# Chapter One

# Introduction

## 1.1 Background to the Study

Food prices in Nigeria have become considerably higher and unstable since 2012. For the poor masses whose lives revolve around meager livelihood and small farms, life has become more unbearable and disturbing.[1] The continuous increase in the prices of food over the years has raised grave concerns regarding the nutrition of the poor in developing countries as Nigeria.[2] Food price has increasingly been gaining importance as a result of the negative outcomes, especially on the less priviledged who spend a large share of their earnings on food. These increases in food prices has led to more health issues as a result of malnutrition and food insecurity among the poor, negative impact on trade balance, low investment and possible social unrest among most developing countries of the world. [3] Also, government policies responsible to changes in food prices has become more challenging as a result of the increasing price volatility and has negatively impacted the investment and consumption tendencies of many businesses and consumers.[4] The problem of food security is another major challenge confronting the nation; many households are buyers or consumers of food in Nigeria. Therefore, spikes in food price distorts the consumption pattern of most households which leads to serious implications of food insecurity in the country.[5] The high food prices trends unveiled mostly in 1999 and in 2007 which later continued to worsen in April 2008 affecting prices of grains such as rice, sorghum, cassava, soybean, maize, millet, and wheat the most. The prices of food continued to skyrocket even after 2008 owing to the demand pressure from the neighbouring countries on Nigeria, as a result of its big brother role in ensuring food security by exporting dry grains such as millet, maize, rice and sorghum. Also, domestic increase in food production have not kept pace with population growth, resulting to

an increase in food imports and declining levels of national food self-sufficiency. Owing to the high importation of food, the international food market prices is to be held responsible for the increasing prices of food experienced over the years. There is a popular notion that the rising food inflation in low income countries is a pointer to the fact that the degree of uncertainty in food market is still enormous.[6] High food inflation, among other issues such as heightens cost of living reduces household's access to the right quantity and quality of food and consequently reduces welfare. The effect of high inflation and uncertainty in food prices is relatively higher in low income countries such as Nigeria. [7]

Apart from the market mechanism (food supply and demand), uncertainty arising from highly unstable transport fare and fuel markets which constitute a huge chunk of costs in production, are issues that have been generating public debates in Nigeria. The global food crises of 2008 and 2011 have been implicated as the contributing factor and the major reasons for rising cost of food globally [8] with increasing effect on the poor and less priviledged in the low income countries.[9] These have also increased the level of poverty and malnutrition in net food importing and low income countries in the sub-Saharan Africa. Rising food inflation in sub-Saharan African (SSA) has pushed more households into poverty and reduces their standard of living which [10] compromised good feeding habits (balanced diet) [11]; and negatively affecting the productivity of the households.[12]

Food and nutrition insecurity in sub-Saharan Africa (SSA), including Nigeria, is indeed a persistent and concerning issue. Despite decades of policy actions and development programming, the region continues to face significant challenges in ensuring that its populations have access to an adequate and nutritious food supply. [13]

For instance, according to FAO statistical data, the average dietary energy supply adequacy in Nigeria exhibited a consistent decline, decreasing from 126% in 2007-2009 to 116% in 2016-2018. Additionally, the protein supply per capita per day decreased from 63.7 grams in

2007-2009 to 55.9 grams in 2016-2018, while the prevalence of undernourishment more than doubled, rising from 6.0% in 2007-2009 to 13.4% in 2016-2018. Concurrently, per capita food production variability has been on the rise, steadily increasing from 2.3 in the year 2000 to 11.5 in 2016. Furthermore, the cereals' import dependency ratio also increased; going from 13.7% in 1999 to 19.2% in 2013.[14] These statistics paint a bleak picture of food and nutrition security in Nigeria, impacting not only the quantity of available food but also its stability and nutritional quality. The preceding data suggests that the numerous policy measures aimed at increasing per capita income in Nigeria over the years have had a minimal effect on food and nutrition security, especially in terms of nutritional quality.[15] This had attracts attention to the negating influence of policy-induced rising food prices in Nigeria. It is imperative to note that Nigeria has been experiencing escalating and volatile food prices over the past decades, which Shittu, Obayelu, and Salmon[16] attached to domestic monetary policies, particularly policy- induced Naira depreciation. During the period from 2007 to 2018, to illustrate, the composite food price index in Nigeria exhibited a steady increase, climbing from 67.05 in January 2007 to 296.4 by December 2018, with an average year-on-year food inflation rate of 12.3%. Additionally, in 2010 and 2011, there was another substantial surge in food prices, primarily driven by the rising cost of petroleum, which subsequently transmitted to the domestic economy, leading to heightened transportation expenses and increased food prices. Subsequently, the prices decreased from 340 to 169 by June 2016.[17] The concurrent and large increases in food prices have been connected to a number of individual factors such as rate of exchange, lending rate, money supply, real GDP per capita, stocks, and oil price etc. Judging from the past few years, studies have shown and observed the relationship existing among these individual factors and price changes of food in Nigeria. [18, 19, 20, 21]

Incessant increase in international prices of food has affected the macroeconomic policy actions leading to inflation, high lending rates, and volatile exchange rate. The exorbitant

interest rates associated with agricultural production loans have led to a rise in production expenses. Importing agrochemicals has added complexity to procurement, further contributing to cost increases due to the depreciation of the Naira. Consequently, private sector investments in agriculture have dwindled as a consequence of the escalating expenses associated with acquiring farm inputs and the reduced profitability of agricultural enterprises in Nigeria.[22] Unfortunately, Nigeria finds itself in the paradoxical situation of being a net exporter of crude oil while simultaneously being a net importer of oil-derived fuels such as Premium Motor Spirit (PMS or petrol), Automotive Gas Oil (AGO or diesel), and DPK (Kerosene), among others. Adding to this complexity is the inherent instability of both the global crude oil and oil-derived fuels markets, further underscoring their significant influence on the food sector.[23, 24]

It's worth noting that oil-derived fuels such as PMS, AGO, and DPK serve as the lifeblood of Nigeria's economy, serving both industrial and household purposes. The instability in these markets has a direct and indirect impact on households, unlike the crude oil market. PMS and AGO are particularly vital for the transportation sector in Nigeria. Among these fuels, the price of PMS experiences the most significant fluctuations, causing concern for business owners, including farmers, due to the uncertainty in the fuel market. This uncertainty has a ripple effect, disrupting stability in various markets, especially in transportation. As a result, the transportation of food and agricultural produce between states and communities becomes exceptionally challenging, inefficient, and costly. Food price volatility refers to the erratic and substantial shifts in the prices of food commodities within a short time frame.[25]

The correlation between exchange rate depreciation and rising petroleum product prices foretells that the prices of food commodities will likely continue to track this trend unless proactive measures are taken. With the escalating exchange rate and persistent increases in

the cost of petroleum products, farmers are compelled to allocate more funds to transport their agricultural produce to the markets. Given that these petroleum products serve as fuel for generators used in corn mills, rice mills, bakeries, and small-scale industries, the consequence is an astronomical surge in food commodity prices. Nevertheless, the research community remains divided on the impact of energy prices on the food market, with many scholars positing that an uptick in oil prices plays a pivotal role in the disruptions experienced in the food market (Chimaobi et al and Maku et al..) [26, 27] Other researchers such as (Meyer et al and Valdemir Verbicki) [28, 29] are of the divergent view that a change in fuel prices has no direct impact on prices of food.

The persistent increases in consumer food prices in Nigeria since 2016 have led to significant hardships in the country. Notably, changes in the prices of food items in Nigeria have consistently coincided with variations in the exchange rate and petroleum product prices. To illustrate this trend, in 1996, the exchange rate stood at ₦21.90 per US Dollar, PMS was priced at ₦11 per liter, and the price of food items was at 23.99%. By 2001, the exchange rate had risen to ₦111.94 per US Dollar, PMS was now ₦22 per liter, and the price of food items had increased to 28.02%. In 2011, the exchange rate reached ₦153.86 per US Dollar, PMS was ₦65 per liter, and the price of food items had dropped to 10.30%. Fast forward to 2016, and the exchange rate was ₦253.49 per US Dollar, PMS was ₦145 per liter, while the price of food items had risen to 14.95%. Finally, in 2021, the exchange rate had climbed to ₦399.96 per US Dollar, PMS was ₦162 per liter, and the price of food items remained at 20.40%.[30, 31, 32]

## 1.2 Statement of Problem

Despite substantial investments in the agricultural sector, made by both private and public institutions with the aim of rejuvenating agriculture and ensuring an ample food supply for the population, these efforts have failed to generate commensurate returns on investment. It is

widely held that the agricultural sector fell into decline following the 1970s oil boom, as the government shifted its focus towards oil production, abandoning agriculture.[33] Likewise, many Nigerian farmers, after harvesting their crops, both food and cash crops, opt to sell their produce in the international market to earn foreign currency as a means of exchange. This practice results in a shortage of these products in the local market. To counter this scarcity, the Nigerian government engages in food imports to meet the domestic demand. However, this surges the exchange rate due to the elevated consumer preference and demand for foreign products.[34]

Fuel price volatility and exchange rate fluctuations have long been recognized as two major factors impacting food prices in the Nigerian economy and challenges faced by consumers and farmers in Nigeria.[35] Prior research has highlighted a robust correlation between fuel price instability and exchange rates concerning food prices in emerging economies. However, the intricacies of this relationship in the Nigerian context have remained largely unexamined. In recent years, several studies have further emphasized the connection between fuel price fluctuations and exchange rates as causative elements in food price inflation. Among studies that used Nigeria as a case study are widely spread in the literature Fasanya and Awodimila 2020 [36], For instance, researchers employed the feasible quasi-generalized least squares method to evaluate the Monetary authority's effectiveness in using the exchange rate to forecast food inflation in Nigeria and South Africa during the period from 1980 to 2018. Their findings indicated that the exchange rate serves as a reliable predictor of food price inflation in Nigeria, and similar results were observed for South Africa. Additionally, in 2020, Bawa and colleagues applied the NARDL framework to analyze the asymmetrical relationship between consumer price inflation and oil prices in Nigeria. They discovered that oil prices have a significant positive impact on food inflation in Nigeria. Their conclusion pointed to the influence originating from global inflation transmitted to domestic inflation through the international increase in oil prices.[37] Assertions of these studies followed Bala

and Chin study, where Pooled Mean Group (PMG) estimator employed to examine the impact of oil price on inflation of African OPEC countries – Algeria, Angola, Libya and Nigeria, used annual data between 1994 - 2014.[38] The results shows that oil price, positive or negative has a positively influence on food price inflation in these countries. Also, Bada et al. used quarterly time series data from 1995Q1 to 2015Q1 to examine exchange rate pass-through effect on import and consumer prices.[39]It is observed that the depreciation of the Nigerian Naira results in heightened consumer and import price inflation within the country, with a more pronounced impact on import prices. Consequently, the paper advocates for the implementation of credible exchange rate policies in the foreign exchange market to stabilize exchange rates and mitigate their influence on prices.

Furthermore, previous studies examining the relationship between fuel price volatility and exchange rates on food inflation, particularly those focusing on Nigeria, have overlooked certain gaps in the literature. Firstly, these studies tend to narrow down the causal factors of inflation. Many of these studies, such as the work by Bawa and colleagues in 2020, primarily considered oil price volatility as a key driver of food inflation, while other potential factors, such as foreign exchange, vice versa remained unexplored.[40] The strategies and measures aimed at mitigating food inflation in Nigeria have shown limited, if any, effectiveness, as consumer food prices continue to surge daily, rendering the basic necessities and sustenance for the majority of the population increasingly unattainable. This indicates that the root causes of food inflation in Nigeria remain unidentified and may necessitate alternative approaches for resolution. Furthermore, many studies have employed the Johansen-Juselius (JJ) co-integration method as the basis for long-term analysis. However, it has been observed that this method has limited power in capturing the adjustments that may occur in a cycle when testing the long-term co-integration of relationships. Bondia and colleagues have raised questions regarding the reliability of JJ co-integrating static values due to the possibility of time series variables adjusting to economic shocks.[41] This underscores the need to re-evaluate

the enduring association between fuel price volatility and exchange rates concerning food inflation, while considering the potential adjustments in the underlying variables. Such an analysis can hold significant relevance for the Central Bank of Nigeria in refining its strategies for addressing food inflation.[42]

While prior research papers have separately explored the influence of fuel price volatility and exchange rates on food prices, there have been limited comprehensive studies on their collective impact on the Nigerian food market. This gap in research has led to a somewhat narrow perspective of the dynamics involved. Consequently, this research holds substantial importance for policymakers and stakeholders in Nigeria, as it can provide valuable insights into developing strategies to alleviate the negative consequences of external economic shocks on food prices. In doing so, it can significantly contribute to bolstering food security in Nigeria.[43, 44]

### 1.3 Research questions

This Study tends to provide answers to the following questions, which are the basis of this study;

i. What is the effect of fuel Price and exchange rate on Food price in Nigeria?
ii. What is the level of volatility in fuel Price and exchange rate in Nigeria?
iii. What is the effect of the volatility in fuel Price and exchange rate on Food price in Nigeria?
iv. What is the asymmetric effect of Volatility in fuel Price and exchange rate on Food price in Nigeria?

## 1.4 Objectives of the study

The Broad objective of this Study is to investigate the role of volatility in fuel Price and exchange rate on food price in Nigeria between the first quarter of 2000 the fourth quarter of 2022. The specific objectives of the study are;

i. Investigate the effect of fuel Price and exchange rate on Food price in Nigeria;
ii. Analyze the level of volatility in fuel Price and exchange rate in Nigeria;
iii. Examine the effect of the volatility in fuel Price and exchange rate on Food price in Nigeria;
iv. Evaluate the asymmetric effect of Volatility in fuel Price and exchange rate on Food price in Nigeria.

