3. Methodology

3.1. Data Source

The dataset comprises monthly observations on global macroeconomic variables, including the common factor of commodity prices and global factors, as well as commodity price volatility, which covers the period from early April 1971 to late July 2024. The study employs the following acronyms: Global Macroeconomic Variables (GMV), Common Commodity Price Factor (CCPF), and Global Factors (GF), as well as Commodity Price Movements (CPM), specifically Copper (CP), Maize (MP), and Oil Price (OP) in Nigeria. The data are compiled from the Central Bank of Nigeria platform, a reliable financial source. This period reflects various economic conditions, including the pre-pandemic environment, the onset and impact of the COVID-19 pandemic, subsequent recovery phases, and ongoing global economic uncertainty. This selection ensures the ability to evaluate the model's performance under various market conditions, including periods characterised by abrupt regime changes.

3.1.1. Granger causality model

The Granger causality technique is used to determine whether one-time series can predict another. Essentially, the Granger causality test assesses whether past values of one variable (e.g., X) can help predict future values of another variable (e.g., Y), beyond the information provided by past values of Y alone. This is based on the idea that if X is the Granger-cause of Y, then the history of X should contain information useful for predicting Y. However, this does not imply direct causality in the traditional sense; rather, it implies a predictive correlation. The model is typically specified using a vector error correction (VEC) framework, where the relationship between multiple time series is modelled. If two variables are considered, an unconstrained model incorporates both variables:

$$Y_t = \alpha_0 + \alpha_1 Y_1 + \cdots + \alpha_P Y_P + \beta_1 X_{t-p} + .. + \beta_P X_p + \gamma_1 z_t + \cdots \gamma_p z_{t-p} + \theta_1 s_1 + \cdots + \theta_p S_{t-p} + \varepsilon_t$$

The restricted model, where the effect of previous values of X, Z, and S is excluded:

$$Y_t = \alpha_0 + \alpha_1 Y_1 + \cdots + \alpha_P Y_P + \beta_1 X_{t-p} + \varepsilon_t$$

The null hypothesis of the Granger causality test is that X is not Granger-induced. If including prior values of X significantly improves the prediction of Y, we reject the null hypothesis and conclude that X is Granger-induced by Y. The Granger causality test is useful for understanding the interactions between global macroeconomic variables and commodity price fluctuations, especially in the Nigerian context, for several reasons. First, it allows us to explore dynamic relationships over time. For example, it can reveal whether global factors, such as commodity price trends or economic indicators, influence Nigerian commodity prices, including oil, copper, or maize. In a country like Nigeria, where the economy is highly sensitive to fluctuations in global commodity markets, determining whether these global variables lead or lag domestic price fluctuations is essential for informed policy decisions. Second, by applying the Granger causality theory, we can identify temporal patterns of influence. For example, suppose global oil prices influence domestic oil price trends in Nigeria (or vice versa).

In that case, it is crucial to understand whether changes in global oil prices precede changes in Nigerian oil prices or vice versa. Understanding these relationships provides valuable insights for predicting future trends and preparing for price shocks, which can have significant implications for Nigeria's economic stability and development. Granger causality testing provides a statistical framework for testing hypotheses about the direction of influence between variables. This is particularly important for Nigeria, as the country's heavy dependence on oil exports makes it vulnerable to global price fluctuations. If global macroeconomic variables, such as oil prices or the value of the US dollar, have a causal effect on domestic prices, policy measures like price stabilisation mechanisms, fiscal interventions, or even exchange rate policies can be tailored accordingly. Granger causality offers a powerful method for identifying and quantifying the dynamic and predictive relationships between global economic factors and commodity prices in Nigeria, thereby enabling stakeholders to anticipate and respond to economic fluctuations. However, before testing Granger causality, the data set is fitted with a Vector Error Correction (VEC) model, a specialised form of the Vector Autoregressive (VAR) model used when integrating the analysed time series data. The VEC model can be expressed as follows:

$$\Delta Y_t = \alpha + \pi Y_{t-1} + \sum_{i=1}^{p-1} \Gamma_i \Delta Y_{t-1} + \varepsilon_t$$

Yt is a vector of the five variables at time t: Yt = [CCPF, CP, GF, MP, OP] (for example, the global macroeconomic variables and commodity prices you are analysing).

ΔYt is the first difference between the variables (i.e., the variance of the variables).

α is a constant term (coordinate at the origin).

Π is the long-run relationship matrix (cointegration matrix). Its rank determines the number of integral equations. It contains information about the long-term equilibrium relationships between variables.

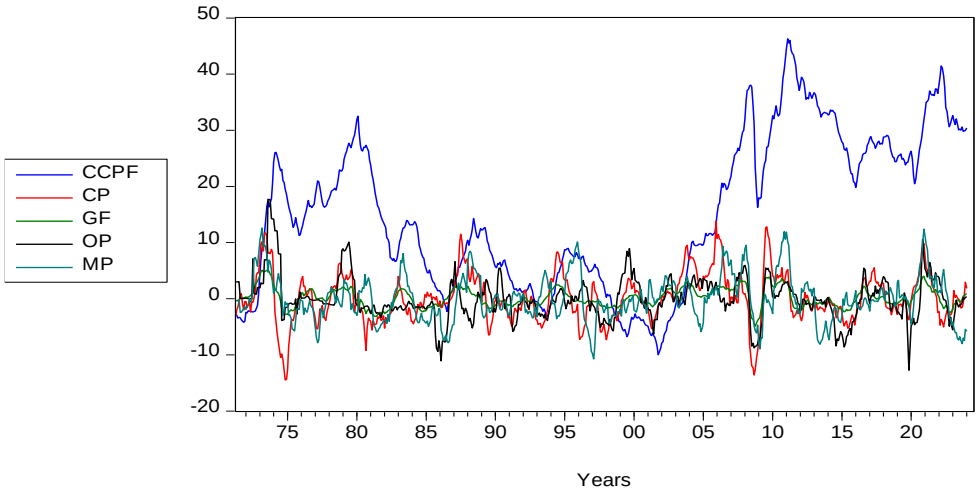
Γi represents the short-term dynamics of the system, illustrating how variables interact in the short term.

ε_t Represents the error term.

The VEC model is a powerful tool for modelling the interactions between global macroeconomic variables and commodity price fluctuations. By capturing both short-term dynamics and long-term equilibrium relationships, it provides a deep understanding of the impact of global factors on commodity prices, as well as the impact of commodity prices on global factors, in the context of Nigeria or any other economy with similar characteristics.

4. Results

The time series graphs shown in Figure 1 illustrate the evolution of dynamic patterns in global macroeconomic variables and commodity price movements in Nigeria over a specified period. These variables include two global macroeconomic indicators, the Common Commodity Price Factor (CCPF) and the Global Factor (GF)—as well as three key commodity prices: copper (CP), maize (MP), and oil (OP). Through the time series graphs, we can observe the common movements, trends, and volatility behaviours among these variables: The Consumer Price Index (CPI) and the Global Producer Price Index (GF), as global macroeconomic indicators, generally exhibit broad cyclical movements, capturing global shocks or synchronous changes in international economic activity.



