



Oil Shocks and Food Inflation in Nigeria: Cointegration and Granger Causality Test

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ABSTRACT

This study uses monthly time series data from January 2012 to January 2025 to investigate the dynamic relationship between food inflation and shocks to the oil price in Nigeria. It examines how domestic oil prices, international oil prices (per US dollar), and monetary policy rates affect food inflation using the Johansen Cointegration approach, Vector Error Correction Model (VECM), and Granger Causality tests. The application of cointegration analysis is supported by the unit root tests, which demonstrate that all variables are integrated to order one. According to empirical findings, there is a significant long-run positive relationship between domestic oil prices and food inflation, implying that increases in fuel costs drive food price volatility. In contrast, international oil prices have a small and statistically insignificant long-run effect. The monetary policy rate has an unexpectedly strong positive long-run effect on food inflation, highlighting the limited effectiveness of monetary tightening in addressing cost-push inflation. Granger causality results show a bidirectional causality between domestic oil prices and food inflation, as well as a unidirectional causality between food inflation and the monetary policy rate. According to the study, Nigeria's inflationary pressures are primarily driven by energy-related costs and structural inefficiencies, not monetary factors. As a result, it recommends targeted energy reforms, improved food supply infrastructure, and a coordinated policy response to reduce the inflationary impact of oil price shocks

INTRODUCTION

Crude oil prices have risen and fallen in recent years. It increased from US\$25 per barrel in 2002 to US\$55 in 2005, reaching a high of US\$138 in the middle of 2008. It fell precipitously from that level, reaching US\$30 in January 2016 before gradually rising to around US\$57 per barrel by the third quarter of 2017 (CBN, 2017). Demand and supply shocks in the global crude oil market were blamed for the period's variations in oil prices (Hamilton, 1983; Lorruso and Pierroni, 2015).

Researchers are interested in examining how oil shocks relate to inflation because of the probable effects they have on actual economic activity. Numerous studies, including Muhammad et al. Yakubu et al. (2021), Bawa et al. (2020), Ogbonna & Ichoku (2022), and others contended that the relationship is asymmetric, meaning that the impact of a drop in the price of oil on stock performance is very different from that of an increase in the price. Other researchers, however, like Abatcha et al. (2021), Uche et al. (2016), and Okeke et al. (2024), found that the link is linear or symmetric, assuming that the effects of rising and falling oil prices are equal but have opposing signs.

Nigeria's oil and gas resources are plentiful, and between 1981 and 2018, production accounted for an average of one-fourth of the country's GDP. Similarly, the country's macroeconomic success has been closely linked to the oil sector, with oil exports making up roughly 95.7% of total exports and oil income accounting for an average of 73.3%.

Nigeria is still the biggest producer of oil in Africa, but it is unable to process its own oil and must import refined petroleum products to suit its own needs. Therefore, in order to preserve price stability in the face of changes in global crude oil prices or exchange rates, the government offers subsidies for petroleum products. Over time, this has significantly reduced the government's fiscal flexibility, but it has also prevented growing oil prices from affecting local refined oil product prices, which lessens their effect on consumer pricing. (Bawa and others, 2020).

Nigeria's economy has been generally protected from the direct impact of oil price changes due to fuel subsidies, but it does tend to suffer from inflationary pressures produced by rises in the cost of producing imported commodities when oil prices rise in the international market. The majority of the nation's capital and consumer products were imported in 2018, amounting to over \$44.0 billion (10.4 percent of GDP), according to accessible international trade figures. (Bawa and others, 2020).

The literature debate over the impact of oil price shocks on inflation is still ongoing. While some authors (e.g., Muhammad et al., 2023) argued that oil price fluctuations have no effect on inflation, others (e.g., Abatcha, 2021; Al-kasasbeh, et al., 2024; Bawa, et al., 2020; and Yakubu et al., 2021) maintained that oil price changes do.

Based on this background, this paper investigates the causal relationship between domestic oil price, oil price per US dollar, and inflation rate in Nigeria from 2012 to 2025 using the Johansen Co integration, VECM, and Granger causality techniques.

To achieve the aforementioned goals, the rest of the paper is broken up into four sections. In section three, the study covers methodology after reviewing the literature in section two. The findings and discussion are presented in Section 4, and some closing thoughts are offered in Section 5.

