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ENERGY PRICE FLUCTUATIONS AND ECONOMIC INEQUALITY IN NIGERIA

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Abstract:
The study examined the role of energy price fluctuations in widening economic inequality across generations in Nigeria from 1985 to 2023 using data from the Central Bank of Nigeria (CBN) Statistical Bulletin, World Development Indicators, International Energy Agency and Worldwide Governance Indicators (2023) publications. Economic inequality served as the dependent variable, while oil price, gas price, expenditure on social welfare and control of corruption were utilized as the explanatory variables. The Augmented Dickey Fuller (ADF) test was used to ascertain the stationarity of the model, and it was discovered that the variables were integrated at first difference, I(1). Consequently, the Johansen co-integration test was employed to ascertain the long-run relationship of the variables. The results from both the Trace statistics and Max-Eigen statistics showed that there was no co-integration, hence establishing no long-run relationship between energy price fluctuations variables and economic inequality in Nigeria. The econometric diagnostics utilized the GARCH model, and the findings of the study do not provide strong evidence that energy price fluctuations significantly influence economic inequality across generations in Nigeria. It is therefore recommended that exploring alternative factors may provide insights into the drivers of economic

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inequality in Nigeria, even if energy price fluctuations do not show a significant direct impact.

JEL: C22, C82, H2, H24, H24

Keywords: energy price, economic inequality, Nigeria

1. Introduction

According to Oxfam (2024), Africa's richest one percent own nearly half of the continent's total financial wealth, arguing that a tax of up to 5 percent on Africa's super-rich could generate an annual amount of $11.9 billion, nearly enough to pay for the 2023 humanitarian requirements for Eastern and Southern Africa. Specifically, Oxfam's (2024) report on inequality and global corporate power reveals that Africa's seven richest men own more wealth ($52 billion) than the 700 million people who make up the poorest half of the continent's population. Between 1820 and 2000, global economic inequality increased by almost 50%, and this level of inequality, which occurred mostly before 1950, has remained almost stable afterwards (Jan-Luiten, Joerg, Foldvari, & Van-Leeuwen, 2011). However, a study by the World Institute for Development Economics Research at the United Nations University found that economic inequality in the 1970s had been expanding most especially in Sub-Saharan Africa, Asia, and Latin America (IMF, 2012).

In Nigeria, economic inequality has increased over the last three decades. According to Oxfam (2024), Nigeria's two richest men have increased their fortunes by 29 percent since 2020, while the bottom 99 percent have become poorer, primarily due to state actions and inactions. Inequality is perceptibly deep-seated and endemic in Nigeria, permeating through almost every part of Africa's largest country. According to the Commitment to Reducing Inequality Index in 2018 by Oxfam (2024), Nigeria falls on the last rung (157 of 157) of countries making efforts to bridge the gap between haves and have-nots. Chiefly, the phenomenon is manifest in the lopsided distribution of resources, where a few elites have control over the wealth of millions of Nigerians. This trickles through all sectors of the economy. The Public Health Centers (PHCs), despite allocated resources, are in a poor state. Primary schools across the country are in dire straits with infrastructure begging for an urgent overhaul. According to many observers, the poor state of things is connected to the fact that the facilities are not used by the privileged elite but the poor masses (Oxfam, 2024).

Nigeria's economy's dependence on oil is two-pronged. On the one hand, oil exports account for a significant portion of the country's GDP and government revenue. As a result, fluctuations in global oil prices have a direct impact on Nigeria's economy. When oil prices rise, Nigeria's oil exports become more profitable, leading to increased government revenue and foreign exchange earnings. This can stimulate economic growth, create jobs, and improve living standards for Nigerians. However, if oil prices fall, Nigeria's oil exports become less profitable, leading to reduced government revenue and foreign exchange earnings. This can negatively impact the country's economy,

leading to slower growth, job losses, and reduced living standards for Nigerians. Conversely, the country's dependence on imported fossil fuels, such as petroleum, makes it vulnerable to price volatility in the global energy market. When global oil prices rise, the cost of energy in Nigeria increases, leading to higher production costs for industries and households. This, in turn, can lead to inflation, which can negatively affect the purchasing power of low-income households, further exacerbating economic inequality. However, the reverse becomes the case with a reduction in the global oil price.

