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IMPACT OF FUEL SUBSIDY REMOVAL ON NIGERIA'S SUPPLY CHAIN: A CASE STUDY ANALYSIS

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Abstract
This study investigated the effect of fuel subsidy removal on Nigeria's supply chain, focusing on the relationships between fuel prices, transportation costs, and food prices. Econometric analysis was conducted using monthly time-series data from 2022 to January 2024 on petrol prices, transportation costs, and food prices. Results from the correlation analysis revealed a statistically significant strong positive correlation ($r = 0.929722$, $p < 0.0001$) between petrol prices and food prices, indicating that increases in petrol prices are associated with increases in food prices. The regression analysis showed that petrol prices had a significant positive impact on transportation costs ($\beta = 0.280966$, $p < 0.0001$), suggesting that rising fuel prices lead to higher transportation costs that could be passed on to businesses and consumers. The cointegration analysis provided evidence of a long-term equilibrium relationship between petrol prices, transportation costs, and food prices. The trace and maximum eigenvalue tests indicated the presence of one cointegrating equation at the 5% significance level. The Granger causality tests showed bidirectional causality between petrol prices and food prices, as well as unidirectional causality from food prices to transportation costs. However, the regression analysis examining the impact of fuel subsidies on food availability yielded a positive but statistically insignificant coefficient ($\beta = 0.208738$, $p = 0.2450$). This suggests that other factors beyond fuel subsidies may play a more significant role in determining food availability in Nigeria. The study concludes that fuel subsidy removal in Nigeria could lead to higher petrol prices, subsequently increasing transportation costs and food prices. This could negatively impact consumer purchasing power and overall food security. Recommendations include implementing targeted support programs, investing in infrastructure, exploring alternative energy sources, and enhancing supply chain transparency through digital technologies.

Keywords: fuel subsidy, supply chain, transportation costs, food prices, Nigeria.

Introduction

Nigeria's longstanding fuel subsidy program, intended to ease the burden on citizens, presents a complex dilemma for the country's supply chain. While its removal promises cost savings, it also risks disruptions and price hikes. Subsidy removal can trigger a period of adjustment within the midstream supply chain, the heart of fuel transportation and storage (Ojo, 2023). As fuel prices rise, market forces come into play. Consumers, faced with higher costs, might cut back, leading to a temporary demand drop. Suppliers, on the other hand, may need to recalibrate operations and delivery schedules to adapt to the new pricing structure (Ojo, 2023). This period of flux could result in temporary shortages or imbalances in the flow of goods.

The impact of subsidy removal transcends the midstream sector. Transportation companies, a critical link in the chain, will likely face a significant rise in operational costs due to increased fuel prices. These costs may then be passed down to businesses and consumers alike, potentially inflating the final price of goods (Nadoo, 2022). This domino effect could contribute to inflation and erode consumer purchasing power, dampening economic activity (Nadoo, 2022). However, the picture is not without its silver lining. With the removal of fuel subsidies, the government could redirect resources towards long-neglected infrastructure projects. This could lead to improved roads, storage facilities, and transportation networks (Omitogun *et al.*, 2021). A more efficient infrastructure system would ultimately reduce transportation costs within the supply chain, benefiting businesses and consumers in the long run (Omitogun *et al.*, 2021). Subsidy removal could also incentivize investment and innovation in Nigeria's domestic refining sector. Currently, the country relies heavily on imported fuel, making it vulnerable to global price fluctuations. By removing subsidies, the government could create an environment that encourages private investment in domestic refineries. This, in turn, could reduce dependence on imports and create a more resilient supply chain, less susceptible to external shocks (Omitogun *et al.*, 2021).

The success of fuel subsidy removal hinges on a well-planned transition. The government should consider implementing programs to ease the burden on transportation companies and consumers during the initial adjustment period. Cash transfer programs or targeted subsidies for low-income earners could help soften the blow of rising fuel costs. Additionally, investing in public transportation infrastructure could provide Nigerians with more affordable alternatives. The long-term benefits of subsidy removal extend beyond cost savings. A more efficient supply chain, facilitated by improved infrastructure and a robust domestic refining sector, would enhance the competitiveness of Nigerian businesses. This, in turn, could stimulate economic growth and create jobs across various sectors. The agricultural sector, for instance, could benefit from lower transportation costs, allowing farmers to get their produce to market more efficiently.

The debate surrounding fuel subsidy removal in Nigeria has been ongoing for decades. While the potential benefits of cost savings and reduced fiscal burden are acknowledged, the impact on the country's intricate supply chain remains a complex and under-researched area. While theoretical frameworks explore the potential disruptions and opportunities associated with fuel subsidy removal, there is a dearth of empirical studies examining the specific effects on Nigeria's supply chain. Existing research often relies on broad economic models or case

studies from other countries, which may not fully capture the nuances of the Nigerian context. This research gap necessitates in-depth case studies or econometric analyses that explore the real-world impact on supply chain.

Research Objectives

There, the following objectives were formulated to further guide this study

i. Analyze the relationship between changes in fuel price and the Food Price in Nigeria.
ii. Examine the impact of change in fuel price on average transportation costs in Nigeria.
iii. Assess the effect of fuel subsidy removal on the availability of food items in Nigeria

Research hypothesis

The following hypothesis were formulated from the research objectives

Null Hypothesis (H0): There is no statistically significant relationship between changes in fuel price and the food price in Nigeria.