Figures 1: Time plots of raw data on global macroeconomic variables and commodity price movements in Nigeria

Peaks or troughs in these indicators are likely to correspond to significant global economic events, such as financial crises or periods of recovery. Commodity prices (CP, MP, and OP) in Nigeria also exhibit significant volatility over time, with oil prices (OP), in particular, showing more pronounced volatility, reflecting Nigeria's dependence on crude oil and its exposure to global oil market dynamics. Copper (CP) and maize (MP) prices exhibit relatively moderate volatility, but track global market conditions, as observed during certain periods of co-movement with the GF and CCPF.

There may be clear correlations between global variables (CCPF and GF) and commodity prices, indicating a potential transmission of global economic trends to local commodity markets. These plots help provide a visual overview of potential relationships between lead, lag, and volatility clustering, paving the way for other econometric models such as Granger causality analysis. Time series plots serve as a preliminary diagnostic tool, revealing how global economic conditions and commodity-specific shocks have impacted commodity price volatility in Nigeria over time.

Table 1: Descriptive statistics of global macroeconomic variables and commodity price movements in Nigeria

	CCPF	CP	GF	OP	MP
Mean	15.281	0.112	0.166	-0.015	0.061
Median	13.460	-0.460	-0.020	-0.410	-0.330
Maximum	46.290	13.810	5.100	17.700	12.600
Minimum	-9.990	-14.450	-4.900	-12.730	-10.730
Std. Dev.	13.557	4.365	1.692	3.841	4.100
Skewness	0.159	0.155	0.280	0.739	0.446
Kurtosis	1.918	3.841	2.957	5.934	3.267
Jarque-Bera	33.549	21.201	8.323	284.674	22.881
Probability	0.000	0.000	0.0156	0.000	0.000
Sum	9672.970	70.92000	105.1700	-9.590	38.620
Sum Sq. Dev.	116158.2	12043.15	1809.726	9323.209	10624.72
Observations	633	633	633	633	633

The descriptive statistics in Table 1 reveal important characteristics of global macroeconomic variables and commodity price volatility in Nigeria. The average values indicate that the Common Commodity Price Factor (CCPF) and the Global Factor (GF) were positive on average, suggesting a general upward trend in global economic pressures. In contrast, oil prices (OP) declined slightly on average. The dispersion, as evident from the standard deviations, is relatively high, especially for the CCPF and CP, indicating high volatility in these series. The extreme and low values confirm the wide range and occasional high volatility of all variables, especially commodity prices. In terms of distribution, skewness values are generally positive, indicating that most variables are moderately right-skewed.

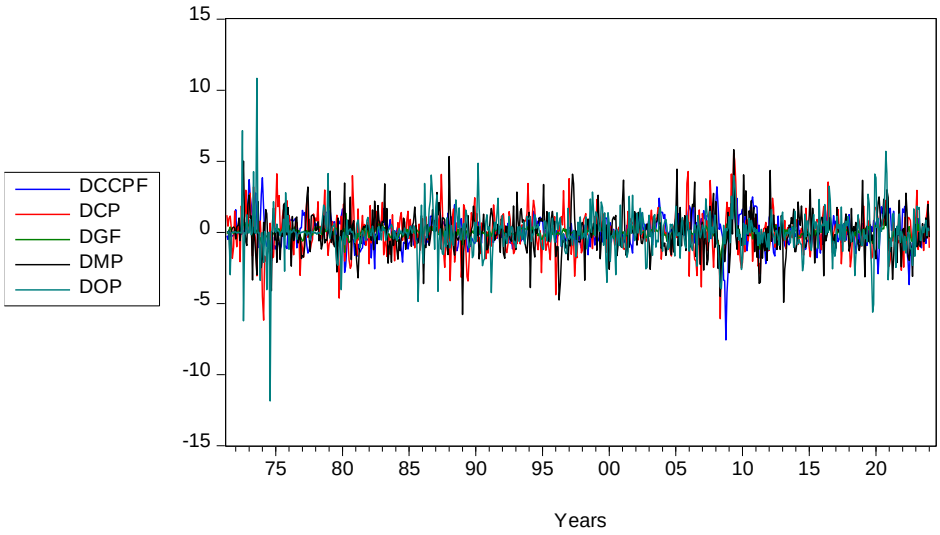
However, oil prices exhibit the highest levels of asymmetry, indicating a greater probability of extremely positive values. Skewness values vary: OP has a high skewness (5.934), indicating a heavy-tailed distribution, whereas CCPF has a flatter distribution (skewness < 3). The Jarque-Bera statistics, as well as their probabilities, are highly significant for all variables, except for GF, whose probability is 0.0156, which is still below the 5% significance level. This implies rejecting the null hypothesis of a normal distribution for all variables, confirming that the distributions deviate from a normal distribution. Therefore, these data series are not normally distributed, which has implications for subsequent econometric modelling, especially with methods that assume non-normal error structures or are sensitive to distributional assumptions. To enhance stationarity, the data were differenced using the unit root test.

Table 2: Unit root test on global macroeconomic variables and commodity price movements in Nigeria

Variables	ADFT		RMK	PPT		RMK	KPSST		RMk
CCPF	-1.988	0.292	1(1)	-1.860	0.351	1(1)	1.088	0.014	1(1)
	-12.469	0.000		-12.485	0.000				
GF	-5.542	0.000	1(0)	-4.866	0.000	1(0)	0.073	0.0013	1(1)
OP	-5.147	0.000	1(0)	-5.866	0.000	1(0)	0.178	0.0103	
CP	-5.080	0.000	1(0)	-5.544	0.000	1(0)	0.090	0.009	1(1)
MP	-4.837	0.000	1(0)	-5.482	0.000	1(0)	0.050	0.019	1(1)

The unit root test results in Table 2 provide evidence of the stationarity properties of global macroeconomic variables and commodity price movements in Nigeria. According to the Augmented Dickey-Fuller (ADF), Phillips-Perron (PP), and KPSS tests, the common commodity price factor (CCPF) is non-stationary at the level but becomes stationary after first differentiation, implying it is integrated to the first degree, I (1). On the other hand, the global factor (GF), oil price (OP), copper price (CP), and maize price (MP) are all stationary at a level according to the ADF and PP tests, implying that they are integrated of order zero, I (0).

However, the KPSS results, which test for non-stationarity, show significance for all variables at the level—implying non-stationarity—except for GF, where the result is marginally supportive of stationarity. Despite these minor inconsistencies, most of the data from the ADF and PP tests confirm that GF, OP, CP, and MP are stationary, while CCPF is stationary only after differentiation. In summary, the null hypothesis of a unit root was rejected for most of the variables at the level, except for the CCPF, which requires prior differentiation to achieve stability.