LITERATURE REVIEW

The effect of oil shocks on inflation in both industrialized and developing nations has been the subject of numerous studies (see Ogbonna & Ichoku, 2022; Al-kasasbeh, et al., 2024; Okeke, et al., 2024; Abatcha, 2021; Bawa, et al., 2020; Yakubu, et al., 2021; Uche, et al., 2016, among others).

Al-kasasbeh, et al. (2024) investigate the impact of oil price volatility on economic growth in six Middle Eastern countries (Saudi Arabia, Jordan, United Arab Emirates, Kuwait, Qatar, and Turkey). The research employed cross-sectional panel data from 1990 to 2020 using the Westerlund and Edgerton technique. The results of the study showed a long-term relationship between inflation, economic growth, and the volatility of oil prices in six different countries.

Sultan et al. (2020) used the Granger causality and Johansen cointegration tests on annual time series data from 1970 to 2017 to examine the connection between oil prices and inflation in India. The results point to both a causal relationship and a long-term cointegration relationship between Indian oil prices and price levels.

Uche et al. (2016) examined the symmetric and asymmetric effects of oil shocks on Nigerian macroeconomic variables using quarterly time series data using the Exponential EGARCH and VAR methods. The results showed that the naira exchange rate was asymmetrically affected by oil shocks, while output, unemployment, government spending, and the exchange rate were all symmetrically affected.

Bawa et al. (2020) utilized quarterly data from 1999Q1 to 2018Q4 to investigate the asymmetric impact of oil prices on inflation in Nigeria using Nonlinear Autoregressive Distributed Lag. The results show that headline food and core inflation in Nigeria are significantly impacted by rising oil prices.

Abatcha (2021) used monthly time series data and the ARDL approach to examine how fluctuations in oil prices affect Nigerian inflation. The findings show that inflation and fluctuations in oil prices are positively correlated.

Musa and Maijama'a (2021) using yearly time series data from 1985 to 2019, investigate the causal relationship between Nigeria's inflation, exchange rates, and local oil prices. The Granger Causality test, the Vector Error Correction Model, and Johansen cointegration were all used in the study. Although there is no proof that the domestic oil price and inflation are causally related, the results show a long-term causal relationship between the exchange rate and the domestic oil price.

Babuga and Naseem (2022) examined the unequal impact of fluctuations in oil prices on inflation in Sub-Saharan African nations. Using Nonlinear Autoregressive Distributed Lag, the panel data was examined. The results

show that the relationship between inflation and fluctuations in oil prices is asymmetrical in both countries.

Ogbonna and Ichoku (2022) discovered that increases and decreases in oil prices affect trade balances with four trading partners, using Nonlinear Autoregressive Distributed Lag for annual time series data from 1999 to 2019.

Muhammed et al. (2023) Examine the asymmetric impact of oil price volatility on Nigerian inflation using annual time series data from 1980 to 2020 using Nonlinear Autoregressive Distributed Lag. The results demonstrate an unbalanced effect in the short and long term, with negative oil price shocks having a greater and more substantial influence on inflation than positive oil shocks.

In a more recent study, Okeke et al. (2024) used the GARCH method and ex post factor to examine the impact of crude oil price shocks on inflation and exchange rates using annual time series data from 1990 to 2022. They discovered that both the exchange rate and oil shock had a significant negative impact on inflation in Nigeria.

In summary, the following reasons will differentiate this paper from the preceding literature and serve as a gap in the literature.

1. Insufficient Focus on Food Inflation as a Distinct Inflation Category.

Most previous studies, such as Uche et al. (2016) and Ogbonna & Ichoku (2022), focused on headline or core inflation rather than food inflation, which accounts for a significant portion of Nigeria's Consumer Price Index (CPI). Given that food inflation disproportionately affects low-income households, analysing it separately is critical for policy relevance. Despite its significant contribution to overall inflation in Nigeria, there is a lack of empirical research that isolates and analyses food inflation as a distinct variable influenced by oil shocks.

2. Inconsistent Treatment of Domestic and International Oil Prices.

Some studies, such as Abatcha (2021) and Bawa et al. (2020), acknowledge the importance of oil prices in influencing inflation, but they frequently treat oil prices as a single aggregated variable, focussing primarily on international crude oil prices.

Few studies distinguish between the effects of domestic (policy-influenced) and international (market-driven) oil prices on Nigerian inflationary trends. This is especially important given Nigeria's subsidy regime, which has historically created a gap between global and domestic pump prices.