Null Hypothesis (H0): The average transportation cost in Nigeria is not affected by changes in fuel price.

Null Hypothesis (H0): Fuel subsidy removal in Nigeria have no significant impact on the availability of food items.

Review of Related Literature

Conceptual Review

Fuel Subsidy Removal in Nigeria

The issue of fuel subsidy removal in Nigeria has been a contentious topic for decades. While the government spends billions of dollars annually to keep fuel prices artificially low for citizens, the economic and social implications of this policy remain fiercely debated (Akov, 2015). Proponents of subsidy removal argue that it would free up government resources for investment in critical sectors like education and infrastructure (Omitogun *et al.*, 2021). Additionally, they believe it would incentivize private investment in domestic refining, ultimately reducing dependence on imported fuels (Omitogun *et al.*, 2021). Opponents, however, highlight the potential negative consequences for Nigerians, particularly the most vulnerable (Nwachukwu *et al.*, 2013). Subsidy removal is likely to lead to an increase in fuel prices, which could have a ripple effect throughout the economy. Transportation costs would rise, potentially leading to higher prices for goods and services (Nadoo, 2022). This, in turn, could contribute to inflation and erode consumer purchasing power (Nadoo, 2022).

The impact of fuel subsidy removal on Nigeria's supply chain is a specific area of concern within this broader debate. Some studies warn of potential disruptions in the midstream sector, responsible for transporting and storing refined petroleum products (Ojo, 2023). As fuel prices rise, consumers might reduce their consumption, leading to a temporary drop in demand. Suppliers, on the other hand, may need to recalibrate operations to adapt to the new pricing structure, potentially causing temporary shortages or imbalances (Ojo, 2023). Furthermore, increased fuel costs could translate into higher operational expenses for transportation companies, a critical link in the supply chain. These costs might be passed on to businesses and consumers alike, impacting the final price of goods (Nadoo, 2022). This domino effect could hinder economic activity and exacerbate existing inequalities (Nwachukwu *et al.*, 2013).

However, the picture is not entirely negative. Subsidy removal could create opportunities for long-term improvements within the supply chain. With freed-up resources, the government could invest in upgrading roads, storage facilities, and transportation networks (Omitogun *et al.*, 2021). A more efficient infrastructure system would ultimately reduce transportation costs, benefiting both businesses and consumers in the long run (Omitogun *et al.*, 2021). Additionally, subsidy removal could incentivize investment in domestic refining, potentially reducing Nigeria's reliance on imported fuels (Omitogun *et al.*, 2021). This would make the supply chain less vulnerable to global price fluctuations and external shocks.

The success of fuel subsidy removal hinges on a well-planned transition strategy. Studies suggest that implementing programs to ease the burden on transportation companies and low-income consumers during the initial adjustment period is crucial (Nwachukwu *et al.*, 2013). Cash transfer programs or targeted subsidies could help soften the blow of rising fuel costs. Additionally, investing in public transportation infrastructure could provide Nigerians with more affordable alternatives.

Supply Chain in Nigeria

Nigeria, Africa's most populous nation and a rising economic power, faces a complex landscape when it comes to its supply chain. While the country boasts abundant resources and a growing consumer base, numerous challenges hinder the smooth flow of goods and services. Understanding these complexities is crucial for businesses operating within Nigeria and those seeking to enter its market. A significant hurdle for the Nigerian supply chain is the inadequacy of infrastructure (Onyemea *et al.*, 2013). Poor road networks, limited storage facilities, and unreliable power supply create bottlenecks, increasing transportation costs and lead times (Ogunlana *et al.*, 2017). This inefficiency makes it difficult for businesses to compete globally and deliver goods to consumers in a timely and cost-effective manner. Also, Security threats, including piracy, armed robbery, and kidnapping, pose a significant challenge for the Nigerian supply chain (Okeke *et al.*, 2018). These threats disrupt transportation routes, increase insurance costs, and discourage investment in logistics infrastructure (Okeke *et al.*, 2018). In addition, the Nigerian logistics sector is characterized by a high degree of fragmentation, with a large number of small, informal operators (Sallis, 2014). This fragmentation leads to inefficiencies, lack of standardization, and limited access to technology (Sallis, 2014). These factors further hinder the overall efficiency of the supply chain. Lastly, corruption within government institutions and the business sector adds another layer of complexity to the Nigerian supply chain (Adesina & Adegbile, 2018). Bureaucratic hurdles, unofficial fees, and a lack of transparency create delays and inflate costs for businesses transporting goods (Adesina & Adegbile, 2018).

Despite these challenges, the Nigerian supply chain also presents significant opportunities. Nigeria's population is projected to continue its rapid growth, creating a vast and expanding market for consumer goods (Soles & van Tulder, 2019). This growth presents a lucrative opportunity for businesses that can navigate the complexities of the supply chain and deliver products efficiently. The Nigerian government has recognized the importance of an efficient supply chain for economic growth. Efforts are underway to improve infrastructure, invest in technology, and reduce bureaucratic hurdles (Soles & van Tulder, 2019). These initiatives, if

successful, could significantly improve the efficiency and competitiveness of the Nigerian supply chain.

The rise of technology, such as mobile money and e-commerce platforms, is transforming the Nigerian supply chain landscape (Akintola *et al.*, 2019). These advancements can improve logistics management, enhance transparency, and connect businesses with consumers in new ways. The need for improved infrastructure, logistics services, and technology within the Nigerian supply chain presents significant investment opportunities for domestic and international players (Akintola *et al.*, 2019). Investment in these areas could not only generate profits but also contribute to the overall growth and efficiency of the Nigerian supply chain.