Figures 2: Time plots of the differenced global macroeconomic variables and commodity price movements in Nigeria

The time-domain graphs in Figure 2, which display a differentiated series of global macroeconomic variables and commodity price volatility in Nigeria, visually confirm the stationarity obtained after transformation. The differentiation process effectively eliminated trends and stabilised the mean of each series, as evidenced by more consistent fluctuations around zero. These graphs show that volatility has become relatively more regular over time, especially for variables such as CCPF, which were initially non-stationary. Although the differentiated series still exhibit short-term fluctuations and occasional spikes, particularly for oil and copper prices (CP), their statistical properties appear more stable than their raw forms. Overall, these visual patterns are consistent with the results of unit root tests, reinforcing the idea that the series are now suitable for other time series modelling, such as VAR or VECM, which require stationary data. To further investigate the properties of the data, a correlation analysis was conducted on the raw and differenced data for global macroeconomic variables and commodity price movements in Nigeria. The results are presented in Table 3 below.

Table 3: Correlation analysis of the raw and differenced data on global macroeconomic variables and commodity price movements in Nigeria

Correlation										
Probability	**CCPF**	**CP**	**GF**	**OP**	**MP**	**DCCPF**	**DCP**	**DGF**	**DMP**	**DOP**
CCPF	1.000									
CP	-0.015 (0.7128)	1.000								
GF	0.036 (0.360)	0.814 (0.000)	1.000							
OP	0.090 (0.023)	0.471 (0.000)	0.612 (0.000)	1.000						
MP	0.125 (0.002)	0.344 (0.000)	0.561 (0.000)	0.307 (0.000)	1.000					
DCCPF	0.032 (0.415)	0.519 (0.000)	0.613 (0.000)	0.354 (0.000)	0.331 (0.000)	1.000				
DCP	-0.128 (0.0013)	0.156 (0.000)	0.001 (0.989)	-0.086 (0.031)	-0.113 (0.005)	-0.002 (0.959)	1.000			
DGF	-0.205 (0.000)	0.205 (0.000)	0.111 (0.0053)	-0.063 (0.112)	-0.071 (0.075)	0.053 (0.180)	0.654 (0.000)	1.000		
DMP	-0.076 (0.056)	0.134 (0.001)	0.113 (0.004)	0.011 (0.783)	0.178 (0.000)	0.052 (0.189)	0.111 (0.005)	0.322 (0.000)	1.000	
DOP	-0.059 (0.135)	0.138 (0.001)	0.130 (0.001)	0.191 (0.000)	-0.060 (0.875)	0.071 (0.074)	0.207 (0.000)	0.422 (0.000)	0.011 (0.782)	1.000

The correlation analysis presented in Table 3 reveals the degree of association between global macroeconomic variables and commodity price fluctuations, both in their aggregate and differentiated forms. In the raw data, most variables exhibit relatively

weak to moderate correlations with the CCPF. For example, the correlation between the CCPF and the GF is weak, with a correlation coefficient of 0.036 (r = 0.360). In contrast, the correlation between the CCPF and the OP is slightly stronger at 0.090 (r = 0.023), and with the MP it is 0.125 (r = 0.002), indicating statistically significant but weak relationships.

Both GF and CP are highly correlated at 0.814 (p = 0.000), indicating a strong association between global factors and copper prices (CP). Similarly, GF is also moderately correlated with OP at 0.612 and MP at 0.561, both of which are significant at the 1% level. OP and CP exhibit a moderate correlation of 0.471, while OP and MP also share a weaker but significant correlation of 0.307. In the differentiated series, the relationships shift. The correlation between the DCCPF and the DGF increases to 0.613 (p = 0.000), indicating a strong contemporaneous relationship in their short-term fluctuations. The DCCPF also exhibits moderate positive correlations with the DCP (0.519), DOP (0.354), and DMP (0.331), all of which are significant at the 1% level, suggesting that the CCPF responds to short-term changes in the prices of these commodities.

Meanwhile, DCP is negatively correlated with DCCPF at -0.128 (p = 0.0013), indicating an inverse relationship in the short run. DGF is negatively correlated with DCCPF at -0.205 (p = 0.000) and positively correlated with DCP at 0.205 (p = 0.000). These results confirm stronger correlations in short-term dynamics than in long-term levels. In short, while the raw data shows mostly weak and moderate correlations, the differentiated series reveal more significant and statistically significant short-term links, particularly between global macroeconomic variables and commodity prices. In another development, a cointegration test was done on global macroeconomic variables and commodity price movements in Nigeria to determine whether a long-term relationship exists between the variables using trace and maximum eigenvalue statistics. The result is shown in Table 4 below.

Table 4: Cointegration test on global macroeconomic variables and commodity price movements in Nigeria

Unrestricted Cointegration Rank Test (Trace)					**Unrestricted Cointegration Rank Test (Max. Eigenvalue)**			
Hypothesized	**Trace**		**0.05**					
No. of CE(s)	**Eigenvalue**	**Statistic**	**Critical Value**	**Prob.****	0.234	167.8880	33.877	0.000
None *	0.234	298.544	69.819	0.000	0.081	53.093	27.584	0.000
At most 1 *	0.081	130.656	47.856	0.000	0.064	41.840	21.132	0.000
At most 2 *	0.064	77.563	29.797	0.000	0.050	32.289	14.265	0.000
At most 3 *	0.050	35.723	15.495	0.000	0.005	3.434	3.841	0.064
At most 4	0.005	3.434	3.841	0.064	0.234	167.889	33.877	0.000
Trace test indicates 4 cointegrating eqn(s) at the 0.05 level					*Trace test indicates 4 cointegrating eqn(s) at the 0.05 level*			
** Denotes rejection of the hypothesis at the 0.05 level*					** Denotes rejection of the hypothesis at the 0.05 level*			
***MacKinnon-Haug-Michelis (1999) p-values*					***MacKinnon-Haug-Michelis (1999) p-values*			

The results of the cointegration tests presented in Table 4, which are based on trace statistics and maximum eigenvalues, provide strong evidence of the existence of long-run equilibrium relationships between global macroeconomic variables and commodity price volatility in Nigeria. Specifically, the trace statistics significantly exceed the critical 5% values at each hypothetical rank, with values such as 298.544, 130.656, 77.563, and 35.723, all of which are well above their respective critical thresholds and associated p-values of 0.000. Similarly, the maximum eigenvalue test also confirms the presence of cointegration, identifying four significant cointegration vectors, with the highest eigenvalue-based statistic being 167.888, compared to a critical value of 33.877. These results lead to the rejection of the null hypothesis of no cointegration at every step up to four cointegrating equations, indicating that the variables (CCPF, GF, CP, MP, and OP) evolve together in the long run despite short-term fluctuations. This confirms the notion that commodity prices and global macroeconomic forces are structurally linked in the Nigerian economic environment. In short, the trace and maximum eigenvalue tests confirm the existence of multiple equilibrium relationships in the long run, thus supporting the cointegration hypothesis among the variables at the 5% significance level (Table 5).