3. Failure to Address the Policy Response Channel (Monetary Policy Rate)

Although Musa and Maijama'a (2021) investigated the causal relationship between oil price, exchange rate, and inflation, they failed to adequately include the monetary policy rate (MPR) as a moderating or intervening variable in the oil price-inflation transmission channel.

There is a need for updated empirical research on the effects of the 2023/2024 fuel subsidy removal and recent monetary tightening on food inflation in Nigeria.

METHODOLOGY

1. Data Source

The study used monthly time series data from January 2012 to January 2025 to perform its empirical analysis. The Central Bank of Nigeria's website (www.cbn.gov.ng) provided all of the data. In light of the global economic crisis, the post-global economic crisis, the recession that the nation entered in August 2016, and the withdrawal of oil subsidies in 2024, this time frame was selected to capture the independent effects of oil prices on food inflation.

2. Model Specification

The study's model is described in functional form as follows:

$$FINF_t = f(LDOIL P_t, LOILP USD_t, MPR_t) \dots \dots \dots (3.1)$$

Thus, the model's econometric specification can be expressed as follows:

$$INF_t = \beta_0 + \beta_1 LDOIL P_t + \beta_2 LOILP USD_t + \beta_3 MPR_t + \mu_t \dots (3.2)$$

Where;

FINF = Food Inflation

LDOIL P = Log of Domestic Oil price

LOILP USD = Log of Oil Price per US Dollar

MPR = Monetary Policy Rate

$\beta_0, \beta_1, \beta_2, \beta_3$ are Parameters of the variables captured in the model,

μ = Error Term and t represents Time Trend

The long-term relationship between the price of oil and the overall price level was estimated using the Johansen cointegration method. All of the model's variables must have the same order of integration in order to use the Johansen approach. First, use the unit root test on each variable in the model to verify that it is stationary. The Philips-Perron and augmented Dickey-Fuller (ADF) tests have been applied in this instance. The long-term relationship between the variables can be estimated using the Johansen method of cointegration if all of the variables are determined to be integrated in the same order.