Fuel Subsidy Removal and the Nigerian Supply Chain

The debate surrounding fuel subsidy removal in Nigeria is a complex one, with far-reaching implications for the country's intricate supply chain. While the government aims to free up resources for other sectors through subsidy removal (Omitogun *et al.*, 2021), the potential for disruptions and price hikes raises concerns about the impact on essential goods like food and the overall efficiency of the system. Transportation costs are a major component of the final price of goods in Nigeria (Nadoo, 2022). With fuel subsidies, the government artificially lowers the cost of fuel, keeping transportation costs in check. However, subsidy removal is likely to lead to a rise in fuel prices (Nadoo, 2022). This increase will likely be passed down to transportation companies, ultimately impacting the cost of transporting food and other goods across the country (Nadoo, 2022). Higher transportation costs due to fuel price increases can translate into higher food prices for consumers (Nwachukwu *et al.*, 2013). This could disproportionately affect low-income households, who spend a larger portion of their income on food (Nwachukwu *et al.*, 2013). Additionally, disruptions in the supply chain caused by fuel price adjustments could lead to temporary shortages of food items in certain parts of the country, particularly in remote areas (Ojo, 2023).

Theoretical Review

The Nigerian government's decision to remove fuel subsidies presents a significant challenge with potential disruptions cascading through the nation's intricate supply chain. Disruption Theory and Institutional Theory offer valuable frameworks for analyzing the multifaceted impact of this policy shift.

Disruption Theory

Disruption theory posits that unexpected events can significantly impact established systems. In this context, fuel subsidy removal represents an unforeseen disruption to the existing pricing structure and operational practices within the Nigerian supply chain. This disruption is likely to trigger a period of adjustment, characterized by:

- *Short-Term Supply Chain Bottlenecks:* Higher fuel costs can translate into increased transportation expenses for businesses. This could lead to temporary shortages of essential goods, particularly food items, as transportation networks grapple with the new cost structure.

- *Operational Challenges for Businesses:* Businesses within the supply chain may face difficulties adapting to the new pricing framework. This could lead to delays in deliveries, inefficiencies in logistics planning, and a need to re-evaluate profit margins in light of increased transportation costs.
- *Consumer Uncertainty and Potential Price Increases:* Consumers are likely to experience a period of uncertainty as businesses adjust their pricing strategies. The potential for higher transportation costs might translate into increased prices for a range of goods and services, impacting consumer purchasing power.

Institutional Theory

Institutional theory focuses on how formal and informal institutions shape economic behavior. Fuel subsidies in Nigeria can be viewed as an established institutional practice, influencing the way businesses operate and consumers make decisions. The removal of these subsidies disrupts this existing institutional framework.

- *Destabilization of Established Practices:* With the removal of subsidies, businesses that previously relied on artificially low fuel prices for transportation may no longer be able to operate under the same model. This destabilization necessitates a re-evaluation of established practices and a search for alternative solutions.
- Emergence of New Institutions: This disruption can pave the way for the emergence of new institutions within the supply chain. These new institutions could take various forms:
  - *Alternative Fuel Sources***:** Businesses might explore alternative fuel sources like Liquefied Natural Gas (LNG) or biofuels to mitigate dependence on traditional, more expensive fuels.
  - *Investment in Logistics Infrastructure:* The government or private sector might invest in improving storage facilities, transportation networks, or public transportation systems to create a more efficient and cost-effective logistics infrastructure.
  - *Changes in Consumer Behavior:* Consumers may adapt their behavior in response to potential price increases. This could include a shift towards locally produced goods to reduce dependence on long-distance transportation or a greater use of public transportation options. Disruption theory helps us understand the immediate challenges and adjustments the supply chain faces due to fuel subsidy removal. Institutional theory provides a broader lens to analyze how this policy shift disrupts established practices and creates opportunities for new institutions to emerge, potentially leading to a long-term transformation of the supply chain. By combining these lenses, a more holistic understanding can be achieved. For instance, disruption theory can help predict potential short-term shortages due to higher transportation costs. Institutional theory can then analyze how this disruption might incentivize investments in local production or alternative transportation solutions as a response (institutional change).

Empirical Review

The study of Adepoju, Balogun and Bekesuomowei (2023) titled impact of fuel subsidy removal on gross domestic product and transportation cost in Nigeria. The study identified economic problem arising from transportation cost due to removal of fuel subsidy in Nigeria. Secondary data were collected from Statista, World Bank web link and prices of Premium Motor Spirit (PMS) from 2011-2023. Data on the three variables i.e GDP, the price of PMS