Table 5: VAR lag order selection criteria on global macroeconomic variables and commodity price movements in Nigeria

Lag	**LogL**	**LR**	**FPE**	**AIC**	**SC**	**HQ**
0	-8420.924	NA	337898.3	26.91989	26.95534	26.93366
1	-3978.031	8800.619	0.250531	12.80521	13.01796	12.88787
2	-3777.429	394.1538	0.142961	12.24418	12.63422	12.39573
3	-3751.133	51.24756	0.142376	12.24004	12.80737	12.46047

4	-3709.686	80.11290	0.135097	12.18750	12.93212	12.47681
5	-3677.297	62.08793	0.131960	12.16389	13.08580	12.52209
6	-3512.591	313.0997	0.084463	11.71754	12.81674	12.14462
7	-3445.852	125.8015	0.073936	11.58419	12.86068	12.08016
8	-3278.532	312.7238*	0.046937*	11.12949*	12.58328*	11.69434*
** Indicates lag order selected by the criterion*						
LR: sequential modified LR test statistics (each test at 5% level)						
FPE: Final prediction error						
AIC: Akaike information criterion						
SC: Schwarz information criterion						
HQ: Hannan-Quinn information criterion						

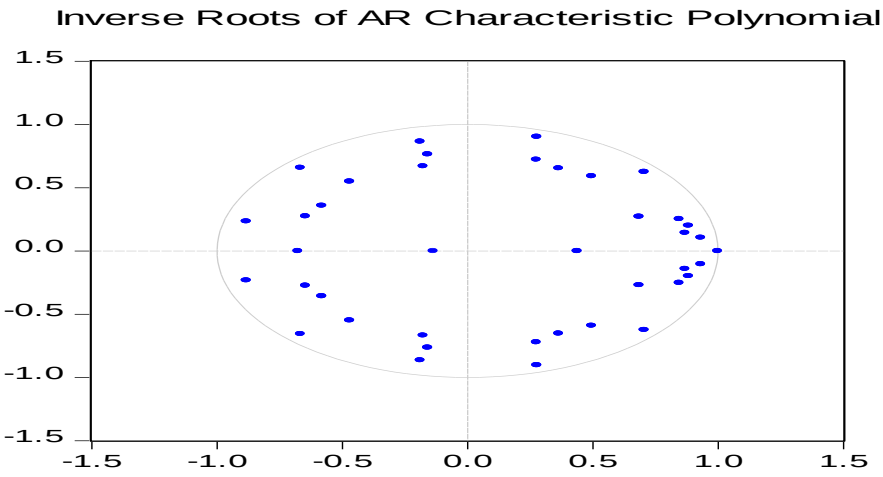
The optimal lag length for the VAR model, as captured by the final forecast error (FPE), Akaike information criterion (AIC), Schwarz criterion (SCC), and Hannan-Quinn criterion (HQ), is eight lags. This suggests that the dynamic interactions between global macroeconomic variables and commodity price volatility in Nigeria can be best captured with eight lags of prior information.

Table 6: Error correction model on global macroeconomic variables and commodity price movements in Nigeria

Dependent Variable	Lags	Coefficient	t-statistic	Interpretation
1. CointEq1 (CCPF (-1) = 1)				
D(CCPF)	7	-0.0005	[-2.53]	Statistically significant. CCPF adjusts slowly (0.05% per period) to restore equilibrium when it deviates from its target.
D(CP)		-0.0007	[-1.55]	Not statistically significant. CP doesn't significantly adjust via CointEq1.
D(GF)		-0.00046	[-4.64]	Significant adjustment. GF adjusts by 0.046% per month to correct disequilibrium.
D(MP)		-0.0008	[-1.61]	Borderline significant. Slow adjustment.
D(OP)		-0.0038	[-6.94]	Strong and significant. OP adjusts fastest (0.38%) toward equilibrium in CointEq1.
2. CointEq2 (CP(-1) = 1)				
D(CP)	7	-0.120	[-5.23]	Highly significant. CP corrects its disequilibrium quickly (~12% per month).
D(CCPF), D(GF), D(MP), D(OP)		Not significant		No evidence of other variables adjusting in response to CP disequilibrium.
3. CointEq3 (GF (-1) = 1)	7			
D(CCPF)		0.533	[12.64]	Highly significant and large. CCPF responds strongly to GF deviation.
D(CP), D(GF), D(MP), D(OP)		All significant and positive	[5.60–3.41]	Strong mutual adjustment to GF-led disequilibrium.
4. CointEq4 (MP (-1) = 1)				
D(MP)		-0.152	[-7.38]	Strong and significant adjustment. MP corrects quickly (15.2%/period).
Others		Not significant		They don’t respond to MP disequilibrium.

The results of the error correction model on global macroeconomic variables and commodity price movements in Nigeria are presented in Table 6. The results show that both OP and GF exhibit significant adjustment toward the equilibrium identified by CointEq1 (driven by CCPF), indicating a strong long-run correlation between CCPF, OP, and GF. Furthermore, CP adjusts aggressively and independently to its long-run deviation. The others do not react significantly. This is the most responsive equilibrium relationship: all series adjust significantly to GF deviations, especially CCPF. Similarly, MP is self-correcting, exhibiting strong correction of endogenous errors, but does not significantly affect the others in the short run. In summary, the major macroeconomic variables and commodity prices in Nigeria exhibit varying speeds and intensities of adjustment toward equilibrium in the long run. Specifically, the oil price (OP) and global factors (GF) react aggressively and rapidly to correct the imbalance in their mutual complementarity, while the common commodity price factor (CCPF) adjusts gradually. Copper (CP) and maize (MP) prices exhibit strong self-correcting mechanisms but do not significantly influence the adjustment of other

variables, suggesting that some variables primarily drive equilibrium restoration within their dynamics rather than through broader system-wide corrections.



Figures 3: Dynamic stability plot on global macroeconomic variables and commodity price movements in Nigeria

The dynamic stability graph in Figure 3 depicts the behaviour of the global macroeconomic variables system and commodity price fluctuations in Nigeria over time, assessing whether the estimated vector error correction model (VECM) remains stable. Visual inspection confirms the stability of the model, as all characteristic polynomial roots lie within the unit circle. This implies that the long-run relationships between the common commodity price factor (CCPF), global factors (GF), and commodity prices (copper, maize, and oil prices) are dynamically stable, and that shocks to the system will dissipate gradually rather than persist indefinitely, thus verifying the model's reliability for policy analysis and forecasting.

