PETROLEUM PRICE DYNAMICS AND INFLATION IN NIGERIA: A GRANGER CAUSALITY ANALYSIS 1990-2023

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ABSTRACT
Persistent inflation threatens Nigeria's economic stability, eroding purchasing power and increasing financial uncertainty. Considering the nation's dependence on petroleum products, comprehending their impact on inflation is crucial for effective policy formulation. This research investigates the causal relationship between domestic petroleum product prices and inflation in Nigeria using the Granger Causality/Block Exogeneity Wald Tests developed by Toda and Yamamoto (1995). An ex post facto research design was applied, utilising time series data from 1990 to 2023, sourced from Bobai's (2012) study, the 2018 Nigerian Oil and Gas Industry Annual Report, National Bureau of Statistics (NBS) (2019–2023), and the Central Bank of Nigeria (CBN). Findings reveal a unidirectional causal link between Automotive Gas Oil (AGO) prices and inflation, indicating that AGO price fluctuations directly affect inflation rates. However, no significant causal relationship exists between inflation and the pricing of Dual-Purpose Kerosene (DPK) or Premium Motor Spirit (PMS). The study also identifies a unidirectional causal link from the Real Effective Exchange Rate (REER) to inflation, underscoring the importance of exchange rate management in controlling inflation. These findings highlight the need for targeted regulatory measures in the AGO market and sound exchange rate policies to curb inflation and ensure economic stability.

Keywords: Petroleum Price, Automotive Gas Oil Price, Dual-Purpose Kerosene, Real Effective Exchange Rate, Inflation Rate, Granger Causality Test
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INTRODUCTION
Price stability is a fundamental macroeconomic objective for both developed and developing economies, particularly for a country like Nigeria, where energy plays a critical role in socio-economic progress. The stability of petroleum product prices directly influences industrial productivity, transportation costs, and overall

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economic growth. Nigeria, endowed with abundant natural resources, has considerable potential for economic development (Manu & Ahmad, 2021).

Since the mid-20th century, crude oil has been the dominant global energy source, primarily due to the industrial boom and the extensive use of petroleum products in transportation, industrial production, and electricity generation (US Energy Information Administration [EIA], 2023). However, fluctuations in oil prices have far-reaching consequences, often triggering inflationary pressures and economic instability (Bawa, Abdullahi, Tukur, Barda & Adams, 2020).

Nigeria remains highly dependent on petroleum imports, including Premium Motor Spirit (PMS), Dual-Purpose Kerosene (DPK), Automotive Gas Oil (AGO), and Aviation Turbine Kerosene (ATK) (Department for International Development [DFID], 2012). The government has historically regulated petroleum product pricing. However, prices remain subject to international crude oil price volatility, which is influenced by the Organization of Petroleum Exporting Countries (OPEC) and other global market dynamics. These fluctuations are deteriorated by factors such as smuggling, stockpiling, and underperforming domestic refineries, which operate below their designed capacities (Tunde & James, 2018). As a result, price instability in the petroleum sector contributes to broader economic challenges, including inflation and exchange rate volatility. An examination of domestic pump prices of petroleum products (premium motor spirit) in Nigeria indicates a persistent increase. In 1990, the fuel price was N0.60 per litre during General Ibrahim Babangida's regime. By 2018, during President Muhammadu Buhari's administration, it had increased to N167.10 per litre (Agbaeze & Abner, 2018). The National Bureau of Statistics (NBS) indicated a rise to N185 per litre in 2022.

In response to increasing demand and supply limitations, successive Nigerian administrations have instituted fuel subsidies to mitigate the effects on consumers. The Nigerian government controls domestic petroleum product pricing, correlating them with international crude oil prices established by OPEC. The government regulates pricing frameworks via the Nigerian National Petroleum Corporation (NNPC), resulting in considerable subsidy costs, approximately $2.5 billion, which profoundly impact budgetary sustainability (Tunde & James, 2018).

Inflation, a critical macroeconomic indicator, is often linked to fluctuations in petroleum product prices. According to Özaydın (2019), increases in fuel prices drive up transportation costs, which, in turn, escalate the prices of goods and services, creating a ripple effect across the economy. Persistent price instability erodes purchasing power, discourages investment, and undermines economic growth. Therefore, ensuring price stability, particularly in the energy sector, is crucial for fostering sustainable economic development and mitigating the adverse

effects of inflation.