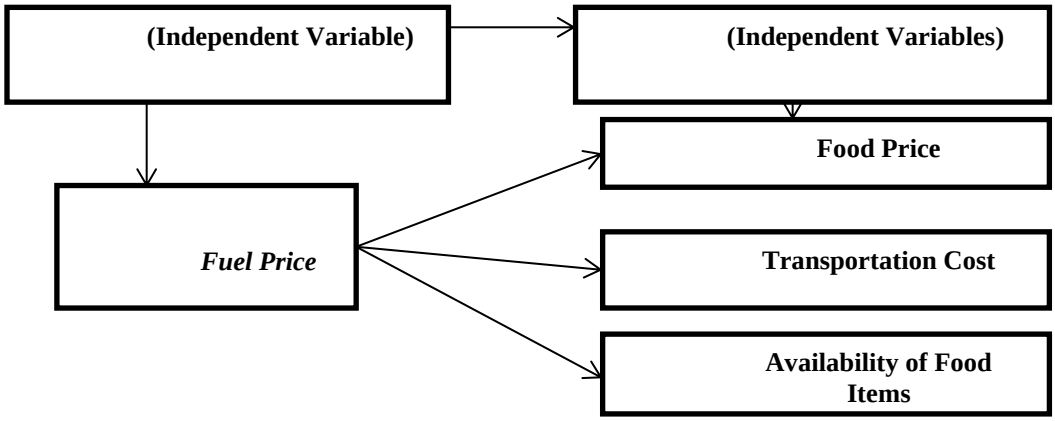
and inflation rate were correlated to determine their level of relationships. Pearson Product Moment Correlation Coefficient was used to analyse the secondary data with the aid of SPSS software. The result from the analysis indicated that, inflation increased by 64% with increased fuel price decreasing GDP by 42.5%. Inflation is witnessed to have increased and GDP decreases. It can be seen that fuel is very critical to the development of Nigeria. It has a direct effect on GDP and surprisingly price inflation has impact on Nigerians. Solving one problem perhaps of fuel has a significant effect on economy. The study recommended that two things that should be done as alternatives to subsidy removal; the first is to make the supply of fuel more than the demand. The second option is to find alternative fuel like other countries because the demand for crude oil as major revenue may dwindle over time if the buyers who are planning vigorously on alternative fuel are able to do away with our crude oil. The use of electric vehicle, solar powered vehicles, hybrid vehicles and policy that will encourage non-motorized transport can assist Nigeria to forestall future challenges of global oil demand.

Also, in the study of Olaniyi (2016), titled effects of fuel subsidy on transport costs and transport rates in Nigeria. The study adopts the qualitative research design. The study observed that fuel is a major factor among many others influencing transport costs and transport rates in Nigeria. It plays significant role in the production of goods and services in all sectors of the economy, that is why countries find it necessary to subsidize and ensured citizens have access to fuel which is of national importance. Fuel in Nigeria is an inelastic product both at demand and supply sides, which means that it is very difficult for consumers to find alternatives to the use of it in their daily lives. Transport costs are monetary measure of what the transport provider must pay to produce transportation services. Transport rates are the prices or fares of transport services paid by their users to the transport service provider. There are several factors influencing transport costs and rates, meanwhile fuel subsidy also influences those factors influencing transport costs and transport rates. Among other indices of attaining a diversified economy is the diversification of transport modes and energy sources. For a developing country like Nigeria, fuel subsidy is considered as major tool to enhance citizens' welfare most especially the middle and low income earners, meanwhile, the disbursement of fuel subsidy must be properly monitored to guide against corruption as shown in the past administrations. Strict policies can be set aside as punishment (such as death sentence, life imprisonment and other costly punishments) for any corrupt political office holder.

Lastly, in the study of Ekine and Okidim (2013), titled analysis of the effect of fuel subsidy removal on selected food prices in Port Harcourt, rivers state Nigeria. The study was conducted to analyse the effect of fuel subsidy removal on selected food prices in Port Harcourt (2001-2012) the food items considered were rice, yam, garri, beef and fish. The study objectives were to examine the impact of subsidy removal on prices of rice, garri, yam, beef and fish, examine the price of different food items before and after subsidy and to examine if subsidy removal causes inflation. Secondary data were used. Five simple regression equations were built with fuel subsidy as independent variables (X1) while rice (Y1), yam (Y2) beef (Y4), garri (Y3) and fish (Y5) were the dependent variable. The study showed that from 1966 to 2012, Nigeria had removed subsidy 24 times in 58 years, and that

the prices of most food items increased astronomically from 2001 to 2012 especially beef and fish due to fuel subsidy. The coefficient of determination (R2) showed that there was a significant relationship between food prices and fuel subsidy. The study concluded that removal of fuel subsidy has affected food prices. It recommended that the policy of removal of subsidy be implemented gradually to avoid further increase in price of food items.

Conceptual Framework



Source: Authors Design, 2024.

Methodology

The study employed a quantitative research design using secondary data analysis. Specifically, it utilized time-series data from reliable sources such as the National Bureau of Statistics (NBS) and Central Bank of Nigeria (CBN). The study collected monthly time-series data for the following variables: Petrol prices in Nigeria; Transportation costs (e.g., transportation price index); Food prices (e.g., food price index). The data covered a specific time period, from 2021 till January 2024, to capture the various phases of fuel subsidy implementation and removal in Nigeria. The study employed a range of econometric techniques to analyze the collected data. These techniques included: Unit Root Tests: To check for stationarity in the time-series data, unit root tests such as the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests were conducted. Cointegration Analysis: If the variables were non-stationary but cointegrated, cointegration tests like the Johansen cointegration test were performed to investigate the long-run relationships between the variables. Granger Causality Tests: These tests were used to examine the causal relationships between fuel prices, transportation costs and food prices. Regression Analysis: Regression models were estimated to analyze the impact of fuel prices on transportation costs and food prices. Appropriate regression techniques, such as Ordinary Least Squares (OLS) were employed based on the properties of the data. The data analysis was conducted using econometric software EViews 9.5. The software package provided a wide range of tools and techniques for time-series analysis, regression modeling, and hypothesis testing. The study acknowledged any limitations associated with the data sources, data quality, and the assumptions underlying the econometric techniques employed. Potential limitations included data availability, measurement errors, and the inherent assumptions of the statistical models used.