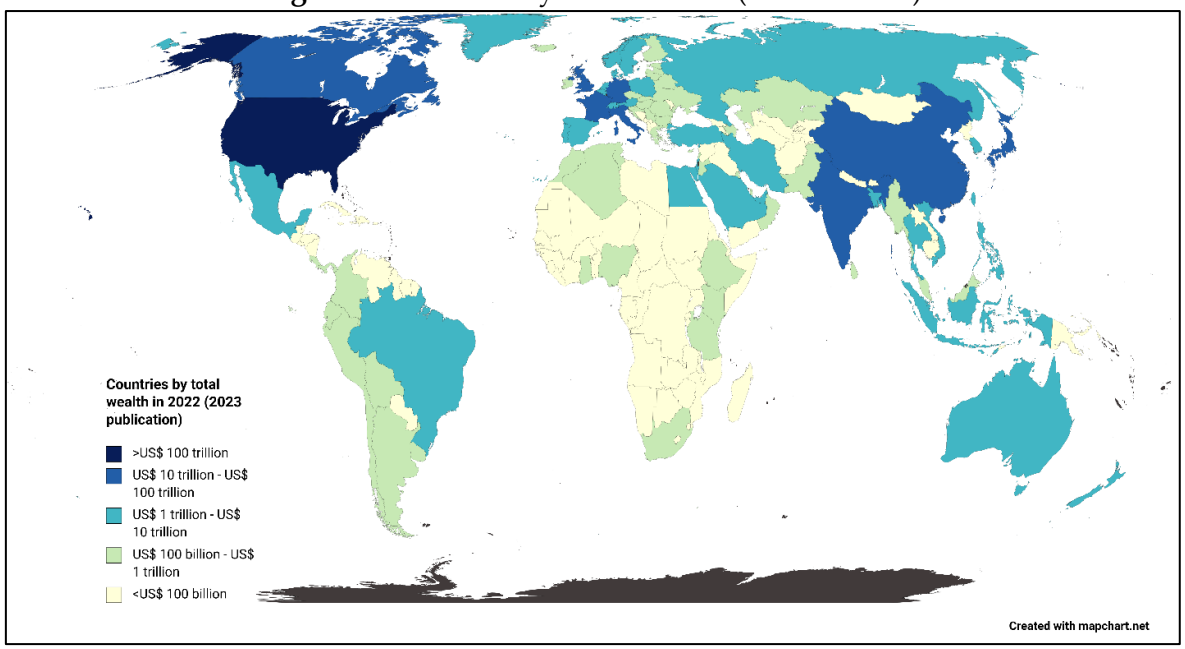
The rate of increasing inequality globally has attracted the attention of academia and policymakers alike. Substantial literature has attributed income inequality to several causes. Goesling and Baker (2008) found a link between education and health and income inequality. Acemoglou and Robinson (2012) saw a link to the interplay of political institutions. The United Nations (2024) found inequality in the notion of dualism in the world. Multiple other causes of international inequality have been proposed, such as geography, economic structure, environmental and cultural factors, globalization, and labour market structure. Several other studies have identified the determinants of economic inequality to include education, globalization, inflation, population, monetary policy, fiscal policy, governance, technological development, and labour market institutions. Few studies have examined the linear and nonlinear effects of some of the factors mentioned above on economic inequality. Acemoglu and Robinson (2012), Stiglitz (2015), Guerello (2018), and O'Farrell and Rawdanowicz (2016) examined the effect of monetary policy on income inequality. Others focused on the roles of financial development (Bolarinwa & Akinlo, 2021; Naceur & Zhang, 2016; Jung & Vijverberg, 2019; Thorton & Tommaso, 2019), oil rent/resource boom (Carmignari, 2013; Bhattacharya & Williamson, 2015; Howie & Atakhanova, 2014; Goderis & Malone, 2011) and institutions (Mehlum, Moene, & Torvik, 2006; Krieger & Meierrieks, 2016; Acemoglu & Robinson, 2006). Energy price fluctuations have been found to have an impact on the economy through several sectoral adjustment channels. These include consumer spending, investment, government revenue, trade balance and exchange rates. Essentially, changes in oil prices working through these channels affect the economy and income distribution. From the foregoing, therefore, the export-import cycle of Nigeria's economic mainstay in relation to economic inequality necessitated this study, as available empirical literature on this topic is relatively scanty. The study seeks to examine the role of energy price fluctuations in widening economic inequality across generations in Nigeria. However, the specific objectives of the study are to examine the effect of energy price fluctuations on economic inequality in Nigeria and to evaluate the impact of government expenditure on social services in bridging the inequality gap in Nigeria.