## 1.5 Research hypothesis

Since hypothesis statement are quantifiable statements that are waiting for testing. The hypothesis for the test is put forth as;

### Hypothesis 1

$H_0$: There is no significant statistical effect of fuel price and exchange rate on food price in Nigeria

$H_1$: There is significant statistical effect of fuel price and exchange rate on food price in Nigeria

### Hypothesis 2

$H_0$: There is no significant statistical effect that fuel price volatility and exchange rate to some extent affects food price in Nigeria

$H_1$: There is significant statistical effect that fuel price volatility and exchange rate does not in any extent affect food price in Nigeria.

**Hypothesis 3**

$H_0$: There is no significant statistical effect that fuel price and exchange rate exhibits asymmetric effect on food price in Nigeria.

$H_1$: There is significant statistical effect that fuel price and exchange rate does not exhibit any asymmetric effect on food price in Nigeria.

## 1.6 Scope of the study

The research under study tends to look at the implication of fuel price and exchange rate volatility, as it affects the domestic food price in Nigeria as a result of its multiplier effect on food cost of production/price and endangering food security in Nigeria. The research will use data from the first quarter in 2000 to the fourth quarter in 2022 considering various fluctuations that have occurred in the exchange rate and fuel price domestically and its implications on the food price in Nigeria.

Nigeria, historically recognized as an agrarian economy that significantly contributed to its national income through substantial exports of agricultural products, underwent a substantial transformation with the discovery of oil. This shift led to a decline in the agricultural sector, impacting both exports and domestic consumption, with adverse repercussions for the country's economy. Iconic symbols of Nigeria's agricultural past, like the Northern groundnut pyramid and the Western cocoa house, gradually faded into obscurity and neglect.

## 1.7 Significance of the study

This study has been undertaken with the intention of conveying to the Nigerian government and lawmakers the imperative to transition from a mono-economy to an oligo-economy, where multiple sectors contribute significantly to the nation's revenue. While recognizing that the oil sector remains a vital component of the economy, it is crucial not to allow it to overshadow and neglect other sectors that were flourishing even prior to the discovery of oil. Furthermore, this study advocates for the implementation of policies aimed at addressing the persistent increase in the foreign exchange rates of other currencies relative to the Naira within the economy. Such measures are necessary to ensure a more balanced and stable economic environment.

This study is intended to provide valuable insights for the Nigerian government and private investors, prompting them to explore alternative avenues of income generation, such as agriculture. Agriculture is characterized by lower price volatility, sustainability, cost-effectiveness, and reliance on domestic resources. However, the transition to an agriculturally focused economy must be complemented by the formulation, diligent oversight, investment, and rigorous execution of agricultural development policies. These policies should actively promote farming as a means of economic advancement, ultimately fostering food availability and affordability within a favorable farming environment and distribution system. The study will also provide valuable insights to the government regarding the positive and negative externalities stemming from fuel price volatility and exchange rate, affecting food production and prices, as well as the broader macroeconomic implications on food prices. Given that oil derivatives and exchange rate, are essentials and major determinants of food prices in Nigeria, a negative externality, such as an increase in their prices/rate, would trigger a corresponding rise in the cost of food production. This, in turn, would lead to an escalation in food prices

and the prices of other goods and services, ultimately fostering inflation vice versa. Therefore, it is incumbent upon those in positions of authority to diligently manage economic affairs, striving to secure stability in fuel prices and exchange rates. This stability would provide enabling environment for other sectors of the economy to flourish, operate with minimal production costs, and contribute to economic development and growth

## 1.8 Operational Definition of terms

i. Fuel – is a substance that is consumable to produce energy. In this thesis, the name fuel is basically for Diesel and petrol and other oil products needed as energy to power and transportation of the agricultural produce from the producer to the final consumers.

ii. Fuel price – This is the amount paid per litre for the refined product of crude Oil e.g. Petrol, Diesel, kerosene etc

iii. Food - any nutritious substance that people eat or drink, substance consisting essentially of protein, carbohydrate, fat, and other nutrients used in the body to sustain growth and vital processes and to furnish energy.

iv. Food price - refer to the average price level for food in the country. Food prices have an impact on producers and consumers of food. Price levels depend on the food production process, including food marketing and food distribution.

v. Volatility - Essentially the rate at which prices of something fluctuates (increases or decreases). It is also the unpredictable or rapid increase or decrease in price movement in the market.

vi. Exchange rate – This is the rate at which one currency is exchanged for another currency in the international market. It's also the movement of money between countries i.e. the domestic currency value compared with the foreign currency value.[12]

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# CHAPTER TWO

# LITERATURE REVIEW

## 2.1 Conceptual review

**2.1.1 Food price** is the average price of specific food commodities, measured domestically, consistent across regions and states? Food prices exhibit significant variation and evolve over time, often providing valuable insights into the dynamics of domestic markets and agricultural production.[1] Food prices impact both consumers and producers of food. Producers encompass the essential raw or unfinished materials utilized in the production process to create finished goods for consumer consumption, such as consumer foods.[2] The price of food is contingent upon the expenses associated with the food production, encompassing food marketing and distribution processes. Food price fluctuations are predominantly influenced by various factors, such as political events, global demand, exchange rates, government policies, diseases, energy costs, weather conditions, and the availability of natural resources for agriculture, like arable land.[3,4] These factors contribute to fluctuations in food prices, with various consequences, including elevated food costs, threats to food security in less developed nations, social unrest, diminished living standards, malnutrition, and increased poverty. The persistent rise in food prices in Nigeria has been linked to a surge in kidnappings, frequent instances of violence for monetary gains, youth unrest, and a notable emigration of Nigerians seeking better opportunities abroad.[5]

**2.1.2 Fuel Price,** also known as the pump price of fuel at filling stations, is the regulated rate paid per liter of fuel. It is set as the maximum regulated retail selling price by the Department of Petroleum Product Price Regulatory Agency of Nigeria (PPPRA). When calculating the cost of fuel products in Nigeria, two cost structures are considered: the cost of production (for

domestically refined crude oil products) and the landing cost (for imported refined oil products). These costs are then combined with the operational expenses of the Nigeria National Petroleum Corporation (NNPC). Additionally, the pump price per liter of fuel in Nigeria is influenced by the NNPC's profit margin and the profit margin of marketers.[6]

"The fluctuation in petroleum product prices is closely tied to the rise or fall in oil prices. Prices play a crucial role in the process of transporting food products from producers to consumers and shape the dynamics between suppliers and consumers. However, price instability, particularly in oil prices, stems from shifts in market forces within the oil industry, as observed by Hamilton in 1983. In the context of the Nigerian economy, the international oil market largely influences changes in domestic petroleum prices since the majority of refined products used in the country are imported. This underscores the significance of exchange rates in assessing fluctuations in petroleum product prices in Nigeria.[7]

**2.1.3 The Exchange rate** can be understood as the rate at which one currency is traded for another on the global stage. The prevailing exchange rate commonly used worldwide is the floating exchange rate, also referred to as a flexible exchange rate. This system permits a country's currency to be exchanged for another with flexibility, adjusting according to market forces.[8] Exchange rates are assessed using several methods, including the spot exchange rate, forward exchange rate, real effective exchange rate (REER), and bilateral exchange rate. The spot exchange rate signifies the immediate currency exchange rate in the foreign exchange market, allowing for instant transactions. The forward exchange rate involves an agreement between two parties to exchange currencies at a prearranged rate on a future date, serving as a risk management tool for international transactions. The real effective exchange rate considers the nominal exchange rate alongside a currency's relative price level compared to its trading partners. Bilateral exchange rates gauge the value of one currency relative to another, with the US dollar (USD) being the most commonly used currency in bilateral

exchange rate calculations.[9] It is mandatory to note that the rate of exchange are constantly changing due to a variety of economic and political factors. Therefore, it is essential to rely on up-to-date and reliable sources, such as financial institutions or central banks, when measuring exchange rates for practical purposes.

2.1.4 **Volatility** refers to the occurrence of unforeseeable, swift, precarious, and occasionally abrupt price shifts within the market. It signifies a period of market price fluctuations for a specific product or commodity.[10] Volatility is frequently assessed by calculating the standard deviation or variance to gauge returns within the same market index. The statistical notion of standard deviation enables one to quantify the extent of deviation from the average value. Market volatility is determined by computing the standard deviation of price fluctuations over a specified time frame.[11] Volatility is commonly linked to significant price swings in either direction, and there are various methods for assessing it, including the use of the beta coefficient, option pricing models, and the standard deviation of returns.[12] The persistent rise in food prices in Nigeria is primarily attributed to the volatility in energy prices and the exchange rate of our local currency with the global market.

**2.1.5 Price volatility** denotes fluctuations in prices that have a corresponding impact on the economy.[13] Price represents the monetary value or cost associated with acquiring a product, reflecting what consumers are willing to pay for it at a given point in time. Price serves as a pivotal factor in determining demand, where higher prices correspond to reduced quantity demanded, and vice versa. Consequently, an increase in prices due to factors like fuel price and exchange rates can result in inflation, reduced living standards, and an elevated cost of living for citizens within the economy.[14] The fluctuation in international commodity prices has been a rationale for various policy measures, including the establishment of buffer stocks and counter-cyclical payments. This argument is often substantiated through empirical

evidence, typically employing measures like the standard deviation of prices or the coefficient of variation to assess volatility. Elevated price volatility has been cited as a justification for implementing commodity stabilization initiatives, such as price supports, buffer stock programs, and producer subsidies.[15]

## 2.2 Theoretical review

There are several theories developed to provide explanation on price, which includes price discrimination, price determination, marginal utility theory, cost theory, price elasticity theory and behavioural economics theory. Oil and its derivatives are known to be an essential commodity that powers nearly all the sectors in the economy of Nigeria, volatility in the price of oil and its derivatives; will have a significant effect on agricultural products and pricing. Here are the theories that examine price of commodities in an economy such as Nigeria.

### 2.2.1 Theory of price discrimination

Price discrimination is a pricing strategy employed by businesses to charge distinct prices for the same product or service to different customer segments. The underlying theory of price discrimination posits that by segmenting the market and applying varied pricing, a business can enhance its overall profits and capture a larger portion of consumer surplus. The core concept of price discrimination is rooted in recognizing that customers possess differing levels of willingness to pay for a product or service. By identifying these disparities in willingness to pay, businesses can charge higher prices to customers with a greater willingness to pay, while still serving those who are inclined to pay lower prices. This approach allows businesses to extract more value from their customers and augment their revenue. The theory of price discrimination is typically attributed to Arthur Cecil Pigou, a

British economist who introduced the concept in his 1920 book titled 'The Economics of Welfare.' Pigou examined various forms of price discrimination, as detailed below; [16]

Critics contend that price discrimination may raise concerns of unfairness and introduce market inefficiencies. Common criticisms include:

- Inequity: Price discrimination can result in price disparities among customers, which some view as unjust. Customers with limited ability to pay higher prices may find themselves excluded from accessing certain products or services.
- Market Distortion: Price discrimination can disrupt market competition by enabling businesses to charge varying prices based on customer characteristics rather than the actual cost or value of the product. This can impede market efficiency and diminish consumer welfare.
- Administrative Costs: Implementing price discrimination strategies can be intricate and costly for businesses. It involves segmenting customers, collecting relevant data, and managing pricing structures, which can elevate administrative burdens.[17]

The theory of price discrimination has been propounded by various economists over time. Notable economists who have contributed to the theory include: Arthur Cecil Pigou: An early proponent of price discrimination, Pigou argued that price discrimination could improve economic efficiency by better aligning prices with consumers' willingness to pay. He believed that price discrimination could increase total welfare and benefit both businesses and consumers. Joan Robinson: Robinson's work focused on imperfect price discrimination and market power. She emphasized the importance of market structure and the ability of firms to segment customers in order to extract more profits through price discrimination. Hal Varian: Varian, an economist and information technology expert, explored the role of information and data analysis in implementing price discrimination. He highlighted the significance of

collecting and analyzing customer data to effectively price discriminate. It's important to note that the theory of price discrimination is not universally accepted, and economists have differing views on its merits and drawbacks. Many industries involving client services practice first-degree price discrimination, where a company charges a different price for every good or service sold. Second-degree price discrimination occurs when a company charges a different price for different quantities consumed, such as quantity discounts on bulk purchases. Third-degree price discrimination occurs when a company charges a different price to different consumer groups. For example, a theater may divide moviegoers into seniors, adults, and children, each paying a different price when seeing the same movie. This discrimination is the most common.[18]

According to financial conduct authority of the United Kingdom; price discrimination may encourage competing firms to charge lower prices to win customers and may make all customers better off than uniform pricing. It can also expand the market by allowing customers who might ordinarily be priced out to access the market, but the report also cautions that it can be a sign of weak or distorted competition. Firms can use price discrimination to drive out actual and exclude potential rivals and present barriers to consumers who may want more pricing options.[19]

### 2.2.2 Cost theory

Cost theory is an economic concept that delves into the connection between the production of goods and services. Its objective is to elucidate the mechanisms through which costs are accrued in the production process and the factors that shape these costs. There are several notable authors who have contributed to the field of cost theory; Adam Smith (1723-1790): Although Adam Smith did not solely focused on cost theory but in his book 'The wealth of Nations' laid the foundation for economic theory, including the concept of costs. Adam

Smith emphasized that cost include both explicit expenses e.g. Labour, materials etc and implicit costs e.g. forgone opportunities. Alfred Marshall (1842-1924): Marshall an influential economist delved into cost theory in his book 'Principles of Economics'. He introduced the concept of short run and long run costs, emphasizing the role of supply and demand in determining costs. Joan Robinson (1903-1983): Robinson's work on cost theory, particularly in her book 'The Economics of Imperfect competition', examined the relationship between costs and market structures. She highlighted the impact of market power and imperfect competition on costs. Ronald Coase (1910-2013): Coase's prominent contribution was the theory of transaction costs, in his work 'The nature of the firm', he examined how costs arise due to transactional inefficiencies and explored the role of firms in reducing these costs. Harold Hotelling (1895-1973): Hotelling's research focused on costs related to the extraction and depletion of natural resources known as Hotelling's rule. His work laid the foundation for understanding the interplay between costs, scarcity and resource depletion. It is worth mentioning that cost theory is a vast field with contributions from numerous economists over time. These authors represent a sample of influential figures who have significantly contributed to our understanding of costs and its implications in economy theory.[20]

The determination of the price for a product or service is not easy, several other factors govern it. The theory of cost definition states that the costs of a business, it's highly determined by its supply and spending. The modern theory of cost in Economics looks into the concepts of cost, short-run total and average cost and long-run cost along with economies of scale. The cost of production including employee salaries, raw material cost, fuel costs, rent expenses and all the payments made to the suppliers from the accounting costs.

