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Insightful information on fossil fuel subsidy removal, exchange rate, inflation, and economic welfare: Evidence from Nigeria

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ABSTRACT
Over the years, the economic welfare of many Nigerians and the economy of Nigeria has been poor. This has in turn affected Nigeria's economic prosperity and living standards. The sudden elimination of fuel subsidies in Nigeria, without implementing protective measures first, has hindered the government's ability to achieve the policy's long-term goals: fiscal stability, increased investment in productive sectors of the economy, economic growth, and support for renewable energy. The first objective of this study is to evaluate the Long-run equilibrium impact between fossil fuel subsidy removal, exchange rate, inflation rate and economic welfare in Nigeria. The second objective of the study is to examine the short-run dynamics between fossil fuel subsidy removal, exchange rate, inflation rate and economic welfare in Nigeria. The ex post facto research design was utilized for this study. The estimation method utilized for this study is the Vector Error Correction Model. Data for the study span from 1992-2023.This study discovered that Fossil fuel subsidy removal, and Inflation has a negative insignificant effect on economic welfare in the short-run, while Exchange rate has a positive insignificant effect on economic welfare in the long-run. In the long-run, Fossil fuel subsidy removal and Inflation has a negative significant influence on economic welfare in the long-run, while Exchange rate has a positive significant effect on economic welfare. The study recommends that Nigeria Government should promote investment in domestic refineries to lessen reliance on imported petroleum products and to alleviate the effects of fluctuations in global oil prices.

Keywords:
Economic welfare, Exchange rate, Fossil Fuel Subsidy Removal, Inflation, Vector- Error Correction Model.

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1. INTRODUCTION

Over the years, the economic welfare of many Nigerians and the economy of Nigeria has been poor. This has in turn affected Nigeria's economic prosperity and living standards. The poor state of economic welfare in Nigeria's economy has affected many sectors in the country such as the oil sector, education sector, health sector, banking sector as well as industrial sector which has thwart the growth and development of Nigeria's economy. The economic welfare in Nigeria has been deeply inadequate, as the rise in real gross domestic product has not led to significant growth, leading to a high incidence of poverty and low living standards. Nigeria's poor economic welfare state is currently attributed to factors such as fuel subsidy removal, exchange rate, and inflation rate. The four-year average of the real gross domestic product in Nigeria for 1996 – 1999, 2000 – 2004, 2005 – 2009, 2010 – 2014, 2015 – 2019, and 2020 – 2023 are 1.67, 2.7, 3.9, 5.4, 6.1, and 5.3 respectively. This indicates that the emergence of the COVID-19 pandemic caused a drastic reduction in economic welfare in Nigeria, this however shows the need for this issue to be addressed by policymakers in Nigeria (World Bank, 2024). Government subsidy is a form of government spending provided to individuals, households, and businesses to help stabilize the economy. Its purpose is to ensure that individuals and households have access to necessary goods and services and to enable businesses to remain viable and competitive. Subsidies play a role in promoting long-term economic stability and allow governments to respond to economic shocks during downturns. Keynesian economists supported government spending to boost economic growth and stabilize economies during economic recession. They also saw it as a way to lessen the impact of increased costs on consumers. Therefore, subsidies are aimed at reaching economic and social goals by offering financial aid to certain industries to address market failures (IMF, 2024).