Sustainable Development Goal (SDG) 7 of the United Nations shows the necessity of ensuring access to affordable and clean energy. This necessitates an analysis of both local and international energy pricing, particularly petroleum product prices, and their effects on economic stability.

This study examines the causal relationship between petroleum product prices and inflation in Nigeria, concentrating on the domestic pump prices of petroleum products and their causal relationship.

The study also focuses on the following null hypotheses:

$H0_1$: Fluctuation in the price of automotive gas oil does not cause inflation in Nigeria.

$H0_2$: Fluctuation in the price of dual-purpose kerosene does not cause inflation in Nigeria.

$H0_3$: Fluctuation in the price of Premium Motor Spirit does not Granger cause inflation in Nigeria.

$H0_4$: Fluctuation in the Real Effective Exchange Rate does not Granger cause inflation in Nigeria.

The findings provide insights into the direction of causality between domestic pump prices of petroleum products and inflation in Nigeria. They will also help policymakers and businesses to better manage the economic impact of fluctuations in domestic pump prices and ensure the stability of the Nigerian economy.

The paper is organised into five sections to fulfil its objectives. Section one comprises the introduction, section two presents the literature review, section three comprises data and methodologies, and sections four and five provide the empirical analysis, conclusion and policy recommendations, respectively.

LITERATURE REVIEW

Conceptual Review

Concept of Inflation

According to Solow (1970), inflation is characterised by a prolonged decline in the buying capacity of currency. In this perspective, inflation persists when increasing amounts of money are required to purchase a standard assortment of goods and services. Conversely, Friedman (1968) stressed that inflation is generally tied to monetary factors, asserting that it can only occur due to more rapid growth in the

money supply compared to economic output.

According to Innocent, Irmiya, and Juryilla (2019), inflation (INF) is a systematic and pervasive escalation in the costs of commodities and services within an economic system. The determination of the INF rate involves the examination of consumer prices through a survey. The impact of price fluctuations on measured INF varies due to the differential weights assigned to items in the basket, as indicated by indices such as the consumer price index and producer price index. As an illustration, the consumer price index (CPI) assesses the expenditure associated with a representative collection of commodities and services the typical consumer acquires. Conversely, INF is measured as the percentage alteration in this price index, indicating varying levels of influence. INF is a remarkable phenomenon of significant historical importance that necessitates the immediate attention of government officials and policymakers. Therefore, it is the objective of governments and policymakers to attain a moderate level of INF to mitigate the adverse effects on household purchasing power resulting from the escalation of prices for goods and services. This phenomenon generates discomfort among individuals and public dissatisfaction with the governing authorities (Özaydın, 2019).

Cost-push inflation is a situation in which increased production costs lead to inflation. It is a phenomenon wherein an escalation in the expense of a production factor results in a corresponding rise in the inflation rate, as it causes upward pressure on the prices of goods and services (Kpagih, Chinda, & Akidi, 2022). In this study, inflation refers to the sustained decline in the purchasing power of the local currency relative to foreign currencies, which adversely impacts consumer purchasing power and overall well-being.

Concept of Petroleum Product

Crude oil is a complex liquid mixture that occurs naturally, as stated by the Energy Information Administration (EIA) (2023).Refining crude oil, which may involve physical separation or breakdown, produces petroleum products. PMSP, AGOP, and DPKP are some of the available products. The term "petroleum products price" refers to the prices placed on the various types of petroleum products once they are ready to be consumed by the final consumer (Omosimua, 2017). This final consumer includes households, industries, and transport.

Petroleum fossil fuels are hydrocarbon mixes derived from the remains of ancient sea organisms, including animals and diatoms that existed millions of years before the emergence of dinosaurs. Over millions of years, the remains of these organisms were enveloped by strata of sand, silt, and rock. The heat and pressure from these layers transformed the leftovers into what is now referred to as crude oil or petroleum. The term petroleum signifies rock oil or oil derived from the soil (EIA,

2023).