The modern theory of cost in Economics also specifies economies of scale where an increased production decreases the cost per unit of production. The returns to scale first increase then stabilize for some time and then decrease.[21]

The theory of cost analysis enumerate a period, so short that during this short run period, a company tries to increase its output by changing only the variable factors such as raw materials or labour. The fixed variables remain untouched. The long-run period is where the company can change any factor to obtain desirable outputs as per their interests, ultimately all these factors result in cost.

### 2.2.3 Price Elasticity of demand theory

Price elasticity of demand (PED) is a metric used to gauge the responsiveness of the quantity demanded for a product or service to alterations in its price. This concept aids in comprehending the impact of price variations on consumer behavior and illuminates how supply and demand for a product evolve in response to price changes. Similarly, supply exhibits its own elasticity, termed as price elasticity of supply, which explores the connection between supply adjustments and price fluctuations. Together, these two elasticity measures collaborate to dictate the types of goods produced and their quantities, and the prices at which they are available in the market. [22]

Economists have observed that the prices of certain goods display very low elasticity, meaning that a decrease in price has minimal impact on increasing demand, and an increase in price doesn't significantly reduce demand either. An example of this is fuel, which has a low price elasticity of demand. Consumers, as well as industries like airlines and the trucking sector, tend to continue buying fuel at similar quantities regardless of price changes. On the other hand, some goods are highly elastic, meaning that price fluctuations can result in

substantial shifts in their demand or supply. If the quantity demanded of a product is highly responsive to changes in its price, it is considered elastic. In other words, the demand point for the product shifts significantly from its previous position. Conversely, if the quantity purchased barely changes following a price adjustment, it is classified as inelastic. The quantity doesn't deviate significantly from its previous level. There are several authors who have contributed to the study of price elasticity of demand. Some notable authors in this field include; Alfred Marshall was an influential Economist who extensively studied the concept of elasticity, including price elasticity of demand. His work laid the foundation for understanding consumer behaviour. John Hicks made a significant contribution to the theory of demand elasticity, particularly through his concept of 'compensated elasticity'. He provided valuable insights into the measurement and interpretation of price elasticity. Marshall Jevons was an English economists who explored the relationship between utility theory and elasticity of demand. He emphasized the importance of understanding consumer preference and how they affect price responsiveness. Paul Samuelson a nobel laureate in economics, contributed extensively to the field of micro economics. His book 'Foundations of economic analysis', highlighted the significance of price elasticity of demand in determining market equilibrium.[23]

### 2.2.4 Behavioural Economics theory

Behavioral economics is an interdisciplinary field that integrates principles from psychology, sociology, and other social sciences to gain insights into how individuals and groups make economic decisions. It challenges the conventional assumption of rational decision-making by acknowledging the impact of cognitive biases, social dynamics, and emotions on economic choices. In essence, behavioral economics contends that individuals frequently deviate from the rational, self-interested conduct presumed by traditional economics. Instead,

they exhibit various cognitive biases that can lead to predictable patterns of behavior. These biases encompass phenomena like loss aversion, anchoring, and present bias, each of which influences decision-making in distinct ways. Behavioral economics endeavors to comprehend these biases and incorporate them into economic models to provide a more accurate depiction of real-world decision-making. This approach allows it to elucidate phenomena that traditional economics might struggle to explain, such as apparently irrational choices by individuals or instances where markets do not reach optimal outcomes.

However, critics of behavioral economics raise several concerns:

- Lack of Predictive Power: Some critics contend that behavioral economics lacks the predictive capabilities of traditional economics. They argue that by concentrating on individual biases, it may overlook the intricacies of economic systems and may not consistently forecast outcomes.
- Subjectivity and Value Judgments: Critics also assert that behavioral economics can be subjective and influenced by value judgments. The identification and interpretation of biases may differ among researchers, leading to varying conclusions and policy recommendations.
- Overemphasis on Biases: Some critics propose that behavioral economics tends to overemphasize the impact of biases on economic behavior. They argue that individuals often exhibit rational decision-making and that biases may be less widespread or influential than suggested by proponents of behavioral economics.[24]

**Notable proponents of behavioral economics include:**

Daniel Kahneman: Kahneman, along with the late Amos Tversky, is considered one of the pioneers of behavioral economics. Their research on cognitive biases and prospect theory,

which challenges the rationality assumption in decision-making, earned Kahneman the Nobel Prize in Economics in 2002. Richard Thaler: Thaler is known for his work on behavioral finance and the concept of "nudges." He has argued that policymakers can design choice architectures that guide individuals towards better decisions without restricting their freedom of choice. Thaler received the Nobel Prize in Economics in 2017. Dan Ariely: Ariely has conducted extensive research on irrational behavior and the impact of social norms on economic decisions. He has written several popular books, such as "Predictably Irrational," which apply behavioral economics concepts to everyday life. These are just a few prominent figures in the field, and behavioral economics has gained recognition and influence among economists and policymakers around the world. Several principles have emerged from behavioural economics research that has helped economists better understand human economic behaviour. From these principles, governments and businesses have developed policy frameworks to encourage a person to make particular choices which in behavioural economics calls a 'Nudge'. A 'nudge' is a way to manipulate people's choices to lead them to make specific decisions or choices; for example, putting fruit at eye level or near the cash register at a high school cafeteria is an example of a "nudge" to get students to choose healthier options. An essential aspect of nudges is that they are not coercive; banning junk food is not a nudge, nor is punishing people for choosing unhealthy options.[24]

### 2.2.5 Price Determination Theory

The theory of price determination seeks to explain how prices are determined in a market economy. One of the most influential theories in this regard is the neoclassical theory of price, also known as the theory of supply and demand. This theory was developed by a number of economists, but it is primarily associated with the work of Alfred Marshall. According to the theory of supply and demand, prices are determined through the interaction of supply and

demand in a competitive market. Here are the key elements of the theory; demand refers to the quantity of a good or service that consumers are willing and able to buy at a given price, during a specific period of time. It is influenced by factors such as consumer preferences, income levels, prices of related goods, and expectations about the future. The law of demand states that as the price of good increases, the quantity demanded decreases vice versa. Supply refers to the quantity of a good or service that producers are willing and able to offer for sale at a given price, during a specific period of time. It is influenced by factors such as production costs, technology, input prices, and expectations about future prices. The law of supply states that as; the price of a good increase, the quantity supplied increases and vice versa. Equilibrium: The equilibrium price and quantity are determined at the point where the demand and supply curves intersect. This is known as the market equilibrium. At this price, the quantity demanded equals the quantity supplied, and there is no excess demand or supply in the market. Changes in Price: If there is a change in either demand or supply, it will result in a shift of the respective curve. For example, an increase in demand will lead to a higher equilibrium price and quantity, while a decrease in demand will lead to a lower equilibrium price and quantity. Similarly, changes in supply will also affect the equilibrium price and quantity.[25]

Alfred Marshall, a British economist, is considered one of the main authors of the neoclassical theory of price determination theory. He developed these ideas in his influential book "Principles of Economics," published in 1890. Marshall's work laid the foundation for modern micro economic theory and greatly contributed to the understanding of price determination in markets. In a free market economy, producers typically want to charge as much as they reasonably can for their goods and services, while consumers want to pay as little as they can to obtain them. Market forces will cause the two sides to meet somewhere in the middle, at the price consumers are willing to pay and the producers are willing to accept.

When the quantity of a good or service that's available matches the demand of potential consumers for it, the market is said to achieve equilibrium. The concept of price theory allows for price adjustments as market conditions change. Equilibrium price occurs when the total number of items available in the market (supply), equates the total number of items that can be consumed by potential customers. If a price is too high, customers may avoid the goods or services or find other alternatives. This would result in excess supply and possibly cause producers to lower prices. In contrast, if a price is too low, demand may significantly exceeds the available supply, causing prices to rise again. The optimal price, taking into account both supply and demand, is also referred to as the clearing price. A market price is not necessarily a fair price, it is merely an outcome. It does not guarantee total satisfaction on the part of buyer and seller. Typically, some assumptions about the behaviour of buyers and sellers are made, which add a sense of reason to a market price. For example, buyers are expected to be self-interested and, although they may not have perfect knowledge, at least they will try to look out for their own interests. Meanwhile, sellers are considered to be profit maximizers. This assumption limits their willingness to sell to within a price range, high to low, where they can stay in business. When either demand or supply shifts, the equilibrium price will change. The example below explains why a market component may move when supply or demand shifts occur. When a bumper develops, supply shifts outward and downward, which means more product is available over the full range of prices. With no immediate change in consumers' willingness to buy, there is a movement along the demand curve to a new equilibrium. Consumers will buy more but only at a lower price. How much the price must fall to induce consumers to purchase the greater supply depends upon the elasticity of demand.[26]

Two forces contribute to the size of a price change: the amount of the shift and the elasticity of demand or supply. For example, a large shift of the supply curve can have a relatively

small effect on price if the corresponding demand curve is elastic. In fact, the elasticity of demand and supply for many agricultural products are relatively small when compared with those of many industrial products. This in-elasticity of demand has led to problems of price instability in agriculture when either supply or demand shifts in the short-term. The examples above focus on factors that shift supply or demand in the short-term. However, longer-term forces are also at work, which shift demand and supply over time. One particular supply shifter is technology. A major effect of technology in agriculture has been to shift the supply curve rapidly outward by reducing the costs of production per unit of output. Technology has had a depressing effect on agricultural prices in the long-term since producers are able to produce more at a lower cost. At the same time, both population and income have been advancing, which both tend to shift demand to the right. The net effect is complex, but overall the rapidly shifting supply curve coupled with a slow moving demand has contributed to low prices in agriculture compared to prices for industrial products. At various levels of a market, from farm gate to retail, unique supply and demand relationships are likely to exist. However, prices at different market levels will bear some relationship to each other. For example, if hog prices decline, it can be expected that retail pork prices will decline as well. This price adjustment is more likely to happen in the long-term once all participants have had time to adjust their behaviour. The three major pillars of pricing strategy are cost and profit objectives, customer demand, and competition. The major goal is to persuade clients that this product is indeed worth its price. To determine to price, sum all of the costs together and deduct any other sources of revenue: this is the minimum profit you'll need to break even, thus this is the starting point. To calculate the maximum selling price, think about both clients and the demand for their goods. Now that a pricing range has been established, apply profit targets and competitor information to determine the ideal price. In principle, the notion is simple, but in practice, one must account for market factors and undercutting competition.

Constant adjusting and monitoring are required to strike a balance between competitive prices and maximum revenue.[27]

### 2.3 Empirical review

Several papers have discovered that increase in fuel price and exchange rate could account for a decline in the growth of gross domestic product (GDP) and an increase in the level of inflation rate. This section reviews the measurement used by different authors to enumerate the effects of volatility in fuel prices and exchange rate on food production and prices in Nigeria. They also inform and recommend the causes and remedy for fuel price volatility and exchange rate, its implications on food production and prices in Nigeria;

#### 2.3.1 Implications of fuel price volatility and exchange rate on food prices

This study utilizes data from Iran to investigate the short- and long-term effects of exchange rates and energy prices on food production and prices. Using Iran as a pertinent case study, recent years have witnessed a significant rise in both fuel and food costs for its consumers. The study employs ten food product prices, exchange rates (the value of the Iranian rial per US dollar), and petroleum prices as variables. It applies panel unit root tests, Pedroni co-integration tests, as well as estimation techniques like Pooled Mean Group (PMG), Mean Group (MG), and Dynamic Fixed Effects (DFE) to a panel of monthly prices for ten food products covering the period from March 1995 to February 2018. The results indicate that both in the short and long term, food prices tend to increase in response to rising energy prices. Additionally, the findings suggest that the appreciation of the United States Dollar (USD) concerning the Iranian rial has a positive and noteworthy influence on food prices in the long run.[28]

The study investigated the influence of oil prices, real GDP, and exchange rates on the fluctuation of food prices in Malaysia. It utilized quarterly data spanning from the first quarter of 2000 to the second quarter of 2016 and employed the asymmetric unrestricted non-linear autoregressive distributed lag (NARDL) model. The bound test for co-integration revealed a significant long-term relationship among the variables and fluctuations in food prices. However, it was observed that oil prices exert a symmetric long-term effect on food price fluctuations, while GDP and exchange rates have an asymmetric long-term impact on food price movements. In the short term, oil prices were found to have an insignificant influence on food price volatility, while both GDP and exchange rates exhibited a significant impact on changes in food prices. As a result, the study recommends that policymakers should pay more attention to the exchange rate factor as opposed to oil price volatility when formulating policies.[29]