Many nations have introduced energy subsidies to enhance fairness and social safety nets, bolster energy supply security and economic growth, promote local production and jobs, and manage inflation. On the flip side, they may lead to inefficient fuel consumption, thereby discouraging investment in fuel-efficient and renewable energy technologies. Furthermore, fuel subsidies can incentivize smuggling to neighboring countries with higher fuel prices (Aryanpur, 2022). The sudden elimination of fuel subsidies in Nigeria, without implementing protective measures first, has hindered the government's ability to achieve the policy's long-term goals: fiscal stability, increased investment in productive sectors of the economy, economic growth, and support for renewable energy (Chukwunonso, Nosike, Odey and Chike, 2024). The removal of fuel subsidies in Nigeria has resulted in the devaluation of the local currency (naira), high inflation, and a decline in the economic well-being of many Nigerians. Consequently, this has led to higher fuel prices, increased transportation costs, elevated prices of goods and services, hike in hospital bills, increase in rent, increase in school fees, elevation in the cost of living, increase in the cost of maintaining facilities and a decrease in the purchasing power of the naira throughout the economy. The removal of fuel subsidy has led to the re-emergence of economic, political, and socio-cultural challenges in the Nigerian economy, resulting in inflation, hardship, poverty, and even loss of life. These challenges have eroded the nation's economy, diverting resources that could have been used for infrastructural development (Okokon, 2023). Though removing fuel subsidy could bring about advantages in the long term, it may also place financial pressure on households, especially those that are already disadvantaged, increase inflation, and result in exchange rate volatility (Ude, 2023).

The exchange rate represents the value of one country's currency with another currency. It influences the pricing of domestic and foreign products and the extent of a country's involvement in international trade. The exchange rate plays a critical role in impacting all macroeconomic factors in an economy. It is a fundamental macroeconomic factor that guides the development of economic policies and reform programs aimed at achieving specific macroeconomic objectives (Okoroigwe et al., 2023). The exchange rate plays a crucial role in cross-border trade and serves as an indicator of macroeconomic performance. Nigeria's heavy reliance on the oil sector exposes its economy to external shocks, causing the domestic currency (naira) to depreciate and leading to decreased output. Both the COVID-19 pandemic and other external shocks have impacted the exchange rate and the domestic economy. Despite efforts to stabilize the naira through the supply of foreign exchange to the Bureau de Change, the banning of cryptocurrency, and the unification of the exchange rate, the naira has continued to depreciate, reaching US$/N1670.760 by October 2024. This depreciation has created business uncertainty, resulting in the

mass exodus of multinational companies as well as the economic welfare (Voice of America, 2024). The devaluation of a currency usually results in an uptick in exports and a decrease in imports. This is because a weaker currency makes a country's products and services more affordable for foreign purchasers while raising the cost of imported goods for local consumers. Conversely, the appreciation of a currency generally leads to a reduction in exports and an increase in imports, as domestic products become pricier for foreign buyers and imported goods become more affordable for local consumers. The devaluation of a currency enables a transfer of income from importing nations to exporting nations by altering the terms of trade (Subhani et al., 2022; Olubiyi, 2023).

Highly fluctuating exchange rates elevate the risk linked to international trade and investment, possibly resulting in decreased foreign direct investment and diminished economic growth. The unpredictability of exchange rate fluctuations may cause businesses to postpone or abandon investment initiatives, ultimately impeding long-term economic progress (Audi, 2024). However, fluctuations in exchange rates can significantly impact different parts of the economy, such as trade, investment, inflation, and overall macroeconomic performance. In recent years, Nigeria has experienced significant economic and financial difficulties, which have been worsened by the devaluation of its currency. The nation's strong dependence on imported essential goods and services, along with fluctuating export earnings, exposes it to exchange rate shocks. The devaluation of the Nigeria naira has resulted in soaring prices for imported products, leading to higher inflation and an increased cost of living for the people of Nigeria which in turn, deteriorates the economic welfare of Nigerians. The loss of investor confidence, caused by the depreciation, has resulted in capital outflows and further destabilization of the economy resulting in inflation. Inflation is a significant macroeconomic variable because it reflects the purchasing power parity in an economy. Inflation is a crucial macroeconomic factor that impacts different facets of an economy (Agarwal and Baron, 2023). Its cause is a topic of debate in economic theory. Classical economists attribute inflation to an oversupply of money, Keynesians point to aggregate expenditure, monetarists emphasize money supply growth, and Mundell-Fleming argued for inflation resulting from exchange rate devaluation through imports (Malec et al., 2024).