In this study, petroleum products denote refined derivatives of crude oil utilised in domestic, industrial, and transportation applications. These comprise Automotive Gas Oil (AGO), Premium Motor Spirit (PMS), and Dual-Purpose Kerosene (DPK).

Theoretical Review

The Cost-Push Theory

The Cost-Push Inflation Theory, developed by John Maynard Keynes (1936) and later expanded by economists such as Paul Samuelson and John Kenneth Galbraith in the 1950s and 1960s, emphasises the role of rising production costs in driving inflation. It explains inflation in resource-dependent economies, accounts for supply-side shocks, and emphasises structural issues.

The Cost-Push Inflation Theory suggests that inflation (INF) is caused by pay increases mandated by unions and profit increases by businesses. This concept emerged in the medieval era and was repeated in the 1950s and 1970s. However, the theory ignores demand-side factors, has empirical limitations, and does not fully explain why inflation persists over time. Inflation is a perceived phenomenon where the overall price level of goods and services rises without viable substitutes. The oil crisis of the 1970s is an example of this phenomenon. Economists argue that a significant price increase can lead to a domino effect, resulting in price hikes across various products and an overall escalation in the price level. Adaptive expectations and the price/wage spiral can cause a supply shock and long-lasting consequences.

$$P_e = (1 - \alpha) \cdot P_{e-1} + \alpha \cdot P \quad \text{----------1}$$

for the current year based on the previous year's expectations, and P indicates the actual inflation rate for the current year.

The Cost-Push Theory, a key economic framework in Nigeria, suggests that fluctuations in Petroleum Product Prices (PPP) can lead to inflationary pressures. This theory, which uses a parameter α ranging from 0 to 1, explains how changes in PPP, such as automotive gas oil, dual-purpose kerosene and premium motor spirit, can affect inflationary pressures. Adaptive expectations, which include both prior and error-adjustment components, have been criticised for their reliance on retrospective analysis and systematic errors. However, rational expectations, which assume optimal expectations, have gained popularity in macroeconomic theory.

The theory is relevant to studying petroleum price dynamics and inflation in Nigeria, where fluctuations in fuel prices, particularly Automotive Gas Oil (AGO), significantly impact overall inflation. The study's use of the Granger Causality framework aligns with the theory's focus on external shocks and input costs.

Empirical Review

Kpagih, Clifford, and Odungwe (2022) and Agu and Nyatanga (2021) conducted studies on the impact of energy price fluctuations on inflation in Nigeria. They used time series data from 1985 to 2018 and examined oil prices, petrol prices, and exchange rates as independent factors. The study found that fluctuations in oil or petrol prices did not significantly affect inflation, suggesting the need for fiscal and monetary policy to understand the fundamental causes of inflation in Nigeria.

Agu and Nyatanga (2021) found that anticipated oil price fluctuations substantially and favourably impact inflation in Nigeria, affecting both short-term and long-term periods. Abatcha's (2021) empirical analysis revealed a long-term positive correlation between rising oil prices and Nigeria's inflation rate, with a significant link between short-term swings in oil prices and the inflation rate.

Gylych, Jibrin, Celik, and Isik (2020) and Bawa et al. (2020) also conducted studies on the effects of oil price volatility on monetary variables in Nigeria. They used the Toda-Yamamoto model (TY) and Modified Wald (MWALD) test to determine causation and evaluate the Forecast Error Variance Decomposition (FEVD) and Impulse Response Functions (IRFs). They found that rising oil prices directly affected inflation indices, particularly headline, core, and food indices. Declining oil prices reduced production costs, reducing domestic inflation. Unfavourable oil price shocks also led to rising inflation levels.

Apere's (2017) study found an inverse correlation between oil prices and inflation in Nigeria, with a decline in oil prices reducing inflation. Bobai's (2012) study found a positive relationship between PMS, AGO, and inflation, with PMS having a more significant effect on inflation than AGO. Akinleye and Ekpo's (2013) study found that both positive and negative oil price shocks affect real government expenditure in the long term, with positive shocks causing inflationary pressures and depreciation of the domestic currency. Crude oil price shocks can hinder economic growth in the short term while causing slight price increases in the medium term.