Table 7: Pairwise Granger causality tests for global macroeconomic variables and commodity price movements in Nigeria

Null Hypothesis	Obs	F-Statistic	Prob.
CP does not Granger-cause CCPF	629	16.5947	2.E-15
CCPF does not Granger-cause CP		1.78083	0.1147
GF does not Granger-cause CCPF	629	38.0900	4.E-34
CCPF does not Granger-cause GF		3.27354	0.0063
OP does not Granger-cause CCPF	629	6.03735	2.E-05
CCPF does not Granger-cause OP		4.75970	0.0003
MP does not Granger-cause CCPF	629	4.13104	0.0011
CCPF does not Granger-cause MP		4.28080	0.0008
GF does not Granger-cause CP	629	4.93157	0.0002
CP does not Granger-cause GF		1.30985	0.2580
OP does not Granger-cause CP	629	3.80486	0.0021
CP does not Granger-cause OP		4.80777	0.0003
MP does not Granger-cause CP	629	0.95298	0.4461
CP does not Granger-cause MP		3.55634	0.0035
OP does not Granger-cause GF	629	3.06652	0.0096
GF does not Granger-cause OP		7.75668	4.E-07
MP does not Granger-cause GF	629	0.95443	0.4452
GF does not Granger-cause MP		5.09425	0.0001
MP does not Granger-cause OP	629	1.29177	0.2657
OP does not Granger-cause MP		2.78448	0.0169

The results of the pairwise Granger causality tests provide information on the dynamic relationships and direction of causality between global macroeconomic variables (CCPF and GF) and commodity price movements (CP, MP, and OP) in Nigeria, as shown in Table 7. The results of the causality tests reveal a complex web of relationships between copper prices (CP), the common commodity price factor (CCPF), global factors (GF), oil prices (OP), and maize prices (MP). Starting with copper prices (PC) and CCPF, the test reveals that copper prices (PC) have a significant influence on CCPF in the Granger sense (p-value = 2 × 10^ (-15)). This suggests that past values of copper prices (PC) have predictive power for future fluctuations in the

commodity price factor, suggesting that fluctuations in copper prices (PC) significantly influence the overall commodity price index. However, CCPF does not influence copper prices (PC) in the Granger sense (p-value = 0.1147).

This shows that changes in the commodity price factor do not have a significant impact on copper (PC) prices, thus strengthening the causal relationship between CP prices. Similarly, the relationship between global factors and the global climate framework reveals that Global factors (GF) are driven by the Granger CCPF (p-value = 4.E-34), indicating that global economic conditions, such as macroeconomic trends or geopolitical events, have a profound impact on the Nigerian commodity price index. On the other hand, the CCPF also mediated the relationship between these variables (p-value = 0.0063), suggesting a two-way interaction. Although global factors have a more dominant influence on the GF, fluctuations in the GF can also influence global economic conditions to some extent. In the case of oil prices and CCPF, oil prices (OP) Granger-caused CCPF (p-value = 2.05), indicating that oil market movements have a significant impact on the price factor of a common commodity in Nigeria. This is consistent with the notion that changes in global oil prices are a major factor in determining commodity price movements. Interestingly, there is also a reverse causality relationship whereby CCPF affects oil prices (p-value = 0.0003), although this effect is slightly weaker compared to the effect of oil prices on CCPF. This suggests a mutual correlation between oil prices and commodity prices in general, indicating that changes in one often impact the other. Regarding maize prices and CCPF, the test results indicate that maize prices (MP) induce CCPF (p-value = 0.0011). This suggests that fluctuations in maize prices have a direct impact on broader commodity price fluctuations in Nigeria.

Furthermore, CCPF also induces CCPF (p-value = 0.0011). Maize price (p-value = 0.0008), indicating a feedback loop in which the broader commodity market influences the price of individual commodities, such as maize. When examining the relationship between global factors and copper (Cu) prices, global factors are found to be Granger-causative (P = 0.0002), influencing copper prices in Nigeria. This suggests that macroeconomic trends and global events have a significant influence on copper prices in Nigeria. In contrast, copper (CP) prices are not Granger-causative factors (P = 0.2580), indicating that the copper (CP) market reacts to global economic conditions but does not affect them in return. The causal relationship between oil prices and copper prices (CP) appears to be a correlation. Oil prices influence copper (PC) prices in the Granger sense (p = 0.0021), which demonstrates that fluctuations in oil prices can lead to variations in copper (PC) prices.

Conversely, copper prices (PC) also influence oil prices in the Granger sense (p = 0.0003), suggesting that fluctuations in the copper market can impact oil prices. This suggests that these two markets are closely interconnected, possibly due to their roles in the global commodity market. On the other hand, the relationship between maize prices and copper prices is not statistically significant. Maize prices do not affect copper prices (PC) in the Granger sense (p = 0.4461), meaning that fluctuations in the maize market do not have a significant impact on the copper market (PC). However, copper prices (PC) do affect maize prices (p = 0.0035), suggesting that changes in copper prices influence maize prices, likely due to their interconnected role in broader commodity market trends. Regarding the relationship between oil prices and global factors, oil prices influence global factors in the Granger sense (p = 0.0096), indicating that fluctuations in the oil market can affect the global economic situation. However, global factors also influence oil prices (p = 4.0E-07), indicating that global macroeconomic conditions, such as economic growth or recession, have a significant impact on oil prices.

The relationship between maize prices and global factors reveals that global factors influence maize prices in the Granger sense (p = 0.0001), suggesting that changes in global economic conditions can significantly influence maize prices in Nigeria. However, maize prices do not influence global factors in the Granger sense (p = 0.4452), indicating that maize price fluctuations are not significantly affected by the global economic situation. Furthermore, oil prices and maize prices also exhibit interesting dynamics. (P-value = 0.0169), indicating that fluctuations in oil prices have an impact on maize prices. However, maize prices are not Granger-correlated with oil prices (P-value = 0.2657), implying that fluctuations in the maize market do not have a significant impact on oil prices. These results highlight the complex relationships between global macroeconomic variables and commodity price volatility in Nigeria. While some variables, such as global factors and oil prices, have a significant and dominant influence on others, others, such as maize prices, exhibit more localised effects. These interactions reveal that commodity markets in Nigeria are highly interconnected, with both unidirectional and bidirectional relationships dependent on the variables involved. These results underscore the significant influence of the global economic environment on the Nigerian commodity market, highlighting the feedback loops that exist between various products and macroeconomic factors.