In the past ten years, the inflation rate in Nigeria has been very high, with the average inflation rate recorded at 8.1% between 2013 and 2023, and a peak of 24.6% noted in 2023. Several factors have contributed to this high inflation rate, including the depreciation of the Nigeria Naira against major global currencies like the US dollar, the British pound, and the Euro, as the country relies heavily on imports for both domestic use and raw materials for manufacturing. The emergence of the COVID-19 pandemic contributed to the rise in the inflation rate in Nigeria as the inflation rate rose from 11.40% in 2019 to 24.66% in 2023. Inflationary pressures reduced the purchasing power of Nigeria's Naira, influencing its exchange rate and purchasing power parity (PPP). Consequently, the inflationary trends observed during this time have considerably shaped consumer behavior in Nigeria. As prices rose, consumers had to adjust their spending habits, notably shifting their focus toward essential goods and services. This study breaks new ground by casting light on the impact of fossil fuel subsidy removal, exchange rate, and inflation on economic welfare in Nigeria. The first objective of this study is to evaluate the Long-run equilibrium impact between fossil fuel subsidy removal, exchange rate, inflation rate and economic welfare in Nigeria. The second objective of the study is to examine the short-run dynamics between fossil fuel subsidy removal, exchange rate, inflation rate and economic welfare in Nigeria. Extant studies on fuel subsidy removal, exchange rate and inflation did not account for the impact on economic welfare, majority of the studies examined the effect on economic growth. Furthermore, this study contribute methodologically by utilizing the vector error correction model which offers a flexible framework for analyzing the dynamic interdependencies among multiple time series variables simultaneously. The rest of the study is organized as follows: The second section reviews the theoretical and empirical literature; the third section presents the methodology, model specification and the theoretical framework. The fourth section provides empirical analysis and discussions, and the fifth section concludes and summarizes the study and offers policy recommendations.

2. LITERATURE REVIEW

2.1 Theoretical Review

The theoretical framework for this study is anchored on the Keynesian theory of economic growth. The theory was pounded in 1930 by John Maynard Keynes. Keynesians emphasize that economies are cyclical in nature. At certain times, economies witness growth and booming conditions. Conversely, there are periods of contraction that result in recessions. These cycles are often viewed as unavoidable, but Keynesians believe that specific government policies can alleviate the negative impacts of economic downturns. Consequently, eliminating fossil fuel subsidies in Nigeria is unlikely to lessen the effects of an economic recession. According to Keynesian principles, an uptick in government spending results in enhanced economic growth through an expansionary fiscal policy. When government expenditure rises, production escalates, which boosts aggregate demand and ultimately leads to a rise in gross domestic product (GDP), enhancing the well-being of the populace. Therefore, if government spending increases, assuming other factors remain constant, output will rise, and economic welfare will improve. Based on this perspective, we anticipate a positive correlation between government expenditure and economic growth in Nigeria. Keynesian Economics is an economic theory that supports greater government involvement, especially through fiscal policies—such as enhanced spending during economic slumps and tax reductions or less investment during inflation—to regulate the economy and mitigate the business cycle. It posits that the private sector frequently does not efficiently manage issues like inflation, recession, and unemployment, making government intervention essential. Proponents of Keynesian theory contend that to avert or lessen the impact of recessions, proactive government involvement is crucial. This involvement can manifest as increased public expenditure or tax cuts, aimed at stimulating aggregate demand. This approach of actively overseeing the economy is referred to as demand-side management.