To the best of our knowledge, there are scanty studies examining the impact of petroleum product prices and inflation in Nigeria. Majority of the existing research

in this area focused on international crude oil prices, oil price volatility, and macroeconomic performance (Akinleye & Ekpo, 2013; Kpagih, Chinda & Akidi, 2022; Bawa et al., 2020; Apere, 2017).This research investigates the causal relationship between domestic pump prices of petroleum products and inflation in Nigeria, incorporating updated data and including the real effective exchange rate as a control variable. Furthermore, while previous studies (e.g., Abatcha, 2021; Agu & Nyatanga, 2021) have primarily examined crude oil prices, which do not have a direct effect on the prices of domestic goods and services, this research differs because it looks at domestic prices of petroleum products which is expected to have a direct effect on the general price level domestically. Also, the crude oil price is disaggregated into its components, such as the prices of Premium Motor Spirit (PMS), Automotive Gas Oil (AGO), and Dual-Purpose Kerosene (DPK). This approach represents a significant contribution to the existing body of knowledge.

METHODOLOGY

The study used ex post facto research design utilising time series data spanning from 1990 to 2023. The data for this study were gathered from various sources because of their inherent qualities and restricted availability from a sole source. The World Bank Data set (WB) provided Inflation data. In addition, since there was no one source available, the data on the price of Automotive Gas Oil and the Price of Dual-Purpose Kerosene were gathered from three distinct sources. The data used in this analysis were obtained from Bobai's (2012) study, which provided the prices in Naira from 1990 to 2011. Later, it has been enhanced by integrating data acquired from additional sources. The second segment was derived from the 2018 Nigerian Oil and Gas Industry Annual Report, which covers 2012 to 2018. The last segment was acquired from the National Bureau of Statistics (NBS) for 2019 to 2023, respectively. The data on the price of PMSP were ultimately acquired from the CBN.

Inflation is measured as the annual percentage change in consumer prices. In contrast, the prices of petroleum products (Automotive Gas Oil, Dual-Purpose Kerosene, Premium Motor Spirit) are measured based on Naira's average consumer price range per litre at its pump price. Furthermore, the REER is calculated using the REER index (2010 = 100), which considers the impact of inflation on the purchasing power of local currencies relative to foreign currencies.

Model Specification

This research investigates the causal links between inflation and the domestic prices of petroleum products in Nigeria, employing the Granger Causality/Block Exogeneity Wald Tests developed by Toda and Yamamoto in 1995. The study uses the Granger Causality framework to examine whether changes in petroleum prices,

particularly AGO, PMS, and DPK, precede and potentially cause inflationary trends in Nigeria. This technique aligns with the theoretical framework utilised by this research because both emphasise the role of external shocks and rising input costs in driving inflation.

The Granger causality test is a statistical method that assesses whether one variable can predict the future values of another. The results help researchers and policymakers understand whether domestic pump prices explain inflation. Accordingly, the model can be specified as follows:

$$\Delta Y_t = \sum_{i=1}^{n} \alpha_i Y_{t-i} + \sum_{i=1}^{n} \beta_i X_{t-i} + e_t \quad \text{---------- 2}$$

In this equation, Y_t and X_t represent the observed values of Y and X over specific periods, denoted as t. The difference operator is used. The variable n indicates the number of lags. The parameters, denoted as α and β, need to be estimated. Additionally, the error *e* components are assumed to be serially uncorrelated.

Selecting lead/lag length is challenging, especially with small observations. Granger causality test requires stationary data series, and detrending non-stationary ones require first difference. Therefore, Equation (2) is then rewritten as:

$$\Delta INF_t = \sum_{i=1}^{n} \alpha_i \Delta INF_{t-i} + \sum_{i=1}^{n} \beta_i \Delta (LAGOP)_{t-i} + e_t \quad \text{---------- 3}$$

$$\Delta (LAGOP)_t = \sum_{i=1}^{n} \lambda_i \Delta (LAGOP)_{t-i} + \sum_{i=1}^{n} \delta_i \Delta INF_{t-i} + \mu_t \quad \text{---------- 4}$$

$$\Delta INF_t = \sum_{i=1}^{n} \alpha_i \Delta INF_{t-i} + \sum_{i=1}^{n} \beta_i \Delta (LDPKP)_{t-i} + e_t \quad \text{---------- 5}$$