Table 8: Impulse response function for global macroeconomic variables and commodity price movements in Nigeria

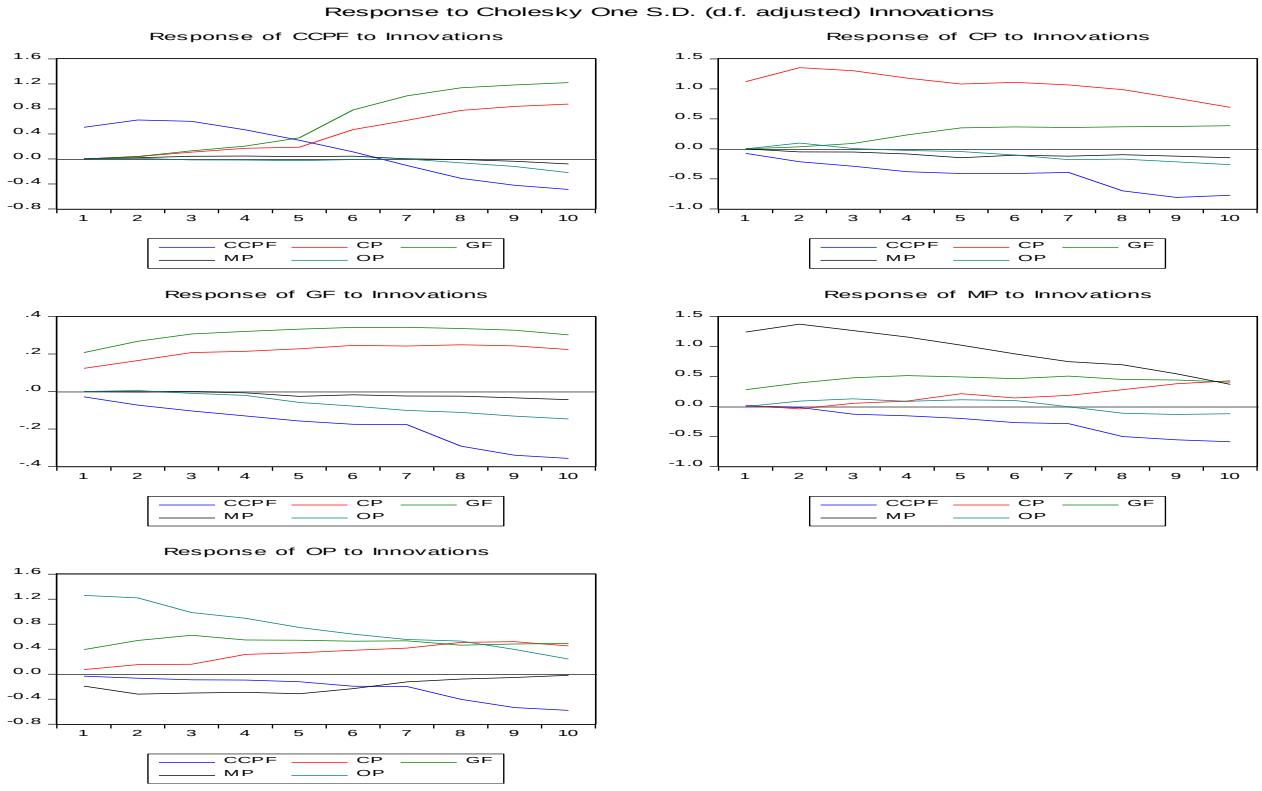
Response of CCPF					
Period	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	0.506644	0.000000	0.000000	0.000000	0.000000
2	0.622834	0.038405	0.038821	0.018726	0.007940
3	0.600333	0.106883	0.128698	0.042480	-0.016014
4	0.465745	0.169417	0.205594	0.045779	-0.019334

5	0.297788	0.187563	0.336406	0.035764	-0.028980
6	0.111605	0.468247	0.784440	0.042791	-0.010971
7	-0.106657	0.616028	1.009373	0.000357	-0.001271
8	-0.310994	0.776028	1.136322	-0.011370	-0.062207
9	-0.422267	0.839329	1.184453	-0.038414	-0.121302
10	-0.488843	0.877322	1.220946	-0.080651	-0.219693
Response of CP					
Period	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	-0.074517	1.120306	0.000000	0.000000	0.000000
2	-0.213950	1.353038	0.035245	-0.049376	0.097996
3	-0.289984	1.302363	0.090559	-0.053168	0.005691
4	-0.380801	1.179421	0.233275	-0.084941	-0.026485
5	-0.410297	1.080444	0.351058	-0.147111	-0.045250
6	-0.411097	1.108089	0.366373	-0.105868	-0.103044
7	-0.391986	1.066606	0.356228	-0.120159	-0.180181
8	-0.698945	0.986408	0.368106	-0.097100	-0.168762
9	-0.807872	0.843379	0.374784	-0.121567	-0.215629
10	-0.773390	0.691772	0.386762	-0.148174	-0.263645
Response of GF					
Period	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	-0.028635	0.123589	0.207791	0.000000	0.000000
2	-0.072843	0.165080	0.268177	-0.002020	0.005335
3	-0.103772	0.207759	0.307092	0.000284	-0.009869
4	-0.130283	0.214190	0.320330	-0.007386	-0.020448
5	-0.157585	0.228305	0.333075	-0.026234	-0.058265
6	-0.174776	0.245891	0.342024	-0.017238	-0.077925
7	-0.176950	0.242997	0.342363	-0.024051	-0.100834
8	-0.291481	0.249405	0.336228	-0.024435	-0.111526
9	-0.339894	0.243338	0.327132	-0.033863	-0.131652
10	-0.357196	0.224171	0.302561	-0.043140	-0.146336
Response of MP					
Period	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	0.008259	0.021450	0.279645	1.241996	0.000000
2	-0.014792	-0.039461	0.392713	1.373026	0.090040
3	-0.128884	0.053226	0.478924	1.266989	0.128093
4	-0.155391	0.089641	0.515265	1.159733	0.086683
5	-0.199345	0.212837	0.493254	1.022741	0.113280
6	-0.268516	0.143251	0.465382	0.877217	0.100428
7	-0.287412	0.184408	0.506685	0.748044	-0.005257
8	-0.501202	0.280656	0.449660	0.695493	-0.112291
9	-0.554992	0.379379	0.442690	0.544627	-0.132246
10	-0.588283	0.428079	0.406583	0.369238	-0.120467
Response of OP					
Period	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	-0.032184	0.072754	0.392971	-0.191224	1.258958
2	-0.064359	0.153382	0.538900	-0.319872	1.219887
3	-0.090837	0.158528	0.621562	-0.301375	0.985656
4	-0.094038	0.316252	0.545937	-0.290633	0.893523
5	-0.121164	0.341811	0.543175	-0.314552	0.746876
6	-0.193393	0.381402	0.527099	-0.231279	0.640015
7	-0.196464	0.416710	0.532376	-0.123032	0.554691
8	-0.402932	0.508579	0.462178	-0.078084	0.528410
9	-0.535105	0.519040	0.482666	-0.053187	0.394649
10	-0.580479	0.451836	0.489900	-0.019319	0.242200
Cholesky Ordering: CCPF CP GF MP OP					

The impulse response function in Table 8 analyses how global macroeconomic variables (CCPF and GF) and commodity price movements (copper (CP), maize, and oil prices) in Nigeria interact over a 10-period time horizon. The impulse response function shows how global macroeconomic variables (CCPF and GF) and commodity price movements (copper (CP), maize, and oil prices) affect each other over a 10-period time horizon in Nigeria. For the local currency exchange rate index, the response to shocks from other variables is initially positive, with the local currency exchange rate index increasing sharply to 0.5066 during the first period. This value increases slightly to 0.6228 during the second period, before gradually declining and becoming negative (-0.4888) by the tenth period. This suggests that initial shocks to copper prices and global factors lead to an increase in the IMF's copper price, but over time, these effects diminish and reverse. In addition, copper (CP) prices initially experience a positive shock (1.1203) but begin to decline over time.