The paper examined the sensitivity of food prices to variations in petroleum prices and exchange rates in Ghana over the period from January 1997 to August 2017. To provide a comprehensive analysis, interest rates were also included as a control variable, considering their potential impact as a macroeconomic policy tool. The study employed various analytical methods, including Johansen co-integration procedures, vector error correction models, impulse response functions, and BEKK-GARCH estimations. The results of the study revealed a positive and significant long-term as well as short-term relationship between food prices and all the macroeconomic variables considered in the model. In other words, an increase in petroleum prices, exchange rates, and interest rates was associated with higher food prices in Ghana. Furthermore, the study found that the effects of food price spikes triggered by shocks in petroleum prices, exchange rates, and interest rates were enduring and did not dissipate quickly over time. Based on these findings, the study recommends that policies aimed at stabilizing food prices should involve the establishment of national

petroleum buffer stocks to mitigate fuel price fluctuations, enhanced management of exchange rates and interest rates, the creation of district, regional, and national food buffer stocks, targeted fuel subsidies for crop farmers and food processors, and the removal of obstacles in the food marketing system.[30]

Through the application of the GARCH model (Generalized Auto-regressive Conditional Heteroscedasticity), the analysis revealed two distinct conditions. Firstly, it was evident that current information regarding the volatility of oil prices, exchange rates, and inflation significantly predicts their future volatility in Nigeria. Secondly, the study found that Nigerians are more responsive to information concerning the stability of oil prices, exchange rates, and inflation than they are to factors determining oil prices and inflation theories. This study underscored the pivotal role of the media in forecasting and reporting exchange rates and inflation rates in Nigeria. Given that the exchange rate has a positive impact on the price level, as well as on the increased domestic production and consumption of goods made in Nigeria, it is imperative for both the government and the media to effectively manage the dissemination of information about the depreciation of the Nigerian currency. This is essential as a preventative strategy to mitigate a sharp increase in demand for the United States Dollar (USD).[31]

The study assessed the pivotal macroeconomic factors influencing food production and price inflation in Nigeria. It investigated the impacts of exchange rates, money supply, and crude oil prices on food production (and consequently food prices) in Nigeria, utilizing data spanning from 1980 to 2018, sourced from the World Bank and the Central Bank of Nigeria. The data underwent analysis using the Auto regression and distributed lag (ARDL) model, which revealed the presence of a long-term relationship among the variables. In the short term, food production, exchange rates, money supply, and crude oil prices displayed

significance, while in the long term, all variables, except for food prices, remained significant. The study offers recommendations aimed at boosting food production, including the provision of loans coupled with prudent increases in money supply, vigilant monitoring of agricultural loan utilization, and robust measures to safeguard the Naira from excessive depreciation.[32]

The study aimed to identify specific thresholds beyond which changes in oil prices could significantly impact agricultural growth in South Africa. The variables examined in this analysis encompass foreign direct investment, exchange rates, and money supply. The study revealed that the influence of exchange rates and foreign direct investment on agricultural growth is positive, while the impact of money supply is negative. Given South Africa's limited reserves of crude oil, the study recommends that policymakers consider pursuing bio-fuel production as an alternative strategy to stimulate agricultural growth. Bio-fuels can be derived from agricultural plants, and their prices may be locally regulated to favor the agricultural sector, particularly during periods of oil price shocks. Additionally, the paper proposes the provision of incentives to farmers in the form of grants or loans to encourage year-round production, as well as the reduction of import duties on agricultural equipment and inputs.[33]

The study examined the impact of oil price shocks on agricultural commodity prices in Nigeria by analyzing monthly data on oil prices, maize, soya beans, and the exchange rate from 1997 to 2016. The analysis utilized both linear Auto-regression distribution lag (ARDL) and non-linear Auto-regression and distribution lag (ARDL) models, both with and without breaks. An asymmetric test employing the Wald statistic indicated the presence of asymmetries in all cases, signifying that positive and negative oil shocks of the same magnitude did not produce equal effects on agricultural commodity prices. The findings of

the study demonstrated a significant positive relationship between oil price shocks and agricultural commodity prices, indicating that an increase in oil prices leads to a corresponding increase in agricultural commodity prices. Similarly, the exchange rate exhibited a significant positive relationship with agricultural commodity prices. In conclusion, the study asserts that oil prices have an overall positive relationship and a significant impact on agricultural commodity prices. Consequently, it recommends efforts to enhance local development in the oil sector, as this will generate positive spillover effects on the agricultural sector. This includes the production of essential agricultural inputs such as herbicides, pesticides, insecticides, and fungicides, which play a critical role in eradicating pests that can damage agricultural products. This, in turn, ensures food availability at affordable prices, contributing to an improvement in living standards and overall welfare.[34]

The study aimed to investigate the factors influencing food price inflation in Malaysia, and it employed the Nonlinear Auto-Regressive Distributed Lag (NARDL) technique to assess the linearity and symmetry of the variables under scrutiny. The results of the study indicated the existence of long-term co-integration among the variables examined. The Vector Error Correction Model (VECM) and Variance Decomposition analysis pointed to the exchange rate as the most exogenous variable. Furthermore, the NARDL approach revealed that the relationship between food prices and the exchange rate exhibited symmetry in the long term but asymmetry in the short term. Given that the exchange rate is the most exogenous factor in the study, and considering Malaysia's adoption of a flexible exchange rate regime, policymakers face challenges in controlling fluctuations in the Malaysian exchange rate to manage food prices effectively. In conclusion, the study suggested that efforts to adjust and control food prices should focus on reducing food imports, thereby mitigating the pass-through effect of exchange rate fluctuations on food price inflation.[35]

This study focused on assessing the spillover effects of oil price volatility on food prices in both rural and urban areas of Nigeria. It aimed to understand the disparities in spending patterns between these areas and how oil price volatility influenced food prices. The study employed the GARCH (1, 1)-TY model to analyze the impulse response function and variance decomposition of these effects on food prices during both the pre-crisis and post-crisis periods. The study's findings revealed that in the post-crisis period, both aggregate food prices (APF) and urban average food prices (APFU) exhibited a positive response to oil price shocks. However, rural average food prices (APFR) responded negatively to such shocks. As a result, the study recommends that policymakers should develop distinct policy frameworks to mitigate the impact of oil price shocks on food prices in rural and urban areas. Notably, these shocks tend to have a more significant effect on urban areas than on rural areas.[36]

This study aimed to examine the factors influencing food inflation in Indonesia, utilizing quarterly data spanning from 2008Q1 to 2017Q4 and employing the GMM estimator. The results indicated that both backward-looking and forward-looking expectations exerted a substantial influence on food inflation. Additionally, various factors such as food production, agricultural sector output, infrastructure, food imports, agricultural sector credit, demand levels, and seasonal events (holidays) were identified as significant determinants of food inflation in Indonesia. Notably, backward-looking and forward-looking expectations, domestic oil prices, and demand levels played a noteworthy role in driving high food prices.[37]

The study delves into the intrinsic connections between vital demand and supply factors, including GDP, the price of crude oil, food imports, and food price inflation in Nigeria. It spans the period from 1988 to 2017 and employs a co-integration and error correction modeling framework. The findings of the study revealed that the price of crude oil, food imports, and real GDP exhibit a long-term positive relationship with food price inflation.

However, real GDP and food imports emerged as the primary determinants of food price inflation. The Error Correction Model (ECM) indicated a gradual adjustment process. As a result, the study recommends a focus on bolstering domestic agricultural production by supplying agricultural inputs rather than cash as a policy incentive. Additionally, it's important to note that expanding the scope of the study could provide a more comprehensive and representative understanding of the dynamics at play.[38]

The study examined the factors influencing inflation through the co-integration approach and found that past total exports and imports (with opposite signs) and the food price index had a significant impact on inflation in Nigeria. The study recommended the implementation of policies to maintain a moderate interest rate level, which would encourage investment and boost production. Furthermore, it suggested reducing importation, enhancing the efficiency of the exchange rate system, and promoting domestic consumption of petroleum products as measures to control inflation in Nigeria.[39]

The study employed an auto-regressive distributed lag (ARDL) method to model the connection between oil prices and global food prices, using weekly data spanning from March 1983 to February 2010. The study's findings demonstrated that alterations in grain prices are notably impacted by shifts in crude oil prices.[40]

"Conversely, a similar study examining the connection between crude oil prices and global food prices identified a direct correlation between oil and food prices. This study utilized a vector error correction model (VECM) and analyzed monthly data encompassing world crude oil, wheat, rice, sugar, soybean oil, cocoa, coffee, and soybeans from July 1989 to February 2010. The findings of this study revealed that changes in oil prices have substantial long-term effects on food prices. While the well-established positive relationship between oil and food

prices is supported by the literature reviewed, it is important to note that existing empirical evidence on this topic varies considerably.[41]

In a study investigating the correlation between oil prices, exchange rates, and commodity prices in the United States, conducted by Harri, Nalley, and Hudson, a Vector Error Correction Model (VECM) was utilized. The study analyzed monthly data spanning from January 2000 to September 2008. The findings indicated that commodity prices exhibit a connection with oil prices for corn, cotton, and soybeans, while such a linkage is not observed for wheat. Moreover, the study revealed that exchange rates do contribute to the connection between prices over time.[42]

"Nonetheless, in a study examining the correlation between the escalating crude oil prices and the growth of the United States current account deficit, as conducted by Abbott, Hurt, and Tyner, it was noted that the consistent rise in oil prices since 2004, coupled with the simultaneous devaluation of the U.S. dollar relative to the currencies of many high and low-income countries, led to an increase in corn prices in the U.S. This was due to the depreciating dollar resulting in more affordable corn exports to countries like China and India.[43]

The study explored the connection between changes in petroleum product prices, exchange rates, and the prices of food items in Nigeria. It utilized monthly data spanning from January 2010 to December 2021. To assess the stationarity of the variables, the Augmented Dickey Fuller (ADF) unit root test procedure was applied, and the data was analyzed using Auto-Regressive Distributed Lag Models (ARDL). The ARDL estimation results revealed compelling evidence that the prices of Premium Motor Spirit (PMS) and the exchange rate have a significant positive impact on the prices of food items in Nigeria, both in the short run and the long run. As a result, the study recommends that the government should consider a

gradual approach to subsidy removal on PMS, rather than an abrupt total removal, to mitigate further increases in the prices of food items and other commodities in the country.[44]

The study examined the impact of fluctuations in the dollar exchange rate on food commodity prices in several African countries from 1990 to 2021. It employed GARCH analysis to assess the prevalence of exchange rate and interest rate volatility in selected African nations. Additionally, the study conducted static and dynamic analyses using panel least squares and the generalized method of moments (GMM) estimators on panel data from several commodity-exporting African countries, including Ghana, Gabon, Tunisia, Nigeria, and South Africa. The dynamic GMM results revealed that variations in exchange rates and interest rates had a positive influence on commodity prices. The GARCH estimates demonstrated a substantial increase in volatility, using both normal and t multivariate distributions. However, based on empirical findings, the t-distribution yielded the highest maximized log-likelihood of -8920.1 and had a satisfactory degree of freedom of 26.82 (which is less than 30). The results further indicated that the Nigerian Naira exhibited the highest coefficient of volatility at approximately 71.2%. Following that, the Ghanaian Cedi had a negative volatility rate of 71%, and the South African Rand had a coefficient of 65%. Notably, while all countries demonstrated negative volatility concerning interest rates, all countries except Ghana exhibited positive volatility in the exchange rates of their currencies. Ghana, Gabon, Tunisia, and Nigeria displayed negative exchange rate volatility.[45]

This study aims to assess the impact of exchange rate volatility on agricultural commodity prices in Nigeria. Additionally, it investigates whether exchange rate volatility has a symmetric or asymmetric effect on agricultural commodity prices in Nigeria. To account for the complex behavior of volatility, including non-linearity and time-varying risk, the study employed the Non-linear Auto-Regressive Distributed Lag (NARDL) model. The analysis

used monthly data encompassing real effective exchange rates, agricultural output prices, inflation rates, and Real Gross Domestic Product (RGDP) from 2000 to 2018. The study revealed a significant and positive relationship between both positive and negative changes in the exchange rate and agricultural commodity prices. Furthermore, it found that the inflation rate had a negative effect on agricultural commodity prices, while RGDP had a positive effect on them.[46]

The study aimed to determine whether prices respond symmetrically or asymmetrically to movements in both official and parallel exchange rates. To investigate this, the study analyzed the impact of domestic prices in response to changes in both official and parallel exchange rates from 1995 to 2019, utilizing Shin et al.'s (2014) non-linear Auto-Regressive Distributed Lag (ARDL) approach. The findings indicated that the influence of parallel exchange rates on domestic prices was greater than that of the official exchange rate in a symmetric scenario. However, domestic prices responded differently to the depreciation and appreciation of the official exchange rate in Nigeria. Therefore, the study suggests that the government should consider implementing fiscal austerity measures and, if necessary, exchange rate unification when the premium on parallel exchange rates becomes excessively large. This could help shield domestic prices from fiscal pressures.[47]