$$\Delta (LDPKP)_t = \sum_{i=1}^{n} \lambda_i \Delta (LDPKP)_{t-i} + \sum_{i=1}^{n} \delta_i \Delta INF_{t-i} + \mu_t \quad \text{---------- 6}$$

$$\Delta INF_t = \sum_{i=1}^{n} \alpha_i \Delta INF_{t-i} + \sum_{i=1}^{n} \beta_i \Delta (LPMSP)_{t-i} + e_t \quad \text{---------- 7}$$

$$\Delta (LPMSP)_t = \sum_{i=1}^{n} \lambda_i \Delta (LPMSP)_{t-i} + \sum_{i=1}^{n} \delta_i \Delta INF_{t-i} + \mu_t \quad \text{---------- 8}$$

$$\Delta INF_t = \sum_{i=1}^{n} \alpha_i \Delta INF_{t-i} + \sum_{i=1}^{n} \beta_i \Delta(LREER)_{t-i} + e_t \text{---------- 9}$$

$$\Delta(LREER)_t = \sum_{i=1}^{n} \lambda_i \Delta(LREER)_{t-i} + \sum_{i=1}^{n} \delta_i \Delta INF_{t-i} + e\mu_t \text{----------10}$$

Where:

Δ is the first difference operator

n is the maximum lag length

t is a time trend, and

INF is the Inflation rate

LAGOP is the Log of Automotive Gas Oil Price

LDPKP is the Log of Dual-Purpose Kerosene Price

LPMSP is the Log of Premium Motor Spirit Price

LREER is the Log of Real Effective Exchange Rate between the Nigerian naira and the American Dollar

α - β are the coefficients of independent variables

e is the error term

μ is a stationary random error.

These equations convert petroleum product prices and REER variables into logarithmic form to handle nonlinearity and heteroscedasticity problems. At the same time, the inflation rate is linear, which allows for percentage changes and elasticity measurements. The model is transformed into a linear-log (lin-log) model, avoiding the violation of the classical assumption of normal distribution.

To prove a causal relationship between two variables, the coefficients of their lagged values in the corresponding equations must be statistically significant. Specifically, in Equation (3), the coefficient β for the lagged LAGOP must be statistically distinct from zero. In Equation (4), the coefficient δ for lagged INF must be statistically

distinct from zero.

When both conditions are satisfied ($\beta \neq 0$ and $\delta \neq 0$), the study can infer the presence of simultaneous causality between the variables. This indicates that each variable exerts a predictive influence on the other. If both coefficients are statistically insignificant ($\beta = 0$ and $\delta = 0$), the study can conclude that INF and LAGOP are independent, signifying an absence of a causal relationship between them. The idea of statistical significance is also applicable to the remaining equations (5 through 10) in the analysis. Analysing the coefficients in each equation, allows us to ascertain the existence or non-existence of causal links among the variables being investigated.

RESULTS AND DISCUSSIONS

Table 1: Descriptive Statistics Results of Variables in the Model

	INF	LAGOP	LDPKP	LPMSP	LREER
Mean	17.13608	3.738916	3.418533	3.418161	4.624943
Median	10.30664	4.094345	3.912023	3.688879	4.610829
Maximum	75.40165	7.040939	6.720003	5.577047	5.609507
Minimum	0.686099	-0.693147	-0.916291	-0.510826	3.907540
Std. Dev.	15.37603	1.949109	1.936567	1.664463	0.377960
Skewness	2.016906	-0.810246	-0.534407	-1.074848	0.587584
Kurtosis	7.491040	3.123063	3.011055	3.386554	3.572365
Jarque-Bera	51.62487	3.741609	1.618522	6.758377	2.420547
Probability	0.000000	0.154000	0.445187	0.034075	0.298116
Sum	582.6267	127.1231	116.2301	116.2175	157.2481
Sum Sq. Dev.	7801.938	125.3679	123.7596	91.42443	4.714177
Observations	34	34	34	34	34

Source: Authors' Computation using Eviews 12

Before estimating a model, it is crucial to conduct a variable exploration to determine their descriptive illustration, as shown in the Table. The ratio of the mean to the median is approximately 1 for all variables. It shows the statistics of INF, LAGOP, LDPKP, LPMSP, and LREER for 34 years' recorded incidents in Nigeria. The mean

INF rate is 17.34, suggesting an average increase in prices for goods and services. The mean price of AGOP is 3.74, with a median price of 4.09, suggesting potential outliers. The mean price of DPKP is 3.42, with a median price of 3.91, and the mean price of PMSP is 3.42. The mean REER is 4.62, with a median REER of 4.61. Standard deviations indicate significant variability in price levels, while the REER has a low standard deviation, suggesting little variability. The data exhibits mesokurtic behaviour, except for INF, which has a leptokurtic distribution.