Table 1 - Variables

Variables	Definition
Dependent Variable	
Food Price	
Transportation Cost	Supply Chain
Availability of Food Items	
Independent Variables	
Fuel Price	Fuel Subsidy Removal

Data Presentation

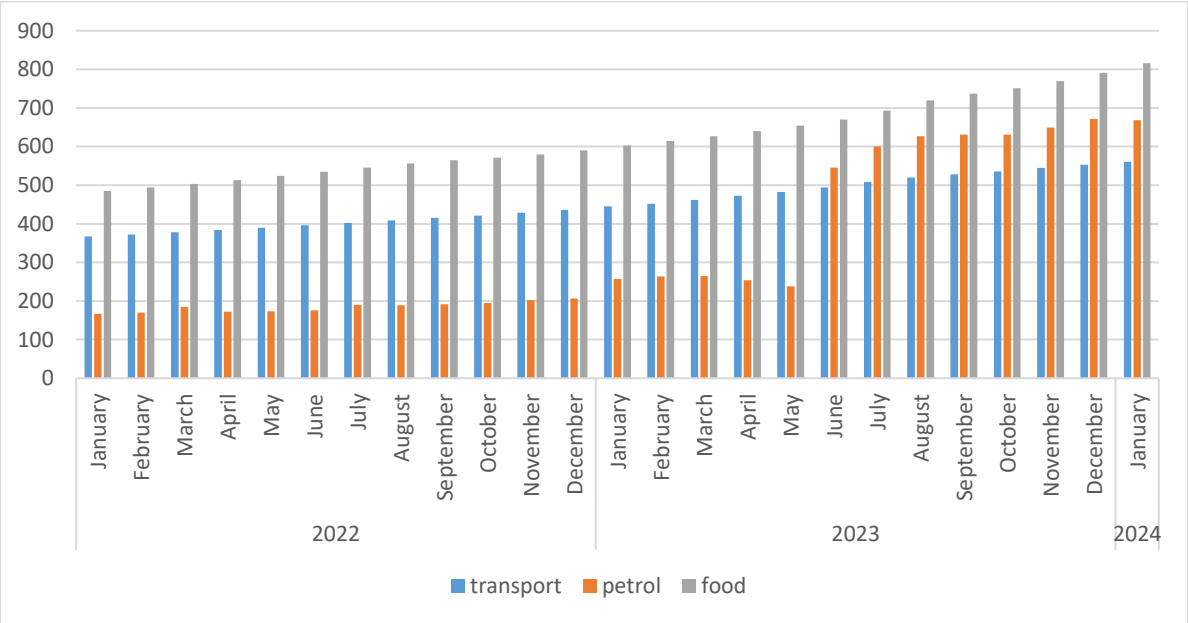


Fig. 1: Bar Chart of Petrol Price, Transport Price and Food Price (January, 2022 – January 2024)

Source: Nigerian Bureau of Statistics and Central Bank of Nigeria, 2024

Result and Discussion

Unit Root Test

Table 2

Group unit root test: Summary
Series: PETROL, TRANSPORT, FOOD
Date: 03/14/24 Time: 08:46
Sample: 1 25
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0 to 2
Newey-West automatic bandwidth selection and Bartlett kernel

Method	Statistic	Prob.**	Cross-sections	Obs

Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	2.63122	0.9957	3	69
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	4.90834	1.0000	3	69
ADF - Fisher Chi-square	0.26031	0.9997	3	69
PP - Fisher Chi-square	0.12698	1.0000	3	72

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

The report presents three tests for unit root:

- **Levin, Lin & Chu t-statistic:** This test assumes a common unit root process for all series. The high p-value (0.9957) suggests we **fail to reject** the null hypothesis of a unit root.
- **Im, Pesaran and Shin W-statistic:** This test allows for individual unit root processes. The p-value (1.0000) again indicates we **fail to reject** the null hypothesis.
- **Fisher tests (ADF and PP):** These tests combine results from individual Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests, which are common unit root tests. The high p-values (0.9997 and 1.0000) suggest we **fail to reject** the null hypothesis for both tests.

Pairwise Granger Causality Tests

Table 3

Pairwise Granger Causality Tests
Date: 03/14/24 Time: 08:53
Sample: 1 25
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
TRANSPORT does not Granger Cause PETROL	23	3.28033	0.0610
PETROL does not Granger Cause TRANSPORT		9.99630	0.0012
FOOD does not Granger Cause PETROL	23	3.09582	0.0699
PETROL does not Granger Cause FOOD		3.81267	0.0416
FOOD does not Granger Cause TRANSPORT	23	12.7226	0.0004
TRANSPORT does not Granger Cause FOOD		1.21142	0.3209

Interpretation of Results:

- **TRANSPORT to PETROL:** The p-value (0.0610) is relatively high, so we **fail to reject** the null hypothesis. There's weak evidence that past TRANSPORT values Granger cause future PETROL values.
- **PETROL to TRANSPORT:** The p-value (0.0012) is very low, so we **reject** the null hypothesis. This suggests PETROL's past values might Granger cause TRANSPORT's future values.
- **FOOD to PETROL:** Similar to TRANSPORT to PETROL, the p-value (0.0699) is high, leading us to **fail to reject** the null hypothesis. Weak evidence exists for FOOD causing PETROL.
- **PETROL to FOOD:** The p-value (0.0416) is lower than the typical threshold (0.05). This suggests we could **reject** the null hypothesis, but with some caution due to the borderline significance level. There's a possibility that PETROL's past values influence future FOOD values.
- **FOOD to TRANSPORT:** The p-value (0.0004) is very low, so we **reject** the null hypothesis. This is strong evidence that FOOD's past values Granger cause TRANSPORT's future values.
- **TRANSPORT to FOOD:** The p-value (0.3209) is high, indicating we **fail to reject** the null hypothesis. There's weak evidence for TRANSPORT causing FOOD.