2. Literature Review

According to the World Bank (2022), the worsening of inequality is considered the most significant outcome of COVID-19. The pandemic has had the greatest impact on vulnerable groups such as the elderly, people with disabilities, children, women, refugees, low-income people, youth, and informal workers. The research and measures

of the World Bank say that "*Covid-19 has increased inequality in nearly every sphere: in the availability of vaccines, in economic growth rates, in access to education and health care, and the scale of job and income losses*". Between 2020 and 2021, global billionaire wealth grew by $4.4 trillion, but at the same time, more than 100 million people fell below the poverty line (World Bank, 2022).

Figure 1: Countries by Total Wealth (Billions USD)



Source: Credit Suisse, 2023.

There are two basic theories of energy price fluctuations and economic inequality. The resource curse theory argues that countries rich in natural resources, like oil and gas, often experience slower economic growth and more inequality than resource-poor countries. The theory emphasized that dependence on oil revenues can lead to economic volatility due to fluctuating oil prices, which can disproportionately affect lower-income households and increase inequality in the long run. The theory further argued that in many oil-rich countries, oil revenues are captured by elites, leading to increased wealth concentration, corruption and rent-seeking, thereby widening income inequality. The second is the oil price-income inequality narrowing hypothesis. The hypothesis that rising oil prices can narrow economic inequality suggests that increased oil prices may lead to reduced income under certain conditions, including increased government revenue and social spending, redistribution policies, job creation and wealth growth, regional development, stabilization funds and sovereign wealth fund. The hypothesis further argued that for the conditions to hold true, there must be effective governance and transparency, inclusive economic policies, as well as social and political stability.

Akinlo (2024) examined the impact of decreased/increased oil prices on income inequality in Nigeria based on annual data covering the period from 1981 to 2018. To achieve this objective, a nonlinear autoregressive distributed lag approach (NARDL) and vector error correction modeling approaches are employed. The outcomes show that

changes in oil prices have an asymmetric effect on income inequality only in the short run. Negative shocks in oil prices reduce income inequality significantly, while positive shocks increase it, though not significantly. The income inequality's response to negative shocks in oil prices is stronger. Moreover, GDP per capita moderates income inequality in both the short and long run. Openness reduces income inequality in the long run but hurts it in the short run. Corruption hurts income inequality in the short run, while the misery index increases it in the long run. Hence, policies that help to reduce oil prices, promote sustainable economic growth and reduce corruption, inflation, and unemployment are needed to reduce income inequality.

Saari, Dietzenbchar and Los (2016) examined how the movement in domestic prices of petroleum products affects the income of Malaysian ethnic groups. The outcomes from the extended social accounting matrix (SAM) model employed reveal the regressive distributional impacts of rising petroleum prices in the Malaysian economy. This indicates that the lowest income groups bear the highest burden while the upper groups suffer the least. The reverse is, however, the case with declining petroleum prices. All the household groups experience a reduction in real income, but the least income groups are less affected compared to the highest income class.

The study by Farzanegan and Krieger (2017) investigates how income inequality responds to positive oil rent shocks in Iran using VAR-based impulse response functions. The outcomes show a significant positive response of income inequality to the oil rent boom. The results reveal that a ten percent upward movement in oil and gas rents causes income inequality to increase by eleven percent in the long run.

Jelilov, Abdulahi, Bilal, and Abdurrahman (2022) aimed to find the short-run empirical analyses of the impact of oil price fluctuation on the monetary instruments (Exchange rate, Inflation, Interest rate) in Nigeria. We explored the frequently used Toda–Yamamoto (TY) model by adopting the TY Modified Wald (MWALD) test approach to causality, Forecast Error Variance Decomposition (FEVD) and Impulse Response Functions (IRFs). The study covered the period 1995 to 2018 (on a monthly basis), and our findings from the MWALD test indicated that there is a unidirectional causality of the log of oil price (LNOILPR) to the log of the exchange rate (LNEXCHR) at a 10% level of significance, also there is a contemporaneous response of log of consumer price index (LNCPI) to log of exchange rate (LNEXCHR) and log of interest rate (LNINTR), and jointly (LNOILPR, LNCPI and LNINTR) granger cause LNCPI. Also, at 5% level of significance, LNINTR responded due to a positive change in LNOILPR and LNEXCHR, and jointly causes LNINTR at 5% level of significance. This is complementedby our findings in FEVDs and IRFs. The empirical analyses show that oil price is a strong determining factor of exchange rate, cost of borrowing and directly influences inflationary or deflationary tendencies in Nigeria.