RESULT AND DISCUSSION

Trend of Oil Price and Food Inflation and Monetary Policy Rate in Nigeria

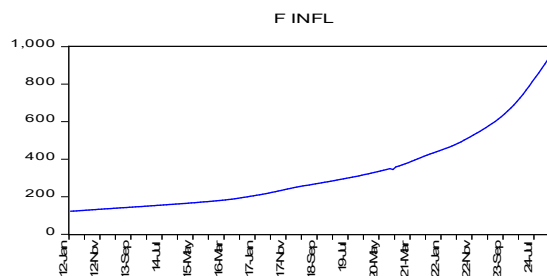


Figure 1. Food Inflation

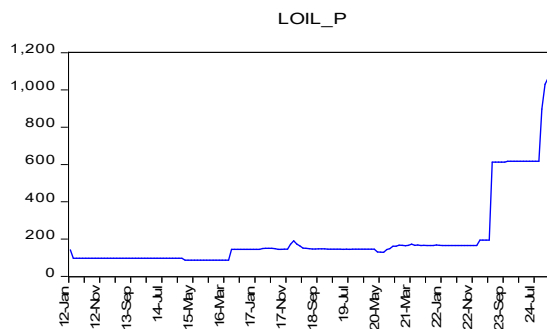


Figure 2. Domestic Oil Price

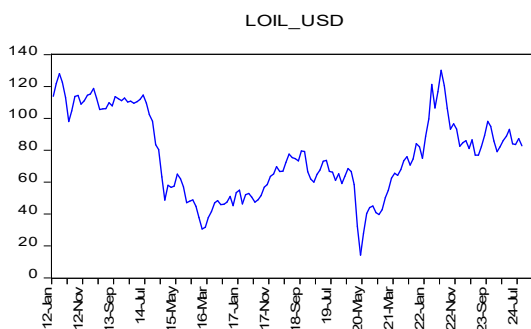


Figure 3. Oil Price Per US Dollar

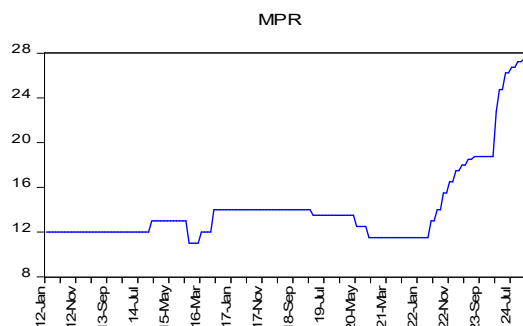


Figure 4. Monetary Policy Rate

Figure 1 shows that food inflation is increasing due to challenges in food production such as poor storage, high post-harvest losses, insecurity in farming regions, and transportation bottlenecks. It also revealed exchange rate depreciation, which has caused the value of the naira to fall significantly since 2015, raising the cost of imported inputs (for example, fertiliser, machinery, and processed foods). Furthermore, periods such as the 2016 recession, COVID-19 lockdowns (2020), and the removal of fuel subsidies in 2024 exacerbated supply disruptions and consumer price increases.

Figure 2 shows that the domestic oil price (DOIL_P) has a significant long-term and short-run effect on food inflation because fuel costs have a direct impact on agricultural production, processing and distribution. However, oil prices fell sharply as a result of the global commodity shocks of 2014–2015; in 2015, Brent crude averaged \$52.37 a barrel. Due to increased global supplies, the price of oil jumped to US\$44.05 per barrel in 2016. Due to higher demand, prices built on the 2017 rebound and reached US\$71.07 a barrel in 2018.

Nigeria's foreign exchange inflows and external reserve accumulation significantly decreased as a result of commodity shocks, which led to a depreciation of the country's currency and an increase in inflationary pressures.

Furthermore, figure 2 of Domestic Oil Price (LOIL_P) and figure 3 of Monetary Policy Rate (MPR) are stable from 2012 to 2022, but have begun rising from November 2022 to July 2024 as a result of the following

Economic Explanation for 2012 to 2022. The government maintained petrol subsidies, protecting the domestic market from global oil price volatility. As a result, domestic prices were artificially stable. Subsidies were phased out between late 2022 and 2024 due to IMF pressure and concerns about fiscal sustainability. Prices were completely deregulated by mid-2023, resulting in a significant increase in domestic oil prices. This coincided with global crude price increases and currency depreciation, passing the entire cost on to consumers. MPR (Monetary Policy Rate): 2012-2022: The CBN took a moderate stance, frequently keeping the MPR at 11% to 14%, citing inflation as cost-push rather than demand-driven. Since November 2022, inflation has skyrocketed due to expectations of subsidy removal. Exchange rate unification, global food price increases.

Unit Root Tests

The result of both Augmented Dicky fuller and Phillip Perron Unit root test are presented in table 2 below

Table 1. Result of Unit Root Test

Variables	ADF Unit root Test				PP Unit root Test			
	Intercept		Intercept & Trend		Intercept		Intercept & Trend	
	level	1 st diff	level	1 st diff	level	1 st diff	level	1 st diff
FINF	3.322	2.335	2.934	-2.089	-1.257	-0.004	1.34 1	- 8.888* **
DOIL P	1.912	- 10.736* **	-0.068	- 8.197***	1.424	-17.894***	- 0.68 2	- 11.094 ***
OILP USD	-2.485	- 9.143***	-2.130	- 9.217***	-2.037	-15.965***	- 1.92 4	- 12.346 ***
MPR	1.325	- 6.511***	0.146	- 6.965***	1.457	-10.444***	- 0.26 5	- 11.022 ***

Table 2 shows that none of the variables are stationary at the level of ADF and PP. However, ADF PP results show that domestic oil price (DOILP), oil price per US dollar (OILP USD), and monetary policy rate (MPR) the PP Test also demonstrates that food inflation is stationary at first difference with trend and intercept, and that they are stationary at first difference both with intercept and trend. Due to the combination of I (1) variables, we were able to ascertain

the short-term association and long-term cointegration between the variables using the Vector Error Correction model and Johansen cointegration.