Cointegration Rank Test

Table 4

Date: 03/14/24 Time: 10:50
Sample (adjusted): 3 25
Included observations: 23 after adjustments
Trend assumption: Linear deterministic trend
Series: PETROL TRANSPORT FOOD
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.655478	34.53168	29.79707	0.0132
At most 1	0.328853	10.02296	15.49471	0.2790
At most 2	0.036337	0.851325	3.841466	0.3562

Trace test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.655478	24.50872	21.13162	0.0161
At most 1	0.328853	9.171632	14.26460	0.2722
At most 2	0.036337	0.851325	3.841466	0.3562

Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

PETROL	TRANSPORT	FOOD
0.016336	-0.457142	0.257615
0.006157	0.013799	0.000156
0.018652	0.241276	-0.182808

Unrestricted Adjustment Coefficients (alpha):

D(PETROL)	-28.05684	0.892844	-8.942426
D(TRANSPORT)	-0.479514	0.408266	-0.002167
D(FOOD)	0.521272	1.376657	-0.178312

1 Cointegrating Equation(s):	Log likelihood	-193.6506

Normalized cointegrating coefficients (standard error in parentheses)

PETROL	TRANSPORT	FOOD
1.000000	-27.98311	15.76940
	(5.27849)	(3.28795)

Adjustment coefficients (standard error in parentheses)

D(PETROL)	-0.458347
	(0.19697)
D(TRANSPORT)	-0.007834
	(0.00305)
D(FOOD)	0.008516
	(0.01003)

2 Cointegrating Equation(s): Log likelihood -189.0648

Normalized cointegrating coefficients (standard error in parentheses)

PETROL	TRANSPORT	FOOD
1.000000	0.000000	1.192909
		(0.94787)
0.000000	1.000000	-0.520903
		(0.03448)

Adjustment coefficients (standard error in parentheses)

D(PETROL)	-0.452850	12.83829
	(0.21047)	(5.51361)
D(TRANSPORT)	-0.005320	0.224840
	(0.00279)	(0.07320)
D(FOOD)	0.016991	-0.219299
	(0.00910)	(0.23827)

This report summarizes the results of cointegration tests conducted on the time series PETROL, TRANSPORT, and FOOD. Cointegration analysis helps determine if these series move together in a long-term equilibrium relationship.

Cointegration Rank Tests

The Trace test suggests the presence of 1 cointegrating equation at the 5% significance level, and Maximum Eigenvalue test, similar to the trace test, it also indicates 1 cointegrating equation at the 5% significance level.

Based on both tests, there's strong evidence that the three series (PETROL, TRANSPORT, FOOD) are cointegrated. This suggests they share a long-term equilibrium relationship, meaning deviations from this equilibrium tend to be corrected over time.

Cointegrating Coefficient

The report presents coefficients for a single cointegrating equation (as suggested by the tests). These coefficients indicate the linear combination of the series that forms the equilibrium relationship. For example, with a coefficient of -27.98 for TRANSPORT, a one-unit increase in TRANSPORT is associated with a decrease of about 27.98 units in PETROL (when holding FOOD constant) to maintain the equilibrium.

Adjustment Coefficients

These coefficients show the short-term dynamics of each series in relation to the cointegrating equation. A negative coefficient for D(PETROL) suggests that deviations from the equilibrium tend to push PETROL back towards the equilibrium in the following period.

Second Cointegrating Equation

The report also presents results for a hypothetical second cointegrating equation, but the tests favor the existence of only one.

These cointegration test results provide evidence that PETROL, TRANSPORT, and FOOD move together in a long-term equilibrium relationship. The specific coefficients can be used to understand the nature of this relationship and potentially for forecasting purposes.

$Hypothesis\ (H1)$: There is no statistically significant relationship between changes in fuel price and the food price in Nigeria.

Regression Equation:

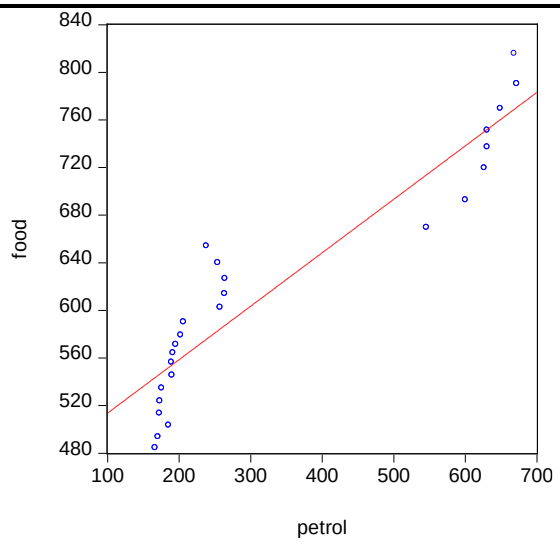
$F = \beta_0 + \beta_1 P + \varepsilon$

- F: Food Price (dependent variable)
- P: Fuel Price (independent variable)
- β_0: Y-intercept (average food price when fuel price is zero)
- β_1: Slope coefficient (represents the change in food price associated with a one-unit change in fuel price)
- ε: Error term (represents random, unexplained variations in food price)