Table 2: Unit Root Result

Augmented Dickey-Fuller Test Result (ADF):

Variables	ADF t-stat at Level	Critical Value	ADF t-stat at First Difference	Critical Value	Conclusion
INF	-2.362270	1%: -3.679322 5%: -2.967767 10%: -2.622989	**-4.022285**	**1%: -3.679322***** 5%: -2.967767 10%: -2.622989	Integrated order 1
LAGOP	**-3.654178**	1%: -3.670170 **5%: -2.963972**** 10%: -2.621007	-4.475139	1%: -3.670170 5%: -2.963972 10%: -2.621007	Integrated of order 0
LDPKP	-1.501274	1%: -3.653730 5%: -2.957110 10%: -2.617434	**-5.670745**	**1%: -3.661661***** 5%:-2.960411 10%:-2.619160	Integrated order 1
LPMSP	**-3.015344**	1%: -3.653730 **5%: -2.957110**** 10%: -2.617434	-3.433561	1%: -3.661661 5%: -2.960411 10%:-2.619160	Integrated of order 0
LREER	-2.350259	1%: -3.653730 5%: -2.957110 10%: -2.617434	**-4.830733**	**1%: -3.661661***** 5%:-2.960411 10%:-2.619160	Integrated order 1

Phillip-Perron Unit-Root Test Results (PP):

Variables	PP t-stat at Level	Critical Value	PP t-stat at First Difference	Critical Value	Conclusion
INF	-2.878905	1%: -3.653730 5%: -2.957110 10%: -2.617434	**-7.561143**	**1%: -3.661661***** 5%: -2.960411 10%: -2.619160	Integrated order 1
LAGOP	**-3.747802**	**1%: -3.653730***** 5%: -2.957110 10%: -2.617434	-3.864013	1%: -3.661661 5%: -2.960411 10%: -2.619160	Integrated of order 0
LDPKP	-1.542694	1%: - 3.653730 5%: -2.957110 10%: -2.617434	**-5.671098**	**1%: -3.661661* 5%: -2.960411 10%: -2.619160	Integrated order 1
LPMSP	**-7.082948**	**1%: -3.653730***** 5%: -2.957110 10%: -2.617434	-3.210093	1%: -3.661661 5%: -2.960411 10%: -2.619160	Integrated of order 0
LREER	-2.546319	1%: -3.653730 5%: -2.957110 10%: -2.617434	**-4.799566**	**1%: -3.661661***** 5%: -2.960411 10%: -619160	Integrated order 1

Note: Mackinnon (1996a) critical values: *** significant at 1%, ** significant at 5%, * significant at 10%.

Augmented Dickey-Fuller (ADF) test and Phillips Perron (PP) unit root test were used to ascertain the stationarity of the variables. Table 2 displays the results of the unit root analyses conducted on the variables. These tests were performed at level and first differences. As indicated in Table 2, the ADF and PP unit root tests yielded consistent results, indicating that two variables (automotive gas oil and premium motor spirit) exhibited zero-order integration (I(0)). In comparison, the remaining three variables (inflation rate, dual-purpose kerosine and REER) displayed first-order integration (I(1)).