Johansen Co-Integration

Table 2. Co integration Rank Test (Trace)

Hypothesize No of CE(s)	Eigen value	Trace Statistics	0.05 Critical Value	Probability
None*	0.349	96.367	55.246	0.000***
At most 1	0.125	32.514	35.011	0.090
At most 2	0.055	12.626	18.398	0.265
At most 3	0.028	4.258	3.841	0.039

Table 2a Unrestricted Co integration Rank Test (Maximum Eigen value)				
Hypothesize No of CE(s)	Eigen value	Max-Eigen Statistics	Critical Value	Probability
None*	0.349	63.853	30.815	0.000***
At most 1	0.125	19.888	24.252	0.170
At most 2	0.055	8.368	17.147	0.563
At most 3	0.028	4.258	3.841	0.039

Trace test and Maximum Eigen value indicates 1 co-integrating eqn(s) at the 0.05 level

Tables 2 and 2a show the Johansen cointegration results with two period lags. Table 2 shows that the trace value for the null hypothesis of no co-integration relation is 96.367, which exceeds the critical value of 55.246. Therefore, at the 5% level of significance, we accept the alternative hypothesis that there is a co-integration relationship between the variables and reject the null hypothesis that there is no co-integration. The Eigen value statistics are displayed in Table 2a. For the null hypothesis of no cointegration, the calculated maximum Eigen statistics are 63.853, which is higher than the critical value of 30.815. Consequently, the results validate that there is at least one co-integration link among the variables in question. Thus, from both of these tables, it can be concluded that a long-run relationship exists between domestic oil prices, oil price per US dollar, monetary policy rate, and food inflation.

Vector Error Correction Model

Table 3. Long-Run Coefficient of the Vector Error Correction Model Dependent Variable FINF

Variables	Coefficients	Standard error	T,statistics
DOIL P	0.694	0.153	4.538
OIL P USD	0.146	0.325	0.450
MPR	15.833	6.365	2.488

The long-term coefficients Food inflation and domestic oil prices have a considerable positive association, according to normalized co-integration, meaning that a one-unit rise in domestic oil prices will cause a 0.694 increase in food inflation. This findings are aligned with the findings of (Maijama'a & Sa'idu, 2021) (Ahmad, et al., 2020) (Abatcha, et al., 2023) (Al-kasasbeh, et al., 2024) who

revealed that there is a positive correlation between oil prices and inflation in India and Middled Similarly the coefficient of oil price per US Dollar also shows positive correlation with food inflation, implying that 1 percent increase in oil price per US Dollar will lead to an increase in food inflation by (0.146). Furthermore, monetary policy rates have a positive effect on food inflation, implying that a 1% increase in monetary policy rates will result in a positive change in food inflation by (15.833).

Table 4. Error Correction Model: Short Run Dynamics Dependent Variable D (FINF)

Variables	Coefficients	Test. Sataistics	P.value
ECM(-1)	-0.012	6.509	0.000***
D(LOIL_P(-1))	0.304	3.746	0.000***
D(LOIL_USD(-1))	-0.007	-2.174	0.031**
D(MPR(-1))	-0.005	-1.835	0.069*
C	3.516	6.326	0.000***
R ² = 0.948,Adj R ² = 0.945, DW=2.220, F-statistics =286.1 (0.000)***			

The Error Correction Model (ECM) estimated short run coefficients have the correct sign of being less than one, negative (-0.012), and statistically significant at 1% (0.000). This provided evidence of co-integration among the variables. It implies that in the event of an economic disequilibrium, the system may correct itself from short run to long run equilibrium at a rate of approximately 12% per month. Furthermore, domestic oil prices were reported to have a short-run significant effect on food inflation at the 1% level, implying that. Throughout the study period, every 1% increase in domestic oil prices results in a 0.30% increase in food inflation. The findings supported the expectation that as oil prices rise, so will transport costs, raising the cost of goods and services. As a result, rising oil prices impact inflation, which gauges the pace of price rises throughout the economy, since crude oil is a crucial economic input.

On the other hand, both oil price per US dollar and monetary policy rate show significant weak negative effect on food inflation at 5% and 10% significant levels, indicating that a 5% increase in oil price per US dollar will lead to a decrease in food inflation by (-0.007) and a 10% increase in monetary policy rate will lead to a decrease in food inflation by (-0.005) respectively.