Covariance Analysis: Ordinary
Date: 03/12/24 Time: 11:37
Sample: 1 25
Included observations: 25

Correlation Probability	PETROL	FOOD
PETROL	1.000000 -----	
FOOD	0.929722 0.0000	1.000000 -----

This is the results of a correlation analysis investigating the relationship between petrol and food prices. The analysis employed a sample size of 25 observations. A statistically significant positive correlation exists between petrol and food prices. The correlation coefficient is 0.929722, indicating a very strong linear relationship. The p-value for the correlation is 0.0000, which is less than the conventional significance level of 0.05. This reinforces the statistical significance of the observed correlation. In simpler terms, when petrol prices increase, food prices tend to follow suit, and vice versa.



The text labels on the axes confirm this, with "PETROL" on the x-axis and "FOOD" on the y-axis. The data points themselves cluster in a way that suggests a diagonal trend upwards from left to right. This would visually indicate that as petrol consumption increases, food consumption also increases. The correlation coefficient you provided (0.929722) strengthens this interpretation. A correlation coefficient closer to 1 indicates a stronger positive correlation.

Null Hypothesis $(H2)$: The average transportation cost in Nigeria is not affected by changes in fuel price.

Equation:

$ATC = \beta_0 + \beta_1 (FP) + \varepsilon$

- β_0: Y-intercept (average transportation cost when fuel price is zero)
- β_1: Regression coefficient representing the change in average transportation cost associated with a unit change in fuel price.
  - If β_1 is positive: Supports H_1 (transportation cost increases with fuel price).
  - If β_1 is negative: Not statistically significant for the hypothesis (relationship cannot be confirmed).
  - If β_1 is zero: Strongly supports H_0 (no impact of fuel price on transportation cost).

Error Term (ε): Represents the unexplained variation in transportation cost not captured by the fuel price.

Dependent Variable: TRANSPORT
Method: Least Squares
Date: 03/12/24 Time: 12:48
Sample: 1 25
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.

PETROL	0.280966	0.023820	11.79535	0.0000
C	358.5722	9.413620	38.09079	0.0000

R-squared	0.858139	Mean dependent var	454.3180
Adjusted R-squared	0.851971	S.D. dependent var	61.95311
S.E. of regression	23.83618	Akaike info criterion	9.256904
Sum squared resid	13067.76	Schwarz criterion	9.354414
Log likelihood	-113.7113	Hannan-Quinn criter.	9.283949
F-statistic	139.1303	Durbin-Watson stat	0.513349
Prob(F-statistic)	0.000000		

This EViews output shows the results of a least squares regression analysis where the dependent variable is "TRANSPORT."
The coefficient for the variable "PETROL" is 0.280966. This indicates that for every one unit increase in petrol price, the predicted transport cost increases by 0.2809 units (on the same scale as the transport cost variable). The positive coefficient implies a positive association between petrol prices and transport costs. The p-value for the petrol price coefficient is 0.0000, which is less than the conventional significance level of 0.05. This suggests a statistically significant relationship between petrol prices and transport costs. The coefficient for the constant term (denoted by "C" in the output) is 358.5722. This represents the estimated average transport cost when the petrol price is zero (which likely doesn't occur in reality). The R-squared value of 0.858139 indicates that 85.81% of the variation in transport costs is explained by the petrol price variable in this model. The adjusted R-squared value is slightly lower at 0.851971, which accounts for the number of variables in the model to provide a more accurate measure of fit.

Null Hypothesis ($H3$): Fuel subsidy removal in Nigeria have no significant impact on the availability of food items.

Model Equation: Food Availability = $\beta_0 + \beta_1$ (Fuel Subsidy Removal) + ε

Dependent Variable: FOODAVAILABILITY
Method: Least Squares
Date: 03/12/24 Time: 13:01
Sample: 1 25
Included observations: 25

Variable	Coefficient	Std. Error	t-Statistic	Prob.

FUELSUBSIDY	0.208738	0.174954	1.193104	0.2450
C	3.616505	0.797143	4.536831	0.0001

R-squared	0.058284	Mean dependent var	4.560000
Adjusted R-squared	0.017340	S.D. dependent var	0.506623
S.E. of regression	0.502211	Akaike info criterion	1.537027
Sum squared resid	5.800971	Schwarz criterion	1.634537
Log likelihood	-17.21283	Hannan-Quinn criter.	1.564072
F-statistic	1.423498	Durbin-Watson stat	1.398838
Prob(F-statistic)	0.244991		

The coefficient for "FUELSUBSIDY" is 0.279221. While the coefficient value itself suggests a positive relationship between fuel subsidies and food availability, the p-value associated with it (0.2450) is greater than the conventional significance level of 0.05. This indicates that the relationship is not statistically significant at the 5% level in this model. There's not enough evidence to conclude that fuel subsidies have a statistically significant impact on food availability based on this data and model. The coefficient for the constant term ("C") is 3.246753. This represents the estimated average food availability when the fuel subsidy variable is zero. R-squared value (0.058284) and adjusted R-squared value (0.017340) are both low low, indicating that the model explains only a small portion of the variation in food availability. The analysis concludes that the fuel subsidy variable, in this model, doesn't have a statistically significant relationship with food availability. The overall model fit is weak, indicating that other factors likely play a more significant role.