Cointegration Test

Table 3: Johansen Cointegration Analysis

Unrestricted CointegrationRank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	5% Critical Value	Prob.**
None *	0.816073	104.6176	69.82141	0.0000
At most 1 *	0.594927	50.43471	47.86291	0.0280
At most 2	0.284451	21.51667	29.77234	0.3262
At most 3	0.243154	10.80612	15.45627	0.2237
At most 4	0.057383	1.891054	3.841465	0.1691
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Max-Eigen Statistic	5% Critical Value	Prob.**
None *	0.816073	54.18292	33.86217	0.0000
At most 1 *	0.594927	28.91804	27.55467	0.0336
At most 2	0.284451	10.71055	21.12893	0.6761
At most 3	0.243154	8.915062	14.29104	0.2933
At most 4	0.057383	1.891054	3.841465	0.1691

Source: Authors' Computation using EViews 12

In Table 3, both the Trace and Max-Eigen statistics reveal the presence of two cointegrating relationships. This implies that there is evidence that these variables will converge in the long run, and any variable that deviates from this convergence in the short run will adjust to equilibrium in the long run.

Table 4: Lag Order Selection Criteria Result

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-222.7073	NA	1.043338	14.231717	14.46073	14.30762
1	-112.5171	179.0591	0.005197	8.907322	10.28145*	9.362806
2	-77.10768	46.47492*	0.003068*	8.256730*	10.77596	9.091785*

Source: Authors' Computation using EViews 12

Table 4 displays the results of this lag length determination process. The results indicate that the ideal lag is two (2), as most of the criteria LR, FRE, AIC and HQ indicate that two lag lengths are optimal, except the SC, which indicated one as an optimal lag. Hence, lag two (2) is considered the optimal lag for this study.

Table 5: Granger Causality/Block Exogeneity Wald Tests

Dependent Variable: Inflation				
Excluded	Chi-sq	df	Prob.	Direction of causality
LAGOP	13.81283***	2	0.0010	LAGOP →INF
LDPKP	0.562866	2	0.7547	LAGOP # INF
LPMSP	4.256819	2	0.1190	LPMSP # INF
LREER	6.870245**	2	0.0322	LREER →INF
All	102.8737	8	0.0000	

***Source*:** Authors' Computation using EViews 12

Following the identification of cointegration or a long-term association among the variables, this study additionally examined the causal relationship between LAGOP, LDPKP, LPMSP, LREER, and INF in Nigeria. The null hypothesis is accepted or rejected depending on the probability value of the Chi-square test.

The null hypothesis ($H0_1$) posits that fluctuations in the price of AGO do not Cause inflation in Nigeria. The research does not provide adequate evidence to support the null hypothesis. The Chi-squared value is 13.81283, with a matching p-value of 0.0010. There exists a causal association between the price of AGO and inflation in Nigeria. Causation flows from the price of AGO to inflation without feedback (unidirectional causation) at a 1% significance level.

The findings concerning null hypotheses two and three ($H0_2$ and $H0_3$) indicate that the study does not possess adequate evidence to reject the null hypotheses, which assert that fluctuations in the price of DPK do not Granger-cause inflation in Nigeria ($H0_2$) and that fluctuations in the price of PMS do not Granger-cause inflation in Nigeria ($H0_3$). The Chi-squared values are 0.562866 and 4.256819, with corresponding p-values of 0.7547 and 0.1190, respectively. No causal correlations exist between the price of DPK and inflation, nor between the price of PMS and inflation. Consequently, the prices of DPK, PMS, and inflation are mutually independent in Nigeria.

A causal relationship exists between the REER and inflation in Nigeria. The causality flows from the REER to inflation without reciprocal influence (unidirectional) at a 5% significance level. The Chi-squared value is 6.870245, with a matching p-value of 0.0322. The null hypothesis four ($H0_4$), which posited that the

REER does not Granger-cause inflation, is rejected due to insufficient evidence to support it. Consequently, the actual effective exchange rate Granger causes inflation in Nigeria.

This study's findings opposed those of Kpagih, Chinda and Akidi, (2022), which indicated that changes in petrol prices and exchange rates do not independently induce inflation in Nigeria, nor does inflation influence them in Nigeria. According to their investigation, there is no causal association among these variables in Nigeria.