The study aimed to investigate the relationship between food and oil prices using an advanced econometric technique called Quantile on Quantile Regression (QnQ). The analysis utilized monthly data spanning from January 1993 to September 2020. To gain a comprehensive understanding, the study categorized oil prices into supply and demand shocks and food price indices into sub-indices such as Meat Price Index (MI), Dairy Price Index (DI), Cereal Price Index (CI), Sugar Price Index (SI), Corn Price Index (COPI), Soybean Price Index (SOPI), and Wheat Price Index (WOPI). The findings revealed a

positive association between food prices and the various indices across different quantiles. In the case of an oil demand shock, a stronger relationship was observed between the extremely high and low quantiles, particularly in dairy, meat, and food indexes. Corn, soybean, and wheat showed a stronger relationship in the lower quantiles. Concerning oil prices, a stronger relationship was noted in the extremely low quantiles, especially in cereal, dairy, meat, and corn price indexes. Conversely, a stronger relationship was observed between the extremely low and high quantiles in the food price index. With respect to the oil supply shock, a stronger relationship was observed in the extremely low quantiles for cereal and dairy indexes, and in the extreme middle quantiles for food prices. Corn, soybean, and wheat prices showed a stronger relationship in the extreme middle quantiles. The results confirm variations in the dependency of variables, with extremely positive effects noted in the lower and middle quantiles. This study's outcomes can assist policymakers in the agricultural sector in formulating robust and comprehensive policies to mitigate the impact of fuel prices on food prices.[48]

The study aimed to assess the volatility in prices of essential staple foods using the GARCH (Generalized Auto-Regressive Conditional Heteroskedasticity) approach and to identify the driving factors behind this volatility over the period from 1970 to 2019. The results of the study demonstrated that there was consistent volatility in food prices during this time frame. Several factors were identified as key drivers of this volatility, including insurgency, political stability in neighboring countries, trade liberalization, GDP per capita, inflation rate, government effectiveness, crop production, crude oil price, and exchange rate fluctuations. Based on these findings, the study recommends several measures. First, it emphasizes the importance of maintaining peace and stability within the nation to support sustainable and increased agricultural production. Second, the study suggests the need for better regulation of cross-border food trading activities. Third, it advises a reconsideration of price stabilization

policies and government interventions, particularly in the pre-liberalization era. Finally, it underscores the importance of adopting a holistic approach to economic planning, given the significant influence of macroeconomic variables on food price volatility.[49]

The study aimed to examine the extent and directions of returns and volatility spillover transmission between exchange rates and domestic food prices in Nigeria. It utilized weekly data spanning from January 2010 to January 2019 and employed the enhanced approach proposed by Diebold and Yilmaz in 2012 to assess these relationships. The study discovered evidence of directional interdependence among the various food prices and exchange rates, as indicated by the obtained spillover index.[50]

"The paper conducted an extensive analysis of the transmission of oil price movements to local price returns in Nigeria, covering the period from January 1995 to May 2019. The findings illustrate that the impact of oil price volatility on food prices exhibits variations across different time frequencies. The results indicate a rapid and direct transmission of oil price shocks to food prices, with limited spillover effects in the short run.[51]

The study adds to the ongoing food security discourse by examining the factors influencing domestic food prices in Nigeria. Employing VAR (Vector Auto-Regression) methodology, GARCH, and panel models, the research revealed that global food prices, as well as exchange rates and local petrol prices, exhibit a substantial and positive impact on food price volatility.[52]

The research investigates the interrelationships between oil price and foreign exchange rate returns with the prices of specific agricultural products. It employs the innovative NOVEL methodology introduced by Diebold and Yilmaz in 2012 to predict and measure the directional volatility spillover from oil prices to food prices in Nigeria.[53]

The study utilizes a panel estimation method to examine the dynamic relationship between oil price volatility and agricultural commodity prices, encompassing various commodities like cocoa, coffee, wheat, palm oil, soya beans, beef, and more. The dataset covers the years 2006 to 2015 and incorporates an indicator for the effective exchange rate.[54]

This study investigates the influence of oil price shocks on inflation in Nigeria. It employs a Non-Linear Auto-regressive Distributed Lag (NARDL) approach, analyzing quarterly data spanning from 1999Q1 to 2018Q4. The findings indicate that rising oil prices lead to an increase in various inflation measures in Nigeria, including headline, core, and food inflation. Conversely, a decrease in oil prices lowers the marginal cost of production, resulting in a moderation of domestic inflation. Furthermore, when exchange rates are removed from the models, negative oil price shocks lead to higher inflation in Nigeria, highlighting the role of exchange rates in mitigating the impact of declining oil prices earlier, particularly as they contribute to reduced external reserves, Naira depreciation, and elevated inflationary pressures. Core inflation responds more significantly to oil price increases than food inflation. These results remain robust across various econometric specifications and sample periods. The study suggests that the Central Bank of Nigeria should prioritize controlling core inflation during periods of substantial oil price increases and reinforce efforts to enhance domestic food production sustainability through agricultural intervention programs to reduce the impact of global oil price fluctuations on food inflation.[55]

This study investigated the impact of exchange rate volatility on inflation in Nigeria, utilizing annual time series data from 1986 to 2019. To achieve this, the study employed the Generalized Auto-regressive Conditional Heteroskedasticity (GARCH) and Vector Error Correction Model (VECM) to assess the long-term effects of exchange rate volatility on inflation. The dependent variable was represented by the Consumer Price Index, while the

independent variables included the nominal exchange rate (NER), money supply (MS), imports (IMP), and exports (EPT). Stationarity tests indicated that the variables exhibited mixed orders of integration, and bounds tests for co-integration confirmed the existence of a long-term relationship among these variables. The findings revealed that both money supply (MS) and nominal exchange rate (NER) had a positive and significant influence on the Consumer Price Index. This implies that fluctuations in exchange rates and an increase in money supply contribute to inflation in Nigeria. Based on these findings, the study recommends that the central bank should implement measures to control the growth of money supply, aiming to reduce inflation to the lowest possible level.[56]

### 2.3.2 Implications fuel price volatility on food prices

This study investigated the impact of exchange rate volatility on inflation in Nigeria, utilizing annual time series data from 1986 to 2019. To achieve this, the study employed the Generalized Auto-regressive Conditional Heteroskedasticity (GARCH) and Vector Error Correction Model (VECM) to assess the long-term effects of exchange rate volatility on inflation. The dependent variable was represented by the Consumer Price Index, while the independent variables included the nominal exchange rate (NER), money supply (MS), imports (IMP), and exports (EPT). Stationarity tests indicated that the variables exhibited mixed orders of integration, and bounds tests for co-integration confirmed the existence of a long-term relationship among these variables. The findings revealed that both money supply (MS) and nominal exchange rate (NER) had a positive and significant influence on the Consumer Price Index. This implies that fluctuations in exchange rates and an increase in money supply contribute to inflation in Nigeria. Based on these findings, the study recommends that the central bank should implement measures to control the growth of money supply, aiming to reduce inflation to the lowest possible level.[57]

For the past four decades, oil has remained a primary source of revenue, energy, and foreign exchange earnings for the Nigerian economy. Nigeria's heavy reliance on oil, however, has exposed the country to economic vulnerabilities due to the inherent volatility in oil prices. This study delved into the analysis of the relationship between oil price volatility and the performance of various economic sectors in Nigeria, spanning the years 1970 to 2018. Granger causality tests and the ARDL model were employed as estimation techniques. The study's findings revealed that the impact of oil price volatility, specifically the domestic pump price of gasoline, and the exchange rate, is evident in both the short run and long run. In contrast, the influence of inflation and the monetary policy rate is a long-term phenomenon. Notably, oil price volatility, the exchange rate, and monetary policy have a positive and significant impact on other economic sectors over the long term. Based on these results, the study recommends diversifying Nigeria's economy by reducing its dependence on oil and fostering the growth of other thriving sectors, such as agriculture and industry. It also suggests that the government should consider reducing the domestic pump price of gasoline through the deregulation of the downstream sector, while simultaneously encouraging private sector participation in oil refining to stimulate healthy competition and bring down fuel prices. Addressing exchange rate variability, the findings propose the development of a systematic exchange rate policy through monetary measures to promote price stability in the food sector and overall economic growth in Nigeria.[58]

The study primarily focuses on human welfare and the satisfaction of fundamental needs, which encompass essentials like food, beverages, shelter, and clothing – the basic necessities of life. It reaches the conclusion that an increase in prices of petroleum motor spirit (PMS) and dual-purpose kerosene (DPK) leads to a subsequent increase in the inflation rate, resulting in a decline in the standard of living and human welfare, and vice versa. The study employed the Auto-Regressive Distributive Lag (ARDL) method, along with a collection of

time series data, to establish a robust connection between human welfare, encompassing food and other fundamental aspects of life, and oil-derived products such as PMS and DPK. This suggests that a surge in fuel prices directly impacts human welfare, subsequently diminishing the standard of living and elevating the cost of living in the economy. [59]

This thesis delved into the determinants of oil price volatility in African oil-exporting countries within OPEC. Employing the pooled mean group Auto-Regressive Distributed Lag model, the study unveiled that oil price volatility significantly impacts inflation in these countries over the long term, but this impact varies in the short term. As a result, the thesis advocates for diversification in African oil-exporting nations, emphasizing the development of alternative sectors such as manufacturing and agriculture to bolster exports and foreign exchange earnings. Furthermore, the study underscores the importance of implementing effective programs to ramp up food production, particularly during periods of elevated oil prices. Encouraging private sector involvement in agriculture and other economic activities, as well as exploring various policy tools to combat inflation and enhance economic performance, is also recommended.[60]

The thesis highlighted the inherent volatility in agricultural commodity prices, utilizing GARCH (1,1) for the analysis. The study established that oil shocks exert a significant short-term influence on the volatility of certain food prices in Nigeria. Consequently, government intervention is deemed necessary to mitigate this price variability, ensuring that it remains at a manageable level and does not pose a threat to farmers or food security in the nation. These interventions could involve enhancements in the market information system, which would help reduce market speculations, price fluctuations, and uncertainty, and prove especially valuable during periods of food crises. Therefore, the government is advised to focus on controlling the pump prices of refined oil products, optimizing the operation of refineries,

promoting the use of alternative energy sources, and advocating for the adoption of organic fertilizers. These measures will help counter the impact of high oil and food prices.[61]

The study delves into the co-integration among the key variables utilized in the analysis, namely food production, oil price, trade openness, and inflation. It employs a non-linear panel Auto-regressive Distributed Lag (ARDL) model. The outcomes of the estimation reveal the presence of asymmetry in the behavior of food prices, particularly in the long run. The study primarily examines the effects of oil price changes on food prices within oil-exporting developing nations. The results indicate that an increase in oil prices tends to result in higher food prices in the long run, while a decrease in oil prices does not necessarily lead to a reduction in food prices over the long term. Neither oil price increases nor reductions appear to have an immediate impact on food prices. Therefore, the study recommends that oil-exporting developing countries should develop and implement long-term agricultural policies to buffer their economies from potential global food crises that may arise due to fluctuations in oil prices. Moreover, it is advised that governments take measures to ensure stability in oil prices, as it is believed that an increase in oil prices can trigger a chain reaction of higher food prices and inflation in the economy.[62]

In the journal article titled 'The Relationship between Oil and Food Prices in the European Union,' the author utilizes 228 monthly observations spanning from 2001 to 2019. The study employs an Ordinal Least Squares regression model for estimation and analysis. The results reveal a statistically significant, albeit economically inconsequential, impact of oil prices on the prices of food in the European Union. Consequently, the study concludes that oil prices do not directly affect food prices in European Union countries. Furthermore, the author points out that there was an increase in the demand and consumption of food in the year 2020, as reported by the European Institute of Innovation and Technology. This increase in food

demand was linked to the significant changes in both oil and food demand during the economic shock caused by the COVID-19 pandemic. The study suggests that individual behaviors might be influenced by the collective behavior of others.[63]

This study investigates the relationships between energy prices and food prices by employing a Vector Auto Regression (VAR) model, focusing on eight Asian economies during the period from 2000 to 2016. The findings of this study reveal that energy prices exert a significant influence on food prices, particularly within the agricultural sector. It is observed that shocks in oil prices lead to a positive response in agricultural food prices. Furthermore, the study emphasizes that inflation in oil prices poses a threat to food security. To mitigate this risk, diversification away from heavy reliance on fossil fuels is recommended. The ideal approach involves transitioning towards a balanced combination of renewable and non-renewable energy sources, which would enhance both energy and food security. The paper highlights that the impact of biofuel prices on food prices is statistically significant, implying that an increase in biofuel demand can adversely affect the prices of agricultural products, thereby jeopardizing food security, particularly in vulnerable and developing economies. Additionally, it was discovered that oil prices, a key component driving food price fluctuations, have both short and long-term positive effects on the volatility of agricultural food prices. This heightened impact of oil price fluctuations on agricultural products is attributed to the growing dominance of industrialized agriculture in both farming and production processes.[64]

### 2.3.3 Divergent views of fuel price volatility and exchange rate on food prices.

The thesis highlights that even though different countries respond distinctively to fluctuations in oil prices, it is not guaranteed that countries with similar experiences will exhibit identical reactions. This suggests that the presence of asymmetry results in varying responses among

countries sharing common tendencies. The thesis employed a non-linear auto-regressive distributed lag model for its analysis, and the estimations indicated that, for oil-exporting nations, the direction of this asymmetry was negative at lower quintiles. These findings support Hamilton's assertion that "significant changes in oil prices are required to have an impact on inflation.[65]

The analysis results reveal that it is inaccurate to assume that changes in oil prices have significant and uniform effects on countries worldwide. This discrepancy arises from the differences in income levels, financial development, and energy legislation among nations. As a consequence, alterations in oil prices impact these economies in distinct ways. Additionally, the study uncovers that fuel price increases do not consistently affect food prices in certain countries across the globe, which may not necessarily lead to inflation.[66]

The regression analysis reveals a distinct relationship between oil and food prices. It suggests that neither the exchange rate nor the total exports of the European Union significantly and substantially affect food prices. However, the unemployment rate demonstrates both a statistically significant and economically impactful relationship with food prices. Consequently, the study recommends that policymakers should prioritize policies aimed at enhancing the agricultural and food industry to mitigate high food prices. It also suggests that less emphasis should be placed on oil prices unless there are substantial infrastructure challenges within the country.[67]

This paper utilized an Auto-regression Distributed Lag (ARDL) model covering the period from 2001 to 2016 and examined a sample of 21 countries that are both food-importing and oil-exporting economies. The study revealed that a negative relationship between oil prices and food prices exists in the short run, while a direct relationship is observed in the long run. Moreover, the research established that causality between oil prices and food prices is

unidirectional, with causality originating from food prices to oil prices. This suggests that the agricultural market plays a significant role in driving the energy markets in the sampled countries. For instance, Nigeria exported 3.2 million tons of cassava to China in 2013 for industrial use (Premium Times, 2013). Such substantial export demand can artificially create food scarcity and lead to price increases if precautionary measures are not implemented. In light of these findings, the paper recommends that policymakers in developing oil-exporting countries should prioritize the implementation of appropriate agricultural policies aimed at promoting favorable food prices and ensuring a stable food supply. These policies could include providing incentives to enhance food production, such as offering fertilizers, credit facilities, seedlings, and farming equipment to farmers, among other measures.[68]

The study examined the relationship between food price inflation and a macroeconomic index by utilizing principal component analysis and VAR Granger causality test. The research employed monthly data spanning from 1961 to 2005, focusing on various food categories, including eggs, meat, milk, oilseeds, rice, sugar, and wheat. The macroeconomic variables under consideration encompassed crude oil prices, the consumer price index, and the food price index. The results of the analysis indicated a correlation coefficient between the derived principal component and the macroeconomic index. This coefficient ranged from 0.87 for the global GDP to 0.36 for the consumer price index. Furthermore, the study identified that the food production index exhibited the most substantial influence on the macroeconomic index. However, the researchers did not uncover a direct connection between oil prices and the food price component. [69]

In conclusion, the examination of the literature review reveals inconsistent findings concerning the interplay among oil price volatility, exchange rates, and fluctuations in food prices. On the whole, it is clear that both oil prices and exchange rates contribute to elevated

food production costs and subsequent price variations. This, in turn, leads to heightened inflation rates and increased food insecurity in Nigeria.