In the tenth period, it declines to 0.6918. This suggests that the CCPF and global factors shocks initially lead to higher copper prices, but over time, the effect weakens, and copper prices tend to decline. For global factors (GF), the initial response to the shocks is positive (0.2078), but over time it becomes increasingly negative, reaching -0.3572 in the tenth period. This suggests that global factors initially have a positive impact on the IMF and copper price shocks, but these effects weaken or reverse over time, particularly in response to maize and oil shocks. Maize (MP) prices exhibit an initial response of 1.2420 to the shocks, with significant volatility over time. In the tenth period, the response declines to 0.3692.

The response to IMF and copper price shocks generally leads to higher maize prices in the early periods, but the effect diminishes in later periods. Oil (OP) prices start at 1.2590 in the first period and gradually decline to 0.2422 in the tenth period. Oil prices are initially affected by shocks from other variables, particularly those related to calcium carbonate and copper prices. Still, this effect weakens over time, particularly for maize and global factors. The results indicate that initial shocks associated with global macroeconomic variables and commodity prices tend to increase the respective prices; however, this effect weakens over time, suggesting that these markets are subject to adjustment and that the initial responses are not sustainable in the long run.



Figures 4: Plots of the impulse response function for global macroeconomic variables and commodity price movements in Nigeria

Figure 4 visually illustrates the propagation of shocks associated with global macroeconomic variables and commodity prices in the Nigerian commodity market over time. The impulse response curves show that the combined commodity price factor initially reacts positively to its shock, indicating a strong immediate response to changes in global commodity prices. However, this reaction weakens and subsequently becomes negative, reflecting a reversal or adjustment in the market as external influences recede. Similarly, the charts show that copper prices react strongly to shocks and then gradually decline, indicating

a strong reaction in the short term but a stabilizing trend. The Global Factor (GF) also has a sustained positive effect on itself and other variables such as CCPF and copper, highlighting its sustained influence on commodity prices in Nigeria. Maize prices initially spike in response to shocks, but this effect dissipates over time, highlighting the transient nature of these disturbances. Oil prices behave similarly, with a strong initial shock that gradually fades, revealing their sensitivity to immediate disturbances but also their tendency to return to equilibrium. The impulse response curves in Figure 4 highlight that the Nigerian commodity market is highly sensitive to global shocks, particularly in the short term. However, the weakening of responses over time suggests a mean-reverting behaviour, where initial shocks, although significant, tend not to persist indefinitely, allowing the market to absorb and gradually adjust to external pressures.

Table 9: Variance decomposition function for global macroeconomic variables and commodity price movements in Nigeria

Variance Decomposition of CCPF						
Period	**S.E.**	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	0.506644	100.0000	0.000000	0.000000	0.000000	0.000000
2	0.804988	99.47596	0.227613	0.232576	0.054117	0.009729
3	1.019045	96.77946	1.242131	1.740105	0.207539	0.030767
4	1.152741	91.95640	3.130689	4.540832	0.319901	0.052175
5	1.252181	83.58681	4.896873	11.06585	0.352686	0.097780
6	1.554659	54.74060	12.24826	32.63818	0.304556	0.068413
7	1.956187	34.87203	17.65312	47.23923	0.192364	0.043253
8	2.412640	24.58676	21.95127	53.23837	0.128683	0.094915
9	2.850041	19.81430	24.40336	55.42279	0.110383	0.249166
10	3.267549	17.31247	25.77453	56.12648	0.144898	0.641613
Variance Decomposition of CP						
Period	**S.E.**	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	1.122782	0.440475	99.55952	0.000000	0.000000	0.000000
2	1.774939	1.629227	97.94913	0.039431	0.077388	0.304825
3	2.222995	2.740313	96.76707	0.191090	0.106540	0.194985
4	2.557359	4.287834	94.38685	0.976443	0.190821	0.158057
5	2.832440	5.593761	91.49441	2.332148	0.425313	0.154369
6	3.094452	6.451503	89.47918	3.355713	0.473385	0.240221
7	3.322761	6.987083	87.90941	4.059779	0.541339	0.502394
8	3.560291	9.939906	84.24678	4.605132	0.545898	0.662280
9	3.773772	13.42995	79.97929	5.085154	0.589655	0.915954
10	3.944501	16.13680	76.28137	5.615879	0.680826	1.285121
Variance Decomposition of GF						
Period	**S.E.**	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	0.243457	1.383407	25.76993	72.84666	0.000000	0.000000
2	0.404698	3.740432	25.96502	70.27468	0.002491	0.017379
3	0.558674	5.412979	27.45439	67.09097	0.001333	0.040323
4	0.691412	7.084718	27.52153	65.26767	0.012283	0.113793
5	0.818553	8.761041	27.41523	63.12440	0.111479	0.587849
6	0.940419	10.09152	27.60695	61.05149	0.118056	1.131974
7	1.050098	10.93308	27.49601	59.59386	0.147142	1.829908
8	1.173010	14.93662	26.55633	55.97527	0.161314	2.370471
9	1.294677	19.15351	25.33224	52.33352	0.200830	2.979901
10	1.403157	22.78682	24.11912	49.20395	0.265503	3.624608
Variance Decomposition of MP						
Period	**S.E.**	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	1.273297	0.004208	0.028380	4.823423	95.14399	0.000000
2	1.915879	0.007819	0.054958	6.332074	93.38428	0.220871
3	2.353948	0.304962	0.087534	8.333996	90.83108	0.442425
4	2.681650	0.570758	0.179187	10.11356	88.69110	0.445388
5	2.928894	0.941701	0.678277	11.31434	86.54273	0.522955
6	3.109214	1.581468	0.814156	12.28039	84.75560	0.568385
7	3.255788	2.221565	1.063309	13.62152	82.57499	0.518621
8	3.410079	4.185296	1.646626	14.15553	79.43136	0.581185

9	3.548333	6.311891	2.663946	14.63044	75.71804	0.675681
10	3.665536	8.490421	3.860181	14.94014	71.96809	0.741172
Variance Decomposition of OP						
Period	**S.E.**	**CCPF**	**CP**	**GF**	**MP**	**OP**
1	1.335027	0.058116	0.296986	8.664447	2.051659	88.92879
2	1.921150	0.140289	0.780833	12.05259	3.762985	83.26330
3	2.274398	0.259609	1.042941	16.06799	4.440689	78.18877
4	2.542173	0.344633	2.382392	17.47314	4.861468	74.93837
5	2.746992	0.489708	3.588676	18.87454	5.474743	71.57233
6	2.910288	0.877874	4.914745	20.09616	5.509142	68.60208
7	3.047665	1.216071	6.351190	21.37669	5.186640	65.86941
8	3.195026	2.696910	8.312617	21.54282	4.778965	62.66869
9	3.339981	5.034685	10.02172	21.80184	4.398510	58.74324
10	3.463470	7.491058	11.02174	22.27563	4.093559	55.11801
Cholesky Ordering: CCPF CP GF MP OP						