Table 6: ***Diagnostic Tests Result***

		Diagnostic Result	
Test	Techniques	Jacque-Bera/ F-Statistic Value	P-Value
Residual Normality	Jacque-Bera	0.678954	0.712143
Serial Correlation	Breusch-Godfred	0.398784	0.6785
Heteroskedasticity	Breusch-Pagan-Godfred	0.375809	0.96
Ramsy	Reset Test	1.409163	0.2797

***Source*:** Authors' Computation using Eviews 12

The study assessed the consistency and reliability of the model using various diagnostic tests. The model passed all tests, indicating homoscedasticity in the stochastic disturbance term's variance. The model was found to be appropriately stated, with acceptable skewness and kurtosis. The residuals adhered to a normal distribution, with probability values of 0.712143 for the Jarque-Bera test, 0.6785 for the Serial Correlation test, 0.9637 for the Heteroskedasticity test, and 0.2797 for the Ramsey Reset Test.

Stability Test

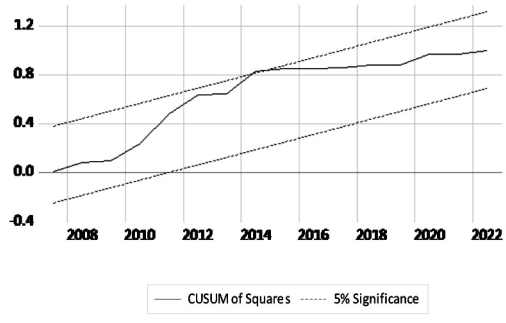

Figure 1: CUSUM of Squares

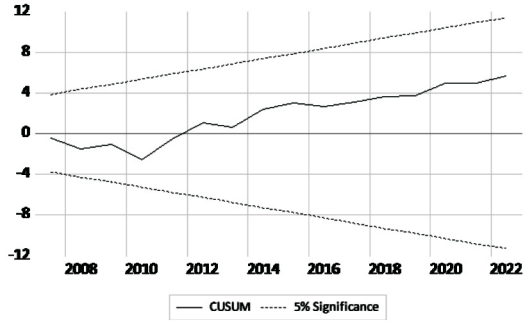

Figure 2: CUSUM

This study evaluates the stability of regression coefficients using the CUSUM of Square and cumulative sum tests. The results show significant adherence to boundaries, indicating the model's stability and efficiency.

The study highlights the impact of fuel prices on inflation, which can lead to poverty. Controlling fuel prices can stabilise inflation and reduce poverty. Understanding the price dynamics of petroleum products is crucial for developing policies for affordable energy. Stable fuel prices can promote economic growth and job creation. Lower fuel prices reduce operational costs for industries, promoting industrial growth and infrastructure development. Managing inflation can reduce economic inequality, especially for low-income households. Stable fuel prices can enhance the afford ability of transportation and essential services, promoting sustainable cities and communities. The study encourages responsible consumption and production patterns and emphasises the importance of collaboration between organisations and institutions for sustainable development.

CONCLUSION AND POLICY RECOMMENDATIONS

The research examines the causal links among petroleum product prices, the REER and inflation in Nigeria from 1990 to 2023. A substantial unidirectional correlation exists between AGO prices and inflation, indicating that regulating AGO pricing may be essential for inflation management. The analysis additionally reveals no substantial causal association between DPK and PMS prices and inflation, indicating their independence. The study highlights the role of exchange rate measures in mitigating inflationary pressures, proposing that stabilising AGO prices via strategic reserves, subsidies, or price restrictions may assist in managing inflation.

The study's findings have several important implications for Nigeria's economic policy and strategy. Because AGO prices have a unidirectional causal relationship with inflation, Nigerian policymakers need to monitor and regulate them closely. Efforts to stabilise AGO prices could help control inflation through subsidies, price controls, or strategic reserves. The government and businesses should anticipate inflationary pressures when AGO prices rise and plan accordingly. This could involve cost-control measures, inflation-indexed contracts, and other financial strategies to mitigate the impact.

The fluctuations in DPK and PMS prices do not significantly influence inflation; resources and regulatory efforts might be better allotted elsewhere. Policymakers can focus less on these fuels in their anti-inflationary approaches. Efforts to stabilise DPK and PMS prices could be driven more by considerations of consumer welfare and accessibility rather than inflation control.

The central bank should consider the REER as a significant factor in its inflation-targeting framework. Interventions in the foreign exchange market might be essential to stabilise the REER and manage inflation. Export and import policies should be aligned to maintain a stable REER. Diversifying the export base and enhancing the competitiveness of Nigerian goods and services can help alleviate REER-induced inflation.

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