### 2.4 Methodological review

In an attempt to investigate the relationship between the exchange rate, fuel price volatility and food prices in Nigeria, this study adopts a non-linear auto-regressive distributed lag (NARDL) co-integration technique which is an extension of the well-known ARDL approach by Pesaran et al.,[70] Auto-regressive distributed lag (ARDL), Generalised Auto-regressive conditional heteroscedasticity (GARCH) and Auto-regressive conditional heteroscedasticity (ARCH), to capture both long-run and short-run asymmetries between variables. Public policy schemes, such as price floor and price ceiling, play an important role in oil-exporting developing countries.[71] The pricing schemes place a limit to how the price can adjust up or down which essentially validates the possibility of asymmetric relationships. Also note the fact that the interplay between firms' cost structures and market power may account for both long-run and short-run asymmetries in price movements.[72] Consequently, an assessment of the effect of the exchange rate, oil price on food prices in a panel, by means of a non-linear technique to capture the asymmetric effect of oil price on food production and prices, becomes necessary. Therefore, this study utilizes a non-linear (asymmetric) Non Auto-Regressive Distributed Lag model as developed by Shin, Yu, and Greenwood-Nimmo.[73]

When compared with the classical co-integration models, NARDL models possess a number of very strategic advantages. First, they perform better in determining co-integration relations in small samples. Secondly, they can be applied regardless of whether the regressors are stationary at the level or at first difference. However, they cannot be applied if the regressors are stationary at the second difference, as the presence of an I(2) variable renders the computed F-statistic for testing co-integration invalid. Thirdly, the NARDL framework is

particularly suitable for this research problem as it allows for capturing both the long- and short-run asymmetries, and also for detecting hidden co-integration. [74]

## 2.5 Theoretical framework

Using the theory of price determination under perfect competitive market structure, which states the assumption that price is determined by the combine forces of demand and supply which is called the invisible hands. In this study, it was discovered that demand and supply is not only the major determinant of price but other factors included; exchange rate fluctuations and pump price of fuel in an economy such as Nigeria. Fluctuation in pump price of fuel and exchange rate can lead to an increase or decrease in prices of foodstuffs in Nigeria.[75]

This theory assumes a perfect competitive market, where the forces of demand and supply are allowed to dictate the price of food using the equilibrium price formula.

$$\mathbf{P_t = f(D_t, S_t)} \qquad 2.1$$

Where $P_t$= Price, f = functional relationship, $S_t$ = quantity supplied, $D_t$ = quantity demanded and

t = time period.

It should be noted that quantity supplied are determined by some certain factors which are;

$$\mathbf{S_t = f(P_t, C_t, L_t, M_t, W_t, Z_t)} \qquad 2.2$$

Where $S_t$ = quantity supplied, f = functional relationship, $P_t$ = price of other commodities, $C_t$ = cost of production, $L_t$ = Government legislation on Agriculture, $M_t$ = market structure, $W_t$ = weather condition and $Z_t$ = other factors affecting supply,

Assuming a linear function in equation 2, it thereby becomes;

$$S_t = \alpha_0 + \alpha_1 P_t + \alpha_2 C_t + \alpha_3 L_t + \alpha_4 M_t + \alpha_5 W_t + e_{t1} \quad 2.3$$

Also note that quantity demanded are determined by some certain factor which are;

$$D_t = f(P_t, Po_t, I_t, T_t, W_t, L_t, Y_t) \quad 2.4$$

Where $P_t$ = price of the commodity, $Po_t$ = price of other commodities, $I_t$ = income of the consumer, $T_t$ = Taste of the consumer for the product, $W_t$ = weather condition, $L_t$ = Government legislations on Agriculture and $Y_t$ = other factors affecting demand.

However, since food does not attract Government legislation as such, it will not be considered in this study as well as Taste (T) and Weather conditions (W).

A linear function is assumed for equation 4;

$$D_t = \beta_0 + \beta_1 P_t + \beta_2 Po_t + \beta_3 I_t + e_{t2} \quad 2.5$$

Therefore, on the assumption of perfect competitive market structure (M), price is determined when the demand equals supply; hence equation 3 and 5 ($S_t = D_t$).

$$\alpha_0 + \alpha_1 P_t + \alpha_2 C_t + \alpha_3 L_t + \alpha_4 M_t + \alpha_5 W_t + e_{t1} = \beta_0 + \beta_1 P_t + \beta_2 Po_t + \beta_3 I_t + e_{t2} \quad 2.6$$

Make $P_t$ the subject of the formula;

$$\alpha_1 P_t - \beta_1 P_t = \alpha_0 - \beta_0 + \alpha_2 C_t + \alpha_3 L_t + \alpha_4 M_t + \alpha_5 W_t - \beta_2 Po_t - \beta_3 I_t + e_{t1} - e_{t2} \quad 2.7$$

$$(\alpha_1 - \beta_1) P_t = \alpha_0 + \alpha_2 C_t + \alpha_3 L_t + \alpha_4 M_t + \alpha_5 W_t - \beta_2 Po_t - \beta_3 I_t + e_t \quad 2.8$$

Divide both sides by $(\alpha_1 - \beta_1)$

$$P_t = \alpha_0/(\alpha_1 - \beta_1) + \alpha_2 C_t/(\alpha_1 - \beta_1) + \alpha_3 L_t/(\alpha_1 - \beta_1) + \alpha_4 M_t/(\alpha_1 - \beta_1) + \alpha_5 W_t/(\alpha_1 - \beta_1) - \beta_2 Po_t/(\alpha_1 - \beta_1) - \beta_3 I_t/(\alpha_1 - \beta_1) + e_t/(\alpha_1 - \beta_1) \quad 2.9$$

$$P_t = \Omega_0 + \Omega_1 C_t + \Omega_2 L_t + \Omega_3 M_t + \Omega_4 W_t - \Omega_5 Po_t - \Omega_6 I_t + \mu_t \quad 2.10$$

Where;

$\Omega_0 = \alpha_0/(\alpha_1 - \beta_1)$, $\Omega_1 = \alpha_2/(\alpha_1 - \beta_1)$, $\Omega_2 = \alpha_3/(\alpha_1 - \beta_1)$, $\Omega_3 = \alpha_4/(\alpha_1 - \beta_1)$, $\Omega_4 = \alpha_5/(\alpha_1 - \beta_1)$, $\Omega_5 = \beta_2/(\alpha_1 - \beta_1)$, $\Omega_6 = \beta_3/(\alpha_1 - \beta_1)$ and $\mu_t = e_t/(\alpha_1 - \beta_1)$.

Note; since in production, fuel (F) and foreign inputs (tractors and machines) which involve foreign currency to purchase these inputs; thereby involving foreign exchange. This will come into the model under the cost of production ($C_t$) which makes equation 10 thus;

$$\mathbf{P_t^* = \Omega_0 + \theta_1 FP + \theta_2 ER + \Omega_2 L_t + \Omega_3 M_t + \Omega_4 W_t - \Omega_5 Po_t - \Omega_6 I_t + \mu_t} \quad 2.11$$

Where $\Omega_0$ to $\Omega_6$ and $\theta_1$ to $\theta_2$ are parameters of the model to be estimated, $\mu_t$ is the error term. FP, ER, L, M, W, PO and I are the dependent variables.

Where FP represents Fuel price and ER represent Exchange rate, L represents Government legislation, M represents Market structure, W represents Weather condition, PO represents price of other commodities and I represent Income of the consumer.

## 2.6 Summary of gaps in the Literature

Fuel price volatility has a significant impact on food price in the long term but not in the short term. Both agricultural food production and prices exhibit positive responses to oil price shocks. The findings indicate that approximately 64.17% of the variance in food prices can be attributed to movements in fuel prices and exchange rate volatility. Additionally, it is evident that inflation in fuel prices poses a threat to energy security and, in turn, endangers food security in Nigeria as a nation.[67] The literature review fails to address the specific factors contributing to the rise in food prices in Nigeria, notably the role played by the continuously increasing exchange rate of the Nigerian Naira against foreign currencies, prices of other goods, income of the consumers, Government spending on Agriculture and weather conditions. The escalating exchange rate issue serves as a central motivation for this research

paper. As of August 24, 2023, using the Xe currency converter app, the exchange rate between the Nigerian Naira and the US Dollar stands at N757 to $1. This substantial exchange rate variation leads to increased costs in oil product imports, particularly given Nigeria's significant dependence on imported refined crude oil. Consequently, this escalation in production costs exerts negative effects on social welfare, standard of living, and results in a higher inflation rate within the country.

The study aims to examine the interconnections among exchange rates, fuel prices, and food prices within the Nigerian context, with a focus on unraveling the consequences of fuel price fluctuations and exchange rate variations on food prices in Nigeria.

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# CHAPTER THREE

# METHODOLOGY

## Preamble

In this section, the model specification, sources of data, measurement of variables and the estimation techniques to be used to achieve the objectives of the work are specified.

## 3.1 Model specification

### 3.1.1 Effect of fuel prices and exchange rate on food prices in Nigeria

From the theoretical framework the model that is employed for this study is presented below, removing M representing Market structure; since there are no data available to capture;

$$\mathbf{P_t^* = \Omega_0 + \Omega_1 FP + \Omega_2 ER + \Omega_3 L_t + \Omega_4 W_t + \Omega_5 Po_t - \Omega_6 I_t + \mu_t} \qquad 3.1$$

Where $\Omega_0$ is the constant in the model and $\Omega_1$ - $\Omega_6$ are coefficient of the variables in the model to be estimated, $\mu_t$ is the error term. FP, ER, L, W, Po and I are the independent variables, which are Fuel price, Exchange rate, Government legislation, Weather condition, Price of other commodities and Income of the consumer. While P* is the dependent variable which is the Price of agricultural products (Food).

Equation (3.1) is the base line model for this study which will be employed to achieve objective one of this study.

$$P_t^* = \Omega_0 + \Omega_1 FP + \Omega_2 ER + \Omega_3 L_t + \Omega_4 W_t + \Omega_5 Po_t - \Omega_6 I_t + \mu_t$$

Hence, the expectation of the coefficient are as follows; $\beta_1$ - $\beta_5 > 0$ and $\beta_6 < 0$.

Equation 3.1 can be stated as;

$$P^* = f(FP, ER, GL, WC, Po, IC) \qquad 3.2$$

Where;

FP is fuel price. ER is exchange rate, GL is Government legislation, WC is weather conditions, Po is price of other commodities and IC is income of consumers.

The model for estimation is the ARDL (Auto-Regressive and Distributed Lag) to determine the effect of changes in fuel prices and exchange rates precede changes in food prices in Nigeria.

Considering an ARDL (1,1) model for simplicity:

$$\Delta P_t^* = \alpha + \beta_1 \Delta P^*_{t-1} + \gamma_1 \Delta FP_t + \gamma_2 \Delta ER_t + \varepsilon t$$

Where:

- $\Delta$ represents the first difference operator.
- $\alpha$ is the intercept term.
- $\beta_1$ is the coefficient for the lagged dependent variable.
- $\gamma_1$ is the coefficient for the first difference of volatility in fuel price ($\Delta FPt\Delta FPt$ ).
- $\gamma_2$ is the coefficient for the first difference of exchange rate ($\Delta ERt\Delta ERt$ ).
- $\varepsilon t$ is the error term.

The model allows direct examination in the short-run effects of changes in fuel price volatility and exchange rate on food prices. To determine the long run effects, the extension of the lag order of the dependent variable or include lagged levels of FP and ER along with their differences in the model.

### 3.1.2 Analyse the level of volatility in fuel prices and exchange rate

Using the GARCH equation model approach to analyse level of volatility in fuel price and exchange rate, equation 3.1 was adopted with volatility symbol on exchange rate, fuel price and food price. Other variables will not be affected by the volatility. GARCH model is widely used to model and forecast the volatility of financial time series data, including exchange rates and fuel prices.

$$VP_t^* = Ω_0 + Ω_1 VFP + Ω_2 VER + Ω_3 L_t + Ω_4 W_t + Ω_5 Po_t - Ω_6 I_t + ų_t \qquad 3.3$$

In equation 3.3 above, VP is volatility in food price, VFP is volatility in fuel price, VER is volatility in exchange rate, L is government legislation, W is weather condition, Po is price of other commodities and I is income of consumers.

$Ω_0$ is the intercept term. $Ω_1$ to $Ω_6$ are the coefficient associated with their respective independent variables.

To analyse the level of volatility in fuel prices and exchange rate, assessment was made to ascertain the magnitude and significance of the coefficient $Ω_1$ and $Ω_2$.

A larger absolute of $Ω_1$ and $Ω_2$ shows that fuel prices (FP) and exchange rate (ER) are more responsive to changes. Higher magnitude indicates higher volatility. Hypothesis testing is performed to determine whether $Ω_1$ and $Ω_2$ are statistically significant. Significant coefficient implies that there is a relationship between fuel price and exchange rate, which contribute to volatility.

Other factors such as L,W, Po and I may be considered, as they could influence fuel prices and contribute to volatility. The significance and magnitude of their coefficient is analyzed in similar manner.

### 3.1.3 Examine the effect of volatility in fuel price and exchange on food price

To achieve objective 3 equation 3.1 was transformed by generating the volatility of the variables using the approach model below;

$$VP_t^* = \Omega_0 + \Omega_1 VFP + \Omega 2VER + \Omega_3 VL_t + \Omega_4 VW_t + \Omega_5 VPo_t - \Omega_6 VI_t + \mu_t \quad 3.4$$

From equation 3.4 to test for volatility, the ARDL (Auto-Regressive Distributed Lag) family was introduced on both sides, thus affecting changes in some variables on the right hand side (independent variables) and on the left hand side (dependent variable).

From empirical standpoint, it was discovered that the major factors responsible for food prices volatility are fuel prices (FP), Exchange rate (ER), Weather conditions (W) and Price of other commodities (Po). Other factors stated in the model like Government legislation. Income of consumers does not really affect changes in prices of food.

### 3.1.3 Asymmetric effects of volatility in fuel price and exchange rate on food price.

To achieve objective 4, using equation 3.1, the NARDL model approach was adopted. NARDL is an approach that accommodates nonlinear interaction between variables.Utilizing the NARDL (Non-linear Auto-Regressive Distributed Lag) model to explore the interrelationships among the variables, including fuel prices, exchange rates, government regulations, weather conditions, the prices of other commodities, and consumers' income. To detects the interactions that exists between fuel prices and exchange rate in Nigeria and its major effect on food prices.

$$VP_t = \beta_0 + \sum n_{i=1}\ \beta_i VP_{t-I} + \sum m_{j=0} \sum_{lk=0} \gamma jklVFP_{kt-j}\ VER_{\ lt-j} + \sum p_{j=0} \sum_{qk=0} \gamma jklVL_{kt-j}\ VW_{\ lt-j} +$$

$$\sum r_{j=0} \sum s_{k=0} \gamma jklVPO_{kt-j}\ VI_{\ lt-j} + u_t \quad 3.5$$

Where:

$\beta_0$ is the untercept term.

$\beta_1$ is the coefficient of the lagged VP terms.

$\gamma jkl$ are the coefficients of the interaction terms between the independent variables. J represents the lag. K and l are the exponents that determine the nature of the non-linearity.

*Ut* is the error term.

Fluctuations in fuel pump prices, whether increasing or decreasing, can lead to price instability. A strong foreign exchange rate relative to our local currency has a detrimental impact on food prices, particularly because Nigeria relies more on imports than exports. Many agricultural machinery and inputs are imported, requiring foreign currency for their purchase. Hence, a high foreign exchange rate for these imports raises production costs, consequently causing an increase in the prices of the end products.

Fuel prices and exchange rates are the integral components of the overall production costs of Agricultural goods. Elevated production costs directly translate to higher final product prices. Government legislation in the agricultural sector pertains to the laws and regulations set by the government regarding the retail pricing of commodities in the market. A specific government agency is tasked with enforcing these pricing laws and regulations. This agency has the authority to adjust commodity prices, either upward or downward, to incentivize local producers or discourage the demand for imported goods.

## 3.2 Measurement of variables

The description of data and its measurements included in this analysis are described below;

**Table 3.1:**

| VARIABLE | DEFINITION | MEASUREMENT | SOURCES |
|---|---|---|---|
| Food price (PF) | The average price level for food across the country, it can also be defined as the price that consumers are charged for food purchased at a particularly time and period. | Food price is measured using the Consumer Price Index (CPI) | Nigerian Bureau of Statistics Bulletin 2022. |
| Exchange Rate (EXCHR) | This is the rate at which the domestic (Nigerian) currency is exchanged with Foreign Currency e.g (American Dollar) | The difference between the Currencies exchange rate divided by the Market Exchange rate | Nigerian Bureau of Statistics Bulletin 2022. |
| Fuel Price (FUP) | The pump price at which Fuel is sold at the Gas station in Nigeria. | Comparing of the pump price of Fuel from different Gas Stations. Looking for Variation in their prices. | The Central Bank Statistical bulletin 2022 and NNPC statistical bulletin 2022 |
| Government Legislation (GL) | An organ of Government vested with the responsibility of enactment of laws concerning fixing of Agricultural products pricing, whether in the Local, State or Federal Government. | They make use of policies to enacts law in other to protect consumers or Local Industries etc | Nigeria Bureau of Statistics Bulletin 2022 |

**Source: Author's computation 2023.**



## 3.3 Sources of data

Food prices volatility is measured by the consumer price index (CPI), offer a measure of the monthly change in international prices of a basket of food commodities. The index consists of the average of five commodity group price indices weighted with the average export shares of each of the groups. It comprises the cereal price index, vegetable oil price index, meat price index, sugar price index and dairy price index. The consumer price index was sourced from the Nigerian Bureau of Statistics (2022), the database of the Food and Agricultural Organization (FAO) of the United Nations. Oil price is the pump price at which Petroleum products are sold in the domestic market. This was sourced from the Nigeria National Petroleum Corporation (NNPC) and Central Bank of Nigeria statistical bulletin 2022. Exchange rate measured by the difference between the two currencies exchange rate divided by the market exchange rate. This is sourced from Nigerian Bureau of Statistics and Central Bank of Nigeria statistical bulletin 2022. Government legislation, laws and reforms of the federal government of Nigeria sourced from the Nigerian bureau of statistics bulletin of 2022.

### 3.4 Technique of analysis

This section entails the presentation of the techniques employed to achieve the objectives of this study. First, the presentation of the process adopted in extracting the Fuel price and exchange rate volatility variable, the pre-test of variables and then presentation of how objectives one, two, three and Four. These include preliminary analysis and test using descriptive statistics, Co-variance analysis, Correlation Analysis, Unit root test (Augmented Dickey-Fuller test) and co-integration test and how each objective are achieved.

#### 3.4.1 Investigate the effect of fuel price and exchange rate on food price.

Using equation 3.1 as baseline model to achieve objective one, ARDL (Auto-Regression and Distributed Lag) Model was used to determine if changes in fuel prices or exchange rates precede changes in food prices, indicating potential causal relationships. Studies was conducted to determine the effect of Fuel price and exchange rate on food price in the short run and the long run; the positive effect of volatility and the negative effect of volatility. In the context of investigating the effect of fuel prices and exchange rates on food prices in Nigeria.

### 3.4.2 Analyse the level of volatility in fuel price and exchange rate

From equation 3.1, the explicit form of the equation is specified as;

$$VP_t^* = \Omega_0 + \Omega_1 VFP + \Omega_2 VER + \Omega_3 L_t + \Omega_4 W_t + \Omega_5 Po_t - \Omega_6 I_t + \mu_t$$

The behaviour of fuel prices and exchange rate was studied, and future volatility in the market was forecasted, using the index data. Majority of volatility models used in forecasting are the GARCH model of Bollerslev (1986)[1], the Exponential GARCH (EGARCH) model of Nelson (1991)[2], and the Glosten, Jaganathan and Runkle (1993) (GJR) model.[3] They all represent models for forecasting volatility (Letema and Mbwambo, 2023).[4] The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) technique was first put forth by Bollerslev in 1986 as a way to identify symmetry in volatility. Since then, several studies (Dritsaki, Chaido 2019; Massimilano Caporin and Michele Costola, 2019) had developed and used different variants of asymmetric GARCH specifications.[5, 6]As the name suggests, the asymmetric GARCH approach helps to account for the leverage effect and specification of the conditioning variance in a logarithmic form. In contrast to traditional time series and econometric models, which work on the premise of constant variance, this kind of model is beneficial for simulating variability in fuel price and exchange rate volatility.[7]

In addition, the Autoregressive Conditional Heteroskedasticity (ARCH) model established by Engle (1993) was quickly extended to include a more flexible lag structure due to the difficulty of negative variance parameter estimations in empirical applications (Bollerslev, 1986). ARCH (p) is stated as

$$\sigma_t^2 = \partial_0 + \sum_{j=1}^{p} \chi_j u_{t-j}^2$$

(3.10)

Where $u^2_{t-j}$is the squared residual from the previous period computed using the volatility information from the previous period.

Furthermore, ARCH (p) simultaneously models the mean equation as

$$y_t = \alpha + \beta' X_t + u_t$$

(3.11)

$$u_t \approx iid(0, h_t)$$

While the variance equation was modeled as

$$h_t = \partial_0 + \sum_{j=1}^{p} \delta_j u_{t-j}^2 \qquad (3.12)$$

The ARCH (p) model can be parsimoniously reduced to GARCH (p,q) using equation (9) above $h_t = \delta_0 + \psi_1 h_{t-1} + \psi_2 u_{t-1}^2$

(3.13)

$\delta_0 > 0$, $\Psi_1 > 0$, $\Psi_2 > 0$ and $\Psi_1 + \Psi_2 < 1$, so that the last period's forecast and last period's squared return are combined to get the following period's forecast for the variance.

Where $h_t$ the variance or volatility is for the current period, $h_{t-1}$ is the residual variance or volatility from the prior year. From equation 9, the explicit form of the equation is specified as

$$h_t = \alpha + \beta Fp_t + XEr_t + \theta L_t + \emptyset W_t + \Lambda Po_t + \hat{y} I_t + \mathcal{E}_t \qquad (3.14)$$

All variables in the model are in their log form.

### 3.4.3 Effect of volatility in fuel price and exchange rate on food price

The estimation technique adopted for objective three is ARDL (Auto-Regressive Distributed Lag) model of approach. The Auto-Regressive Distributed Lag (ARDL) model is a statistical framework used for analyzing the relationships between variables, particularly in the context of time series data. It is especially useful for investigating the long-run relationships and short-run dynamics between variables. The ARDL model has several components:

AutoRegressive (AR) Component: The AR part involves analyzing how the current value of a variable is influenced by its past values. It considers the lagged values of the variable itself to understand its autocorrelation. Distributed Lag (DL) Component: The distributed lag component examines how changes in one variable affect another variable over a range of time lags. This is crucial for capturing the dynamics of the relationship between variables over time. Long-Run and Short-Run Effects: One of the key features of the ARDL model is its ability to distinguish between long-run and short-run relationships. It helps to determine how variables interact in the short term and in the long term.

The AutoRegressive Distributed Lag (ARDL) model equation is typically written as follows:

$$Y(t) = c + aY(t-1) + bX(t) + e(t)$$

Here's a breakdown of the components of this equation:

- Y(t): The dependent variable at time t.
- X(t): The independent variable at time t.

- Y(t-1): The lagged value of the dependent variable at time t-1. This captures the auto-regressive component.
- c: A constant or intercept term.
- a: Coefficient of the lagged dependent variable.
- b: Coefficient of the independent variable.
- e(t): The error term at time t, representing the unexplained variation in the dependent variable.

The ARDL model can involve multiple lags of the variables (i.e., Y(t-2), Y(t-3), X(t-1), etc.) if deemed necessary for modeling the relationships adequately. It's also important to specify whether you're looking at short-run or long-run effects, which may involve different lags of the variables. The goal in estimating the ARDL model is to determine the values of the coefficients (a and b) and assess their significance, providing insights into the relationship between the dependent and independent variables and how changes in the independent variable impact the dependent variable.

### 3.4.4 Asymmetric effect of volatility in fuel price and exchange rate

The estimation used to achieve objective four is the Non-Linear Auto-Regressive Distributed Lag (NARDL) model, which is a variation of the Auto-Regressive Distributed Lag (ARDL) model that allows for Non-Linear relationship between variables. In the context of the equation 3.1 above, the NARDL model can be represented as follows;

Let:

$VP_t$ be the dependent variable (Price of Food)

$VFP_t$ be the independent variable (Fuel Price)

$VER_t$ be the second independent variable (Exchange rate)

$VL_t$ be the Third independent variable (Govt Spending on Agriculture)

$VW_t$ be the Fourth independent variable (Weather Condition)

$VI_t$ be the Fifth independent variable (Consumer Income)

$VPO_t$ be the Sixth independent variable (Price of other goods).

The NARDL model can be written as:

$$VPt = \beta 0 + \sum^{n}_{i=1} \beta i VP_{t-I} + \sum^{m}_{j=0} \sum^{l}_{k=0} \gamma jkl VFP^{k}_{t-j} \; VER^{\,l}_{t-j} + \sum^{p}_{j=0} \sum^{q}_{k=0} \gamma jkl VL^{k}_{t-j} \; VM^{\,l}_{t-j} + \sum^{r}_{j=0} \sum^{s}_{k=0} \gamma jkl VPO^{k}_{t-j} \; VI^{\,l}_{t-j} + u_t$$

Where;

$\beta_0$ is the intercept term.

$\beta_1$ is the coefficient of the lagged VP terms.

$\gamma jkl$ are the coefficients of the interaction terms between the independent variables, j represents the lag, k and l are the exponents that determine the nature of the non-Linearity.

$U_t$ is the error term.

The lag structure for each independent variable can vary depending on the specific context of the data.. The NARDL model captures potential Non-Linear relationships by including interactions between the lagged values of the independent variables.

## Endnotes


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# Chapter 4

# DATA PRESENTATION AND ANALYSIS

## Preamble

This chapter of the study covers the detailed econometric analysis of implications of volatility in Fuel price and Exchange rate on Food prices in Nigeria between the year 2000 and 2022. This analysis was carried out based on the theoretical framework and the specified empirical models in the previous chapter. Furthermore, in this chapter the descriptive analysis of the economic variables was presented, also the empirical results according to the specific objectives.

## 4.1 Preliminary Analysis

This section of the research study shows the graphical illustration of each variable used in this study. Using quarterly reviews, the graphs reveal various levels in the plotted lines how each variable varies quarter by quarter within the year 2000 to 2022 in Nigeria.

### 4.1.1 Graphical Analysis

From the graph below, it shows a clear upward trend in food prices over the 23-year period, spanning from 2000Q1 to 2022Q4. This graph represents the cost of food products over these quarters. The "Price of Food" started at approximately 29.50 in 2000Q1 and generally increased over the years. There were periods of both gradual and more significant price increases, with some fluctuations.

The prices reached their highest point around 2022Q3, with a value of about 555.48. This graph shows an overall upward trend, indicating that food prices have increased over time, which could be to various economic and Market factors. Understanding the specific reasons

behind these price changes would require additional economic analysis and Context. The graph reflects a long term increase in the cost of food over the years, with some short term variations along the way.

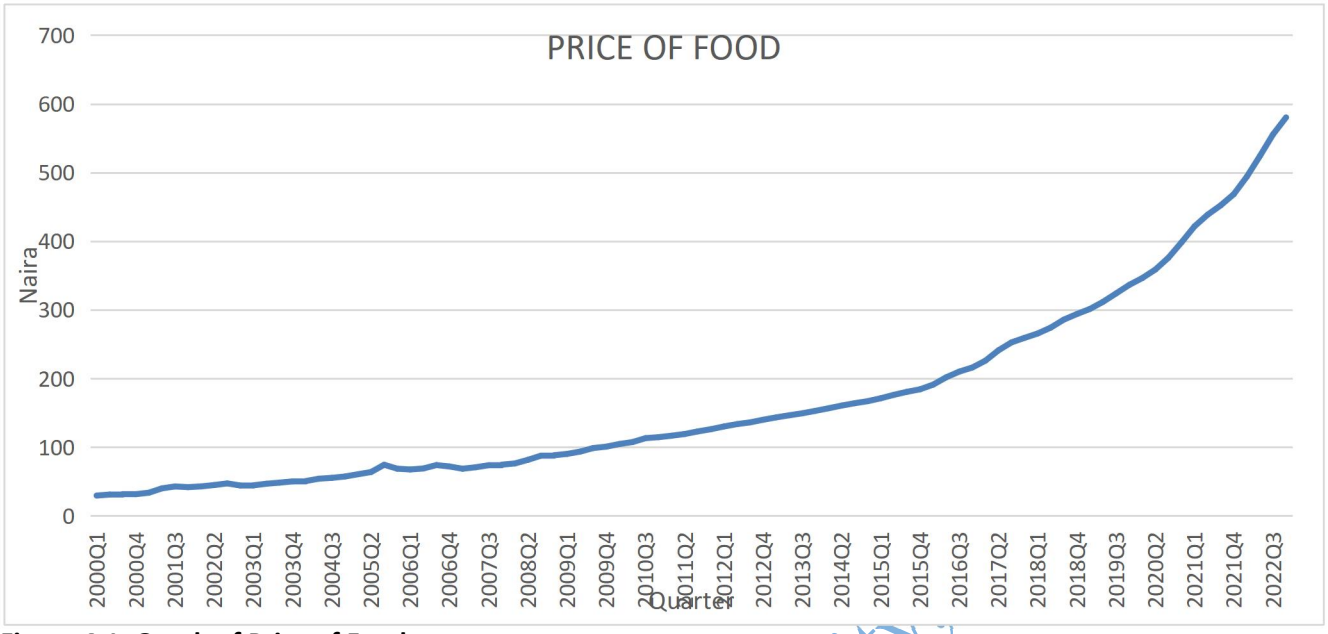


**Figure 4.1: Graph of Price of Food**

**Sourced: Author's Computation 2023**

The graph below represents the price of Petroleum product (PMS) in Naira per litre over a span of 23 years, from 2000Q1 to 2022Q4.

This graph reflects the price of PMS (Premium Motor Spirit) at pump price. In 2000Q1, the fuel price started at 20 and remained relatively stable for the first few years, with some minor variations. From 2009Q2, there was a noticeable increase in fuel prices, which continued to rise. The most significant price increase occurred between 2012Q1 and 2012Q2, where the price almost doubled from 65 to 125.5.

There were fluctuations in fuel prices in the following years, but overall, the prices remained relatively high compared to the early 2000s. In 2017, there was some fluctuation in fuel prices but no significant long-term trend. Starting in 2020Q2, there was another increase in fuel prices, which continued into 2022Q3, where it reached the highest value of 190.37. The price of fuel remained relatively high in 2022Q4, with a value of 201.32.

The graph shows periods of stability in fuel prices, followed by significant increases in various quarters, particularly from 2009 onwards and another notable increase starting in 2020. These price fluctuations can be influenced by factors such as global oil prices, government policies, and economic conditions.

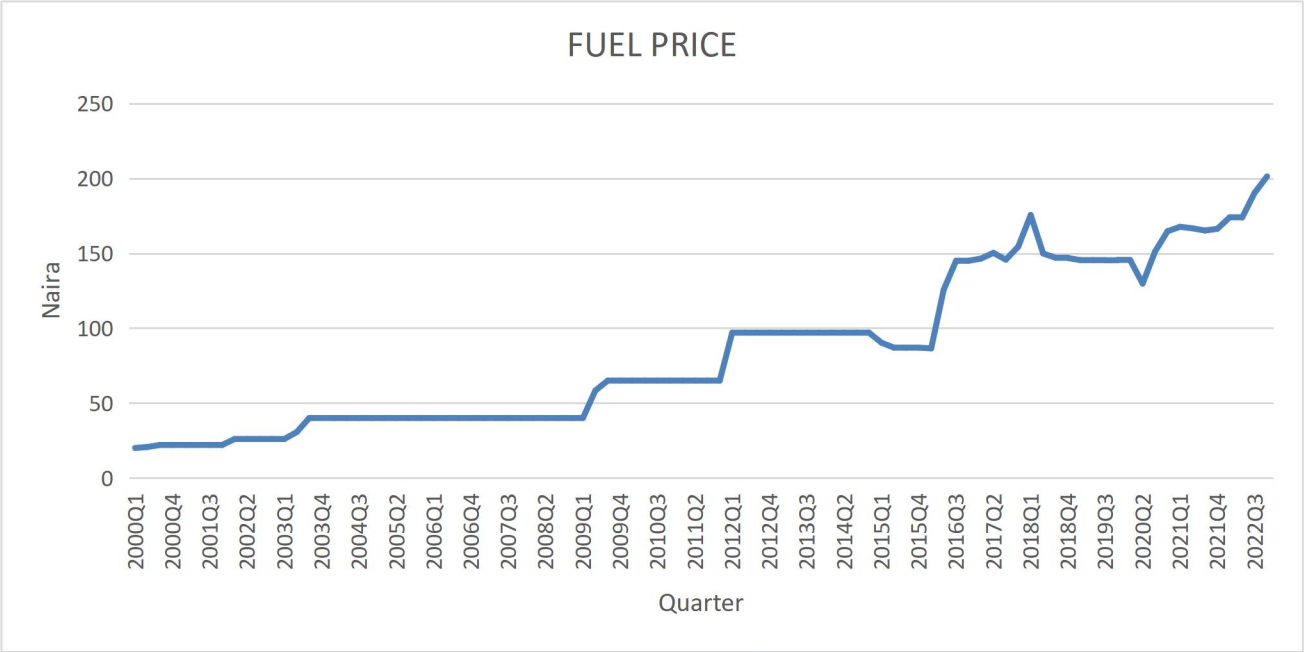


**Figure 4.2: Graph of fuel price**
**Source: Author's Computation 2023.**

The graph below, illustrates the fluctuating (volatile) behaviour of Exchange rate over the years 2000Q1 to 2022Q4 in Nigeria. This graph shows how the exchange rate of Nigeria Naira changed over time in comparison to American Dollar.

The exchange rate starts at around 99.99 in 2000Q1 and gradually increases to 128.9 by the end of 2002Q4. This indicates a relatively stable exchange rate during this period with some gradual appreciation. From 2003Q1 to 2007Q4, the exchange rate remains relatively stable, fluctuating between 120.37 and 137.92. This is a period of relative exchange rate stability.

In 2008Q4, there is a significant increase in the exchange rate, reaching 146.59 by 2009Q1. This can be seen as a depreciation of the currency. The exchange rate fluctuates within a relatively higher range during this period. The exchange rate continues to increase, reaching 160.27 by 2011Q4. This is a period of appreciation for the currency. From 2012 to 2014, the exchange rate remains relatively stable, with minor fluctuations. It ends the period at 172.02 in 2014Q4.

There is a significant increase in the exchange rate in 2015Q1, reaching 191.11, and continues to rise, reaching over 305 by 2016Q4. This is a period of substantial currency appreciation. The exchange rate remains stable around 305 for most of this period. From 2019 onwards, the exchange rate starts to rise steadily, reaching 445.71 by 2022Q4. This is a significant appreciation of the currency during this period.

The exchange rate graph shows periods of stability, appreciation, and depreciation over the years.

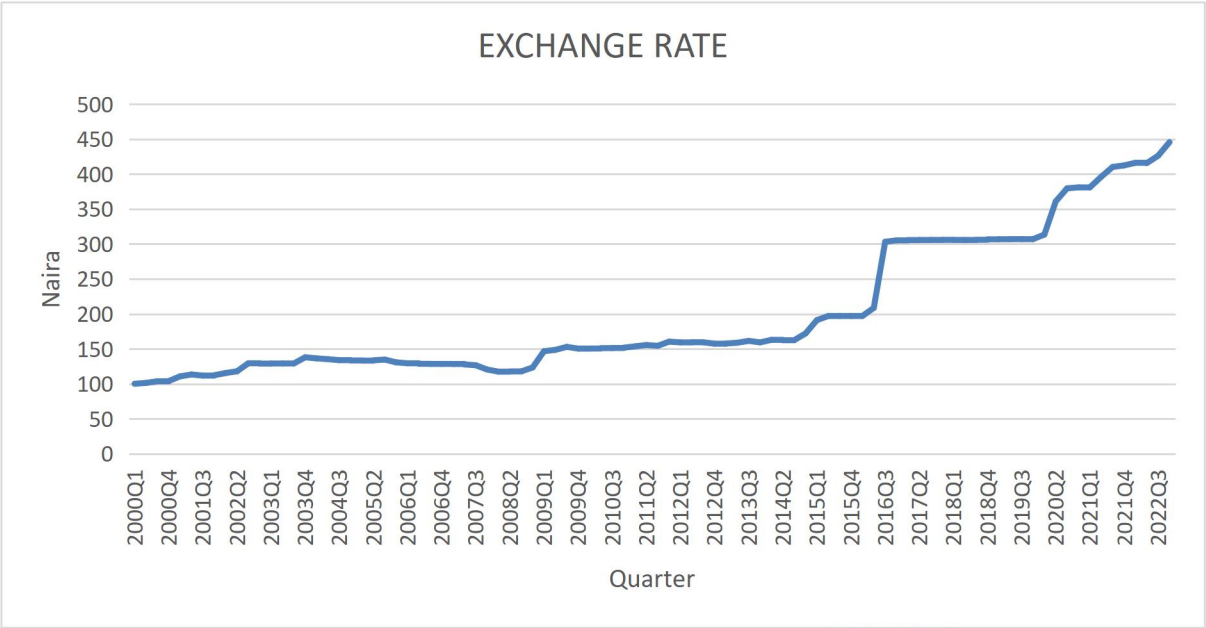


**Figure 4.3: Graph of Exchange rate**

**Source: Author's Computation 2023.**

The graph below represents government Legislation (Govt spending on agriculture) from the year 2000Q1 to 2022Q4.

The government legislation spending on agriculture starts at 6.34 in 2000Q1 and steadily increases to 10.36 by 2003Q4. This period shows consistent growth in spending on agriculture. There is a significant increase in spending from 11.3 in 2004Q1 to 57.17 in 2007Q4. This indicates a substantial boost in government support for agriculture during this period. Government spending on agriculture declines from 65.40 in 2008Q1 to 28.22 in 2010Q1. This could be due to various factors, including economic challenges or shifts in government priorities or change in government.

Spending remains relatively stable between 35.28 (2014Q2) and 41.27 (2015Q1) during this period. There are no significant fluctuations, suggesting a consistent level of support for agriculture. Government spending starts to decline gradually from 41.27 in 2015Q1 to 53.06 in 2017Q4. This could indicate a moderate increase in support for agriculture, but it's not as substantial as in the earlier years.

From 2018 onwards, there is a