3. Methodology

The study utilizes annual time series data covering the period from 1985 to 2023. The data are sourced from the statistical bulletin of the Central Bank of Nigeria (2023),

International Energy Agency (2023), World Development Indicators (World Bank, 2023), and Worldwide Governance Indicators (2023). Data availability influenced the choice of the timeframe of this study. The variables of interest that guide the study include economic inequality (proxy by the Gini index) serving as the dependent variable, while crude oil price, gas price, government spending on social welfare and control of corruption are the explanatory variables. However, it is noteworthy that energy prices are restricted to oil and gas prices due to the non-availability of historical data on electricity tariffs in Nigeria from credible sources.

This study examines the role of energy price fluctuations in widening economic inequality across generations in Nigeria using the Generalized Autoregressive Conditional Heteroscedasticity (GARCH). In essence, GARCH is a better and therefore a far more widely used model in financial studies, especially when it concerns price volatilities. GARCH is also robust and more preferable to ARCH because the former is more parsimonious and avoids over-fitting. Consequently, the model is less likely to breach non-negativity constraints. The model was developed independently by Bollerslev (1986) and Taylor (1986). Therefore, the GARCH model allows the conditional variance to be dependent upon its own previous lags, such that the conditional variance equation in the simplest case is:

$$\sigma^2_t = \alpha_0 + \alpha_1 u^2_{t-1} + \beta\sigma^2_{t-1} \quad (1)$$

This is a GARCH (1,1) model. σ^2_t is known as the conditional variance since it is a one-period ahead estimate for the variance calculated based on any past information thought relevant. Using the GARCH model, it is possible to interpret the current fitted variance, h_t, as a weighted function of a long-term average value (dependent on α_0), information about volatility during the previous period ($\alpha_1 u^2_{t-1}$) and the fitted variance from the model during the previous period ($\beta\sigma_{t-1}^2$). Note that the GARCH models can be expressed in a form that shows that it is effectively an ARMA model for the conditional variance. To see this, consider that the squared return at time t relative to the conditional variance is given by

$$\varepsilon_t = u^2_t - \sigma^2_t \quad (2)$$

or

$$\sigma^2_t = u^2_t - \varepsilon_t \quad (3)$$

Using the latter expression (eqn.3) to substitute in for the conditional variance in (eqn.1)

$$u^2_t - \varepsilon_t = \alpha_0 + \alpha_1 u^2_{t-1} + \beta(u^2_{t-1} - \varepsilon_{t-1}) \quad (4)$$

The GARCH (1,1) model can be extended to a GARCH (p,q) formulation, where the current conditional variance is parameterized to depend upon q lags of the squared error and p lags of the conditional variance

$$\sigma^2_t = \alpha_0 + \alpha_1 u^2_{t-1} + \alpha_2 u^2_{t-2} + \cdots + \alpha_q u^2_{t-q} + \beta_1 \sigma^2_{t-1} + \beta_2 \sigma^2_{t-2} + \cdots + \beta_p \sigma^2_{t-p} \quad (5)$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \quad (6)$$

The conditional variance is changing, but the unconditional variance of μ_t is constant and given by:

$$var(u_t) = \frac{\alpha_0}{1-(\alpha_1+\beta)} \quad (7)$$

To investigate the influence of oil price fluctuations on the exchange rate in Nigeria, the model is specified below:

$$INEQ_t = f(OILP, GASP, SOWE, CONC) \quad (8)$$

Where:
INEQ = Inequality index (proxy by Gini coefficient index),
OILP = Oil Price,
GASP = Gas Price,
SOWE = Social Welfare Expenditure,
CONC = Control of Corruption,

Equation (8) is transformed into an autoregressive conditional Heteroskedastic Model with the conditional mean equation as:

$$INEQ_t = \beta_0 + \beta_1 OILP + \beta_2 GASP + \beta_3 SOWE + \beta_4 CONC + \mu_t \quad (9)$$