The results of the variance analysis in Table 9 provide insight into the dynamic interrelationship between global macroeconomic variables and commodity price volatility in Nigeria, revealing the extent to which the variance in the forecast error of each variable can be explained by the shocks it and others experience over time. For the Common Commodity Price Factor (CCPF), initial periods indicate that its shocks largely explain its volatility; however, as the horizon widens, the influence of other global variables, such as the Global Factor (GF) and Copper Prices (CP), becomes increasingly significant. In the tenth period, the CCPF explains less than a fifth of its variance, while GF and CP together dominate its variance. This suggests a high long-term sensitivity of Nigeria's commodity price structure to external macroeconomic and commodity-specific shocks, particularly those emanating from the global financial or trade environment. Copper Prices (CP), although initially self-determining, are gradually influenced by the CCPF and GF. In the tenth period, a significant portion of the variance in copper prices can be explained by these global factors, suggesting a closer correlation between the price of copper in Nigeria and global commodity market signals.

This underscores copper's dual role as both a driver and a factor in the broader commodity price network. The Global Factor (GF) exhibits a declining trend in unexplained variance, with increasing contributions from the CCPF and CP over time. This interaction reveals that Nigeria's economic exposure to global dynamics is not unidirectional; rather, it reflects feedback loops, particularly when commodity prices indirectly affect the global conditions to which they are exposed. The increasing share of interpretive power held by the IMF over the global framework, particularly beyond the medium-term horizon, underscores how emerging market commodity structures can influence global frameworks. Maize prices, which have been largely isolated in the short term, are gradually reflecting global correlations, although they remain dominated by their internal dynamics. Over time, factors such as GF and CP are contributing more to their variability, suggesting that while maize may be locally anchored due to planting patterns or policy easing, global shocks are increasingly diffused, especially in the event of prolonged external disruptions. Oil prices (OP), initially determined by their shocks, show a decline in their endogeneity as GF and CP gain importance in influencing their movements. By the tenth period, less than 60% of the variance in oil prices is explained internally, with the remainder attributed to broader global variables. This trend underscores Nigeria’s sensitivity to oil market volatility stemming from global macroeconomic trends, especially given its status as an oil-exporting country. The analysis reveals a common pattern: the dominance of short-term internal shocks gives way to significant long-term external influence, particularly from the global factor and the Climate Change Adaptation Fund. This has policy implications for Nigeria, suggesting that domestic commodity markets have become more exposed to and closely linked to external macroeconomic conditions. Policymakers need to be more proactive in managing this exposure, including through diverse trade policies, commodity risk management strategies, and macroeconomic stabilisation tools that mitigate global shocks.

5. Discussion of findings

The results of the data analysis on global macroeconomic variables and commodity price volatility in Nigeria provide valuable insights into the interconnections within the global commodity market. The results are divided into several main sections, including correlation analysis, cointegration tests, short-run dynamics, Granger causality tests, impulse response analysis, and variance analysis. First, the correlation analysis reveals that while the raw data generally exhibits weak correlations between the common commodity price factor and global economic variables, the discrete data exhibit stronger relationships in the short run. This suggests that fluctuations in global macroeconomic variables have a more direct impact on commodity prices, which is consistent with similar findings in the literature. For example, studies by Blanchard and Galí [4] and Ghosh [8] indicate that commodity prices respond more rapidly to global economic shocks than to long-term trends, as confirmed by the significant correlations observed in the discrete series.

Furthermore, the results of the cointegration tests provide strong evidence of the existence of long-run equilibrium relationships between global variables and commodity prices. This finding supports the notion that global economic forces exert a persistent influence on commodity markets in Nigeria, consistent with previous research [5]. The presence of multiple complementarity vectors among variables, such as the commodity integration index, oil prices, and copper prices, suggests that the prices of these commodities are linked to global macroeconomic fundamentals rather than just to domestic supply and demand factors. Similarly, the results of the error correction model indicate that global factors and oil prices exhibit a significant adjustment toward long-run equilibrium, with copper prices adjusting independently of their deviations from equilibrium. This suggests that certain global macroeconomic variables, particularly oil prices, play a significant role in determining commodity prices over the long term. These results are consistent with previous research, such as that by Okoli et al. [9], who showed that oil shocks have significant long-run effects on commodity price dynamics. The results of Granger Causality reveal a complex set of bidirectional relationships. For example, oil prices affect the CCPF (the Granger effect), while the CCPF also affects oil prices, albeit with a weaker impact on them. This highlights the interconnectedness between oil markets and broader commodity markets, as changes in one often lead to changes in the other. The observed bidirectional causality between global factors and the climate change framework supports the idea that global economic conditions and commodity prices influence each other, as demonstrated by studies by Wasseja et al. [3] and Ghosh [1].

In another development, impulse response function analysis demonstrates how shocks to global macroeconomic variables and commodity prices propagate over time. The results indicate that shocks to copper prices, global factors, and oil prices initially lead to higher commodity prices in Nigeria. Still, their effects tend to diminish or reverse over time. This is consistent with theoretical expectations that markets, especially in emerging economies, tend to return to equilibrium after being affected by external shocks [7]. The diminishing impact of shocks over time highlights the importance of understanding both short- and long-term influences on commodity price stability. Similarly, the results of the variance analysis indicate that while commodity prices are initially determined by their internal dynamics, global macroeconomic factors—particularly the global factor and the commodity price index—become increasingly influential over time. This finding supports the argument that commodity prices in Nigeria are strongly influenced by global forces, which are of critical importance in the long run. This observation is consistent with a study by Akram [6], which found that emerging economies, such as Nigeria, are highly sensitive to external shocks, particularly those arising from major global commodity markets.

6. Conclusion

In conclusion, this study offers a comprehensive examination of the relationships between global macroeconomic variables and commodity price volatility in Nigeria. Granger causality tests, cointegration analysis, and variance analysis results highlight the significant impact of global macroeconomic variables on commodity prices, particularly oil prices and the common factor of commodity prices. The results underscore the significant impact of global factors on commodity price dynamics in Nigeria, with both short-term and long-term effects being notable. These findings have significant policy implications, suggesting that Nigerian policymakers should adopt strategies to mitigate the impact of global volatility on domestic commodity markets. Diversified trade policies, commodity risk management, and macroeconomic stabilisation tools will be essential to protect the economy from global shocks and ensure long-term economic stability.

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