Conclusion

The study aimed to examine the effect of fuel subsidy removal on the supply chain in Nigeria, with a specific focus on the relationship between fuel prices, transportation costs, and food prices. The empirical analysis yielded several notable findings that contribute to the existing body of research on this topic. Firstly, the results of the correlation analysis revealed a statistically significant positive correlation between petrol prices and food prices in Nigeria. This finding aligns with the study by Ekine and Okidim (2013), which demonstrated a significant relationship between fuel subsidy removal and the prices of various food items, including rice, garri, yam, beef, and fish. The strong positive correlation observed in this study suggests that an increase in petrol prices, potentially resulting from fuel subsidy removal, could lead to higher food prices, impacting consumers' purchasing power and overall food security. Secondly, the regression analysis examining the impact of fuel prices on transportation costs yielded a positive and statistically significant coefficient. This result corroborates the findings of Olaniyi (2016), who observed that fuel is a major factor influencing transportation costs and rates in Nigeria. As fuel prices rise due to subsidy removal, transportation companies face increased operational costs, which are likely to be passed down to businesses and consumers in the form of higher prices for goods and services. This domino effect could contribute to inflationary pressures and erode economic activity, as highlighted by Nadoo (2022). However, the study's findings regarding the impact of fuel subsidy removal on food availability were inconclusive. The regression analysis assessing the effect of fuel subsidies on food availability yielded a positive but statistically insignificant

coefficient. This result contradicts the study by Ekine and Okidim (2013), which found that fuel subsidy removal led to astronomical increases in food prices, particularly for beef and fish. The weak relationship observed in this study suggests that other factors beyond fuel subsidies may play a more significant role in determining food availability in Nigeria.

Recommendations

1. To mitigate the potential negative impacts of fuel subsidy removal on low-income households and vulnerable groups, the government should implement targeted support programs. These could include cash transfers, temporary subsidies, or voucher systems to help offset the increased costs of transportation and food.
2. The government should prioritize investments in roads, storage facilities, and transportation networks. By enhancing infrastructure, the efficiency of the supply chain can be improved, ultimately leading to lower transportation costs and potentially offsetting some of the impacts of fuel subsidy removal
3. To reduce the reliance on imported fuel and mitigate the effects of global price fluctuations, the government should encourage and incentivize the exploration and adoption of alternative energy sources.
4. Implementing digital technologies and enhancing supply chain transparency can help optimize logistics operations and reduce inefficiencies. This could involve the adoption of real-time tracking systems, data analytics, and digital platforms to facilitate coordination among various supply chain actors.

Limitations of the Study

It is important to note that the study acknowledges potential limitations associated with data availability, measurement errors, and inherent assumptions of the statistical models employed. Additionally, the specific time period covered in this analysis (2021 to January 2024) may not fully capture the long-term effects of fuel subsidy removal on the supply chain.

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Appendix 1

Monthly Petrol, Transport and Food Prices (January, 2022 – January, 2024)

year	month	transport	petrol	food	LogP	LogF	LogT
2022	January	367.6	166.3987	484.7	2.22115	2.685463	2.565362
	February	372.4	170.4248	493.8	2.231533	2.693523	2.570995
	March	377.9	185.2966	503.6	2.267868	2.702062	2.577434
	April	383.7	172.6103	513.6	2.237067	2.710651	2.583958
	May	389.7	173.0799	524.0	2.238247	2.719315	2.590697
	June	396.0	175.8949	534.7	2.245253	2.72812	2.597663

	July	402.4	190.0108	545.6	2.278778	2.736903	2.604697
	August	409.1	189.4634	556.4	2.277525	2.745402	2.611777
	September	415.4	191.6476	564.4	2.282503	2.751584	2.618461
	October	421.5	195.294	571.3	2.290689	2.756878	2.624797
	November	428.6	202.4799	579.3	2.306382	2.76291	2.632008
	December	436.2	206.1874	590.2	2.314262	2.771032	2.639671
2023	January	444.9	257.1187	602.5	2.410134	2.779989	2.648235
	February	452.2	263.7557	614.0	2.421202	2.788178	2.655319
	March	462.0	264.2896	626.7	2.42208	2.79706	2.664682
	April	472.4	254.0562	640.0	2.40493	2.806209	2.674278
	May	482.7	238.1133	654.1	2.376784	2.815615	2.683657
	June	494.3	545.8274	669.7	2.737055	2.825901	2.69399
	July	508.2	600.3475	692.9	2.778403	2.840647	2.705994
	August	519.9	626.6998	719.7	2.79706	2.857127	2.715921
	September	528.3	630.6344	737.3	2.799778	2.867651	2.722885
	October	535.5	630.6344	751.4	2.799778	2.875877	2.728729
	November	544.4	648.9336	769.6	2.8122	2.886254	2.735879
	December	552.8	671.8582	790.5	2.827278	2.897921	2.742572
2024	January	560.2	668.2966	815.9	2.824969	2.911651	2.748318

Source: Nigerian Bureau of Statistics and Central Bank of Nigeria, 2024