These concepts are not merely theoretical but practical instruments that can stabilize an economy. By recognizing the cyclical characteristics of economies, proactive measures can be implemented to lessen the negative effects during periods of reduced economic activity. Likewise, by monitoring aggregate demand, policies can be enacted to maintain it at an ideal level. Crucially, the Keynesian perspective on government intervention implies that feelings of despair during economic downturns are unnecessary. Governments possess various tools that they can and should utilize to actively engage in the economy to avert a recession or at least mitigate its impact. In the study of Jibir et al. (2019), the posit that the Keynesian theory posits that government intervention can help stabilize fluctuations in exchange rates, inflation, and economic growth. Governments can enhance economic welfare by implementing suitable economic, political, social, and legal initiatives. Consequently, public expenditure can serve as an external fiscal policy instrument to stimulate growth through its diverse effects on aggregate demand, particularly during economic downturns (Chandana et al., 2021). The multiplier effect of government spending typically has two dimensions (Alshammary et al., 2022). The first dimension indicates that an increase in government size will be counterbalanced by a rise in tax revenue if the multiplier effect equals one, which ultimately helps maintain fiscal balance. The second dimension occurs when reduced taxes counterbalance the growth in government expenditure. In this case, the multiplier's value exceeds one. Therefore, Keynesians assert that the most effective means of fostering growth and development is through fiscal policy, which influences levels of aggregate demand (Zahariev, 2021). Consequently, eliminating fossil fuel subsidies in Nigeria may harm economic welfare by increasing the cost of living, devaluing the exchange rate, and hindering economic growth.

2.2 Empirical review

On Fossil fuel subsidy removal, Okorie and Wesseh (2024) conducted a study on the impact of removing fossil fuel subsidies on economic welfare and environmental quality. They used a computable general equilibrium model for their analysis. Their results showed that the removal of fossil fuel subsidies leads to an improvement in environmental quality but has a negative effect on economic welfare and leads to higher overall prices. This means that getting rid of fossil fuel subsidies has a detrimental effect on economic welfare and leads to increased inflation. Similarly, Olujobi and Iremukhai (2024) examined the elimination of premium motor spirit (PMS) subsidies in Nigeria. They utilized both primary and secondary sources of legislation to gain insights for their research. The findings highlighted the complexities related to petrol subsidy repayments, which have led to corruption, rent-seeking activities, and insufficient use of clean energy sources. Therefore, the elimination of premium motor spirit subsidies contributes to the growth of the black market and hoarding. A study by Aryanpur et al. (2022) examined the retrospective analysis of removing energy subsidies using integrated energy systems modeling. The study used data from 1984 to 2017 and found that reforming subsidies could lead to a reduction in total cumulative electricity consumption. In a separate analysis, Esekpa et al. (2024) investigated the economic consequences of fuel subsidies in Nigeria. They analyzed data from both primary and secondary sources and concluded that a fuel price shock could significantly and persistently increase economic hardship and inflation, while also causing the depreciation of the exchange rate of the Nigerian Naira. Similarly, Ogwuche et al. (2024) evaluated the impact of removing fuel subsidies on economic growth in Nigeria. They utilized the vector error correction model technique and studied data from 2005 to 2023. The findings

indicated that fuel subsidies have a negative effect on economic growth in Nigeria and that inflation and exchange rate fluctuations also negatively influence economic growth. These findings are consistent with Esekpa et al. (2024) conclusion that abolishing fossil fuel subsidies reduces economic growth in Nigeria. Evans et al. (2023) examined the socio-economics of 2023 fuel subsidy removal in Nigeria. The study highlights the significance of informed decision-making to mitigate negative short-term impacts, harness long-term gains, and safeguard the vulnerable segments of the population. Conversely, Raifu and Afolabi (2024) evaluated the inflationary effects of fuel subsidy removal in Nigeria. The Dynamic Auto-Regressive Distributed Lag Model was employed for the study. The findings show that the elimination of fuel subsidies results in an increase in petroleum motor spirit prices in rural and urban areas. This establishes the findings of Esekpa et al. (2024) that fuel subsidy removal in Nigeria enhanced the price of petroleum motor spirit.