Where:
β_0 is the intercept of the model, while,
β_1- β_4 represent the slope parameters of the conditional variance under the GARCH (pq) model, for which the variance equation has the form:

$$\sigma^2_t = \alpha_0 + \alpha_1 u^2_{t-1} + \alpha_2 u^2_{t-2} + \cdots + \alpha_q u^2_{t-q} + \beta_1 \sigma^2_{t-1} + \beta_2 \sigma^2_{t-2} + \cdots + \beta_p \sigma^2_{t-p} \quad (10)$$

$$\sigma_t^2 = \alpha_0 + \sum_{i=1}^{q} \alpha_i u_{t-i}^2 + \sum_{j=1}^{p} \beta_j \sigma_{t-j}^2 \quad (11)$$

4. Results and Discussion

Table 1 shows the descriptive statistics of the variables. As revealed in Table 1, all the variables used in the model are platykurtic as their kurtosis values are less than three, except for the gas price. The implication of this finding is that the series has a normal distribution except for the gas price.

The unit root test in Table 2 reveals that income inequality, oil price, gas price, expenditure on social welfare and control of corruption are all stationary at first difference and are said to be integrated of order one, I(1). This implies that the data have statistical properties that do not vary over time. Based on this result, we tested for the existence of a long-run relationship or co-integration amongst the variables using the Johansen co-integration test, having confirmed that the data are all I(1) series.

Table 1: Descriptive Statistics

Description	INEQ	OILP	GASP	SOWE	CONC
Mean	40.79744	45.53410	3.406667	6.245690	-1.40154
Median	38.70000	36.05000	2.980000	6.670690	-1.19
Maximum	51.90000	109.4500	9.520000	9.176675	-0.9
Minimum	35.10000	12.28000	1.670000	2.170196	-2.1
Std. Dev.	6.005677	30.60593	1.775148	2.374292	0.365510
Skewness	0.939932	0.685782	1.392198	-0.40248	-0.60791
Kurtosis	2.481133	2.138506	4.978297	1.836108	1.695884
Jarque-Bera	6.180058	4.262963	18.95811	3.254204	5.165792
Probability	0.045501	0.118661	0.000076	0.196498	0.075555
Sum	1591.100	1775.830	132.8600	243.5819	-54.66
Sum Sq. Dev.	1370.590	35595.48	119.7437	214.2160	5.076708
Observations	39	39	39	39	39

Source: Author's computation using E-views 12.0.

Table 2: Summary of Unit Root Test Results using the Augmented Dickey Fuller (ADF)

		ADF Test statistics			
Variable		At Level	1st Difference	Decision	Order of Integration
INEQ		-1.158225	-5.924496	Stationary at 1st difference	I(1)
OILP		-1.317132	-5.942856	Stationary at 1st difference	I(1)
GASP		-2.488473	-9.166362	Stationary at 1st difference	I(1)
SOWE		-2.118633	-4.001443	Stationary at 1st difference	I(1)
CONC		-1.640162	-3.800717	Stationary at 1st difference	I(1)
Critical Values	1%	-3.615588	-3.621023		
	5%	-2.941145	-2.943427		
	10%	-2.609066	-2.610263		

Source: Researchers' Computation with E-Views 12.0.

Table 3 summarizes the Trace and Max-eigen statistics for the Johansen co-integration test. Both statistics show no co-integrating equation at 5% level. The criterion for decision here is that there must be at least one co-integrating equation to reject the null hypothesis of no co-integration. Since the Trace and Max-eigen statistics show no co-integrating equation, we therefore accept the null hypothesis and conclude that there is no long-

runeffect of energy price fluctuation and economic inequality across generations in Nigeria. In other words, energy price fluctuation and its related variables have no long-run effect on economic inequality across generations in Nigeria. The absence of a long-run relationship implies that the volatility dynamics are more likely driven by short-term shocks and adjustments rather than any persistent, long-term effects. This implies that the model would be more concentrated on capturing the short-term fluctuations and patterns in the volatility rather than emphasising any long-term trends or relationships.

Table 3: Summary of the Johansen Cointegration Test

Trace Statistic					**Max-Eigen Statistic**		
Hypothesized No of CE (S)	**Eigen-Value**	**Trace Statistics**	**5% Critical Value**	**Prob**	**Max-Eigen Statistics**	**5% Critical value**	**Prob.**
None *	0.523621	52.87500	60.06141	0.1744	27.43703	30.43961	0.1132
At most 1	0.272109	25.43797	40.17493	0.6205	11.75136	24.15921	0.8002
At most 2	0.204932	13.68661	24.27596	0.5634	8.485117	17.79730	0.6522
At most 3	0.117483	5.201489	12.32090	0.5396	4.624144	11.22480	0.5318
At most 4	0.015483	0.577345	4.129906	0.5092	0.577345	4.129906	0.5092

Source: Researchers' Computation with E-Views 12.0.