Table 5. Pairwise granger Causality Test Result

Null Hypothesis	F. sta	P-value	Hypothesis Accept/Reject	Causality
MPR does not granger Cause FINF	10.056	8.050	Accept	No Causality
FINF does not granger Cause MPR	5.622	0.004**	Reject	Unidirectional
DOILP does not granger Cause FINF	5.286	0.006**	Reject	Bi-Directional
FINF does not granger Cause DOILP	7.020	0.001***	Reject	Bi-Directional

OILP USD does not granger Cause FINF	0.724	0.486	Accept	No Causality
FINF does not granger Cause OILP USD	0.196	0.823	Accept	No Causality
DOILP does not granger Cause MPR	2.503	0.085*	Reject	Unidirectional
MPR does not granger Cause DOILP	11.704	2.050	Accept	No Causality
OILP USD does not granger Cause MPR	1.442	0.240	Accept	No Causality
MPR does not granger Cause OILP USD	0.536	0.586	Accept	No Causality
DOILP does not granger Cause OILP USD	0.563	0.571	Accept	No Causality
OILP USD does not granger Cause DOILP	0.266	0.767	Accept	No Causality

The monetary policy rate (MPR) and food inflation (FINF) have a causal link that goes from FIF to MPR rather than the other way around, according to the data above. Because of the statistical significance and 5% p-value, the null hypothesis is thus rejected. According to this, MPR does not granger cause FINF, rather FINF granger causes MPR. Food inflation (FINF) has a bidirectional relationship with domestic oil prices (DOILP), implying that both FINF and DOILP have an impact on one another. The findings are consistent with Sultan et al. (2020), who confirm that changes in oil prices affect general price levels in India. However, it contradicts Musa and Maijama'a's (2021) findings, which found no granger causality between oil prices and food inflation in Nigeria. There is also evidence of a unidirectional relationship between domestic oil price (DOILP) and monetary policy rate (MPR), which means that DOILP causes MPR with no feedback. In other words, neither of the remaining variables, i.e., oil price per US Dollar (OILP USD) and Food Inflation (FINF), oil price per US Dollar (OILP USD) and monetary policy rate (MPR), nor monetary policy rate (MPR) and domestic oil price (DOILP) granger, cause each other.

CONCLUSION

This study examined the link between Nigeria's domestic and international oil prices (in USD), monetary policy rate, and food inflation from 2012 to 2025 using Granger Causality tests, Johansen Cointegration, and Vector Error Correction Model (VECM). According to the findings, there is a substantial long-term positive correlation between domestic oil prices and food inflation, suggesting that rising domestic oil prices cause food prices to rise. In the short term, domestic oil costs significantly reduce food inflation. This emphasises the vulnerability of food prices to energy cost fluctuations, especially in light of the 2024 subsidy removal, which exposed domestic fuel prices to international market volatility. In contrast, the international oil price (OILP USD) had a weak and statistically insignificant long-run impact on food inflation, with a small negative short-run effect, most likely due to distortions caused by subsidies and exchange rate interventions.

Surprisingly, the monetary policy rate (MPR) was found to have a significant and large positive effect on food inflation in the long run, contradicting conventional wisdom and pointing to monetary policy's ineffectiveness in combating supply-driven inflation. MPR had a marginally significant negative effect in the short run, indicating that its impact was limited and delayed. Granger causality results support the idea that food inflation influences monetary policy decisions, but not the other way around. Furthermore, bidirectional causality was discovered between domestic oil prices and food inflation, implying a feedback loop.

RECOMMENDATION

Based on these results, the following policy recommendations are proposed:

1. **Prioritise Domestic Energy Market Reform:** The importance of domestic oil prices in driving food inflation emphasises the need to stabilise domestic energy prices. To reduce reliance on imported refined petroleum products, the government should increase domestic refining capacity and diversify energy sources (for example, gas and renewables). To reduce inflationary spillovers, post-subsidy deregulation must be accompanied by strategic interventions (e.g., targeted transport subsidies or food logistics support).
2. **Address Structural Bottlenecks in the Food Supply Chain:** Because food inflation is influenced by input and transportation costs, policymakers must address infrastructure deficiencies, poor road networks, and market access issues. Incentives for local agricultural production, storage, and processing can help to close the food supply gap and reduce price volatility.
3. **Rethink Monetary Policy Focus:** The Central Bank of Nigeria (CBN) should acknowledge that inflation in Nigeria is primarily cost-push, rather than demand-pull. As a result, rather than aggressively tightening interest rates, monetary policy should supplement fiscal interventions by focussing on exchange rate stability and credit support for agricultural production and distribution.
4. **Improve Exchange Rate Management:** While international oil prices had a limited direct impact, exchange rate volatility mediated the effects. To reduce import-related cost pressures on food and fuel, the CBN should implement consistent and unified exchange rate policies.

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