On studies on exchange rates, Ogwuche et al. (2024) conducted a study on the influence of exchange rate fluctuations on Nigeria's economic growth using the Non-linear Auto-regressive Distributed Lag method. The data analyzed covered the period from 2010 to 2023. The study found evidence of a long-term connection between exchange rates and economic growth. Similarly, Okoroigwe et al. (2023) investigated the impact of fluctuating exchange rates on Nigeria's economy from 1986 to 2021. The results indicated that a high level of stability in exchange rates, inflation rates, and interest rates had a positive effect on economic growth in Nigeria. Audi (2024) evaluated the effects of exchange rate volatility on long-term economic growth in Lebanon through the use of time series data from 1980 to 2023. The study utilized the Auto-regressive distributed lag model and discovered that exchange rate volatility had a significant positive impact on long-term economic growth, while in the short-term, the relationship between exchange rates and economic growth was negative and insignificant. Similarly, in a study by Olorunfemi et al. (2024), the focus was on examining the impact of exchange rate misalignment on long-term economic growth using data from 1981 to 2020. The study utilized co-integration and error correction techniques. It was found that there is a negative short-term correlation between real exchange rate and economic growth, indicating that misaligned exchange rates can hinder economic growth, which aligns with the findings of Audi et al. (2024). Zahra et al. (2023) conducted a study to evaluate the influence of exchange rate and foreign direct investment on external debt using data spanning from 1973 to 2021. The study employed the Auto-regressive distributed lag model. The results revealed a significant positive association among exchange rate, foreign direct investment, economic growth, and external debt in the long run. Additionally, the study showed a negative impact of exchange rate on economic growth in the short run.

In the study of Mohamed and Abdi (2024) the study delved into the interplay of inflation, unemployment, and economic growth in Somalia. They utilized a vector error correction model for their analysis, using data from 1991 to 2021. The results of their research indicated a negative correlation between inflation and economic growth. Sumba, Nyabuto, and Mugambi, in their 2024 study, investigated the impact of exchange rate and inflation dynamics in Kenya. They gathered monthly time-series data from January 2005 to November 2023 for their analysis and employed a Non-linear threshold auto-regressive model. Their findings revealed a non-linear relationship between exchange rate depreciation and inflation, thus indicating that exchange rate depreciation adversely affects economic growth. According to the study of Malec et al. (2024), they examined how inflation, exchange rate, and economic growth impact Ethiopia. They analyzed data from 1991 to 2020 and used the Auto-regressive distributed lag model for both long-run and short-run dynamics. The results indicated that inflation and exchange rate have a negative effect on economic growth, supporting Mohamed and Abdi's (2024) findings that a high inflation rate hinders economic growth. Similarly, Maiga (2024) assessed the impact of inflation, exchange rate, and economic growth in Tanzania using data from 1990 to 2021. They employed reduced-form regression and co-integration analysis and found a significant negative correlation between inflation and economic growth, confirming Mohamed and Abdi's (2024) conclusion that inflation is detrimental to economic growth. This suggests that a high inflation rate impedes economic growth. Conversely, Aribatise et al. (2023) investigated the effect of inflation rate, exchange rate, and economic growth in Nigeria, using annual time-series data from 1990 to 2020. They utilized the vector error correction Granger causality technique and identified a unidirectional causal relationship between exchange rate and inflation rate.

3. METHODOLOGY

3.1 Theoretical Framework

The theoretical framework for this study is anchored on the Keynesian theory. The Keynesian growth was propounded by John Maynard Keynes in 1936. The theory assumes that the best way to enhance economic welfare is by increasing government intervention.

$$Y = C + I + G + (X-M) \quad \text{..... 1}$$

The change in output will be equal to the multiplier times the change in government expenditure

Where:

Y represents economic growth; C stands for consumption; I means investment; G stands for government expenditure

$$\Delta Y = 1/\ \Delta G \quad \text{---------- 2}$$

$$\text{Where } 1 = K / 1\text{-}b \quad \text{---------- 3}$$

$$\Delta Y = K\ \Delta G \quad \text{---------- 4}$$

$$\Delta Y/\Delta G = K \quad \text{---------- 5}$$

Therefore, change in output over change in government expenditure is equal to the multiplier. This shows that government expenditure can be used to influence economic growth in an economy.

3.2 Model Specification

This study therefore adopts and modifies the Keynesian model. In this sense, it is believed that government spending on subsidies determine economic growth. To achieve the objectives of the study, we therefore specify the functional relationship below:

$$RGDP_t = \beta_{0+}\beta_1\, ln\text{FFS} + \beta_2\ ln\text{EXR} + \beta_3\ \text{INF} + \boldsymbol{\theta}_t \quad \text{---------- (3)}$$

Where:

$RGDP_t$ means Real Gross domestic product at the time t

lnFFS stands for Log of Fossil Fuel Subsidy

lnEXR represents Log of Exchange Rate

INF stands for Inflation rate

θ means error term

β_o represents intercept of fuel subsidy

$\beta_1 - \beta_3$ stands for the short-run and long-run dynamic parameters of the regressors

We write the vector error correction model like this.

$$RGDP = {}_{\propto_0} + \sum_{i=0}^{k} \beta_1\ RGDP_{(t-1)} + \sum_{i=0}^{k} \beta_2\ EXR_{(t-1)} + \sum_{i=0}^{k} \beta_3\ INF_{(t-1)} + \ \mu_1$$

3.3 Estimation Method

The *ex post facto* research design was utilized for this study. The estimation method utilized for this study is the Vector Error Correction Model. This method was chosen because of its ability to estimate long-run equilibrium relationships and short-term dynamics between multiple time series variables as well as the short-run adjustment coefficients. The data for this study were sourced from the World Bank Development Indicators and the Central Bank of Nigeria Statistical Bullentin, 2024. Data for Nigeria was gathered which covered the period of 1992 -2023.

4. RESULTS AND DATA ANALYSIS

Table 1 presents summary statistics for variables influencing Real Gross Domestic Product (RGDP): Fossil Fuel Subsidy Removal (FSE), Exchange Rate (EXR), and Inflation Rate (INF). Starting with FSE, which has a mean of 19.11, the data shows the distribution is positively skewed (skewness = 0.56). This suggests that, on average, Fossil fuel subsidy removal contributes positively to real gross domestic product, with most observations clustering around the mean. The moderate kurtosis (3.23) indicates that the distribution is moderately peaked compared to a normal distribution, indicating a moderate concentration of values around the mean. Moving to RGDP, it has a mean of 3.33 and a median of 1.55, indicating that the distribution is positively skewed (skewness = 0.07). This suggests that some higher values are pulling the average upwards, potentially indicating variability in economic performance across Nigeria. The kurtosis (1.39) reflects heavier tails compared to a normal distribution, implying a distribution with more extreme values than expected under normal conditions. Exchange rate, with a mean of 18.78, shows a distribution close to normal (skewness = 2.09) and moderately peaked (kurtosis = 6.42). This suggests a relatively stable contribution from exchange rate to real gross domestic product, with observations spread out relatively evenly around the mean. Inflation rate, having a mean of 112.25, exhibits a slightly positively skewed distribution (skewness = 1.81) and moderate kurtosis (6.33). This indicates that inflation rate contribution to real gross domestic product may have some variability, possibly influenced by factors such as climate conditions or government policies.

However, the Jarque-Bera tests and their associated probabilities further confirm the normality of these distributions, with some variables showing closer adherence to normal distributions than others. Overall, these descriptive statistics provide a foundational understanding of how each variable contributes to or affects real gross domestic product, setting the stage for deeper econometric analysis to explore their interrelationships and impacts on economic growth.

Table 1. Descriptive Statistics Table

VARIABLES	RGDP	FSE	EXR	INF
Mean	3.33	19.11	18.78	112.25
Standard deviation	1.44	1.53	16.25	48.24
Minimum	1.55	15.85	5.39	49.78
Maximum	5.51	22.54	72.84	273.01
Median	3.20	18.94	13.06	101.04
Skewness	0.07	0.56	2.09	1.81
Kurtosis	1.39	3.23	6.42	6.33
Jarquebera	3.44	1.72	38.94	32.39
Probability	0.17	0.42	0.000	0.000

Source: Author's computation, 2024 from STATA 15

Table 2 presents the correlation matrix among key variables affecting Real Gross Domestic Product (RGDP), Fossil Fuel Subsidy Removal (FSE), Exchange rate (EXR), and Inflation (INF). Fossil Fuel Subsidy Removal shows a moderate negative correlation of -0.2086 with RGDP, indicating that the abrupt removal of Fossil Fuel Subsidy may lower Real Gross Domestic Product. Exchange rate reflects a moderate negative correlation of -0.4045, which implies that exchange rate volatility hinders economic growth in Nigeria. This suggests that devaluation of currency in Nigeria cannot spur economic growth. Inflation exhibits a negligible correlation of -0.04 with RGDP, suggesting little to no linear relationship between inflation and Real Gross Domestic Product. This implies that changes in inflation rate may not significantly impact per capita income directly, possibly reflecting an economic where inflation alone does not dictate overall economic welfare.

Table 2. Correlation Matrix

Variables	RGDP	FSE	EXR	INF
RGDP	1.0000			
FSE	-0.2086	1.0000		
EXR	-0.4045	0.1819	1.0000	
INF	-0.0405	-0.3833	-0.0512	1.0000

Source: Author's computation, 2024 from STATA 15

Table 3 indicate the unit root test. The Augmented Dickey Fuller (ADF) test and the Phillips-Peron (PP) test were employed for testing whether the variables are stationary or non-stationary. Following the ADF and PP tests, as indicated by the respective p-value of each variable, the data in Table 3 below demonstrate that all variables displayed stationarity, either at level or after the first difference.

Table 3. Unit Root Test

Variables	ADF@level Statistics/ P-value	ADF@diff. Statistics/ P-value	PP@level Statistics/ P-value	PP@diff. Statistics/ P-value	Order of integration
RGDP	-0.002 (0.870)	-0.449 (0.005)	0.012 (0.401)	0.449 (0.005)	I(1)
FSE	-0.523 (0.001)	-1.099 (0.000)	-0.523 (0.001)	-1.099 (0.000)	I(0)
EXR	-0.237 (0.036)	-0.972 (0.000)	-0.237 (0.036)	-0.972 (0.000)	I(1)
INF	-0.397 (0.009)	-0.997 (0.000)	-0.397 (0.009)	-0.997 (0.000)	I(1)

Source: Author's Computation, 2024 from STATA 15.

Table 4 shows the Johansen co-integration test. At 5% level of significance, the Johansen co-integration results revealed the existence of a long-run equilibrium relationship. The table shows that the trace statistics, when analysed under the null hypothesis, are 71.319, which is more than the critical value of 47.21. At the 0.05 level of significance, the associated probability value, 0.0423, is less than that. As a result, the null hypothesis that there is no co-integration is rejected. Thus, we have one co-integrating equation.

Table 4. Johansen Co-integration Test

Hypothesized No. of CE(S)	Eigen Value	Trace Statistics	5% Critical Value	Probability
None*	0.345	71.319	47.21	0.0423
1	0.829	21.876	29.68	0.5678
2	0.471	4.0277	15.41	0.7889
3	0.134	0.0000	3.76	0.4567

*Note: Trace test indicates 1 cointegrating eqn(s) at the 0.05 level; * denotes rejection of the hypothesis at the 0.05 level.*
Source: Author's Computation, 2024 from STATA 15

4.1 Lag Length Selection Criteria

The various lag selection criteria suggested a maximum lag length of either 1 or 4. This study chose 1 as the lag length suggested by SC (Schwarz information criterion) as shown by the asterisk (*) at the 5% level. Table 5 presents the vector error correction model estimate. The result of the vector error correction model regression for the long- run and short-run relationships between RGDP, FSE, EXC, and INF are displayed below. The findings showed that FSE, EXR and INF are insignificant in the short-run, RGDP was found to be significant in the short-run. FSE, EXR and INF does not have endogenous impact on themselves in the short-run. They are not good predators of economic welfare in Nigeria. The co-integrating equation is positive and insignificant. This implies that past equilibrium or dis-equilibrium will adjust into a short-run equilibrium at the speed of 0.00902. It is significant because the p-statistics is less than 2.3%. However, past RGDP has a positive and significant effect on present RGDP. RGDP has a feedback effect in the short-run and it is desirable to sustain economic welfare in Nigeria. In the long-run, LFSE, LEXR and INF were found to be significant. FSE has a negative and statistically significant effect on RGDP in the long- run. Therefore, one percent increase in FSE would decrease RGDP by 8.213%. This is contrary to the Keynesian theory that government expenditure has expansionary effect on the economy. This case is skeptical to Nigeria because of high level of corruption and embezzlement of public funds by those in government. Also INF has a negative effect on log of RGDP. Thus, one percent increase in inflation would lead to 0.031% reduction in LRGDP.

Table 5. Vector Error Correction Model Result

Variable	Coefficient	Standard deviation	T-ratio
Vector error correction model result for short-run dynamics			
ECM(-1)	0.000902	0.00283	0.31884
D(LRGDP(-1)	0.653454	0.14575	4.48329
D(LFSE(-1)	-0.004651	0.07173	-0.06484
D(LEXR(-1)	0.019894	0.01325	1.50095
D(INF(-1)	-0.000142	0.00012	-1.17881
Vector Error Correction Model Result For Long-Run Dynamics			
LFSE (-1)	-8.21323	3.48232	-2.35855
LEXR (-1)	2.766247	0.42919	6.45527
INF (-1)	-0.03139	0.00059	-5.23931
C	-5.9741		

Source: Author's Computation, 2024.

5. DISCUSSION OF FINDINGS

In accordance with objective of the study which is to determine the long-run and short-run dynamics of the removal of fossil fuel subsidy, exchange rate and inflation on economic welfare; this study discovered that FSE, and INF has a negative insignificant effect on economic welfare in the short-run, while EXR has a positive insignificant effect on economic welfare in the short-run. The study revealed that FSE and INF has a negative significant influence on economic welfare in the long-run, while EXR has a positive significant effect on economic growth in the long-run. This corroborates with the findings of Ogwuche et al. (2024); Okorie and Wesseh (2024) and Audi (2024). The vector error correction model estimate shows that the elimination of fossil fuel subsidies has a detrimental effect on the economic welfare of Nigerians in the short run and long run. This implies that the elimination of fossil fuel subsidy hinders macroeconomic performance in Nigeria. This indicates that the abrupt removal of fossil fuel subsidy reduced the economic welfare of many Nigerians in the short-run and long-run because it spurred inflation in all sectors affecting the economic welfare of many Nigerians. Furthermore, fossil fuel elimination reduced the health stock of many Nigerians as many could not afford to eat three square meals and a balanced diet. This increased the mortality rate as some Nigerians could not afford to visit the hospital for proper health care service as a result of a hike in hospital bills.

6. CONCLUSIONS AND RECOMMENDATIONS

This research concludes that eliminating fossil fuel subsidies negatively impacts economic welfare in both the long run and short run in Nigeria. It is suggested that the government promote investment in domestic refineries to lessen reliance on imported petroleum products and to alleviate the effects of fluctuations in global oil prices. Additionally, the government should provide incentives and support for investments in local refineries to foster self-sufficiency, generate employment, and stimulate economic growth. There is an urgent need to improve transparency and accountability within the downstream sector of the oil and gas industry to address corruption and rent-seeking behaviors that may arise from revenues associated with subsidy removal. The government ought to promote the use of natural gas as a cleaner substitute for petrol and other fossil fuel energy sources in accordance with Nigeria's Energy Transition Plan. Natural gas is more plentiful in Nigeria compared to oil. Gas can serve as a means for generating and supplying electricity through gas turbines. Both compressed and liquefied natural gas can be utilized to fuel vehicles for transportation. It has been estimated that Compressed Natural Gas could be more than four hundred percent less expensive than petrol when implemented. The government should enact policies that hasten the shift from fossil fuels to renewable energy and other low-carbon energy sources. Utilizing renewable energy resources, particularly for electricity generation, will help lessen reliance on fossil fuels such as petrol. Policymakers should establish health reform programs and education reform programs to increase the economic welfare of Nigerians in a time

like this. This would increase the health stock of many Nigerians and increase the life expectancy rate, which in the long run would increase the productivity of labor and hence achieve sustainable growth and development.

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