The ARCH estimate in Table 4 reveals that the oil price has a negative relationship with economic inequality in Nigeria. An increase in oil price decreases income inequality in Nigeria by 0.044120 units. The test of significance shows that the decrease is significant at the 5% level. Gas price in Nigeria has a positive relationship with income inequality in Nigeria. As gas pricesincrease, income inequality in Nigeria increases by 0.212782 units, but the decreasing effect on economic inequality is not significant. Social welfare expenditure in Nigeria has an inverse relationship with income inequality. 1 unit increase in social welfare expenditure significantly decreases economic inequality in Nigeria by 0.985417 units. Finally, control of corruption has a positive relationship with income inequality in Nigeria. A unit change in corruption increases economic inequality in Nigeria.

Table 4: Summary of the Short-run ML ARCH Result

Variable	**Coefficient**	**Std. Error**	**z-Statistic**	**Prob.**
C	54.46473	4.788010	11.37523	0.0000
OILP	-0.044120	0.022253	-1.982658	0.0474
GASP	0.212782	0.382134	0.556826	0.5776
SOWE	-0.985417	0.324290	-3.038688	0.0024
CONC	5.436021	2.022916	2.687220	0.0072

Source: Researchers' Computation with E-Views 12.0.

The constant term, C, in Table 5 has an estimated coefficient of 2.931656. This represents the intercept of the model and indicates the baseline level of the dependent variable when all other variables are held constant at zero. The coefficient for Residual (-1)^2 is 0.826562. This suggests that the squared lagged residual term at lag 1 has a positive effect on the

current variance of the dependent variable. The coefficient for Garch (-1) is -0.023932. This negative coefficient indicates that the lagged GARCH term at lag 1 has a negative impact on the current variance of the dependent variable. In conclusion, the results suggest that the previous residual and GARCH terms have an impact on the current variance of the dependent variable in the GARCH model. The p-values associated with the coefficients indicate the level of statistical significance of these effects. A p-value less than 0.05 is typically considered statistically significant, suggesting a strong relationship between the explanatory variables and the dependent variable. But the p-values are 0.3098 and 0.8943, respectively and greater at the 5% level of significance. This implies that the model does not provide strong evidence that the energy price fluctuation variables significantly influence economic inequality across generations in Nigeria.

Table 5: Variance Equation

C	2.931656	2.078517	1.410456	0.1584
RESID(-1)^2	0.826562	0.813904	1.015552	0.3098
GARCH(-1)	-0.024932	0.187683	-0.132840	0.8943

Source: Researchers' Computation with E-Views 12.0

5. Conclusion and Recommendations

The study examined the role of energy price fluctuations in widening economic inequality across generations in Nigeria from 1985 to 2023 using data from the CBN Statistical Bulletin, World Development Indicators, International Energy Agency and Worldwide Governance Indicators (2023) publications. Economic inequality served as the dependent variable, while oil price, gas price, expenditure on social welfare and control of corruption were utilized as the explanatory variables. The Augmented Dickey Fuller (ADF) test was used to ascertain the stationarity of the model, and it was discovered that the variables were integrated at first difference, I(1). Consequently, the Johansen co-integration test was employed to ascertain the long-run relationship of the variables. The results from both the Trace statistics and Max-Eigen statistics showed that there was no co-integration, hence establishing no long-run relationship between energy price fluctuations, variables and economic inequality in Nigeria. To this end, the study found no strong evidence that energy price fluctuations significantly influence economic inequality in Nigeria. It is therefore imperative to investigate the impact of government policies related to income redistribution, social welfare programs, taxation, and subsidies on economic inequality. Sectoral analysis of the impact of energy price fluctuations on specific sectors of the economy to see if there are sector-specific effects on economic inequality is also recommended. Studies on the long-term trends in economic inequality in Nigeria and how various factors have influenced them over time are recommended for consideration. Finally, there is a need to evaluate regional disparities within Nigeria to understand how economic inequality varies across different regions and whether energy price fluctuations have differential effects.

Conflict of Interest Statement
The authors declare no conflicts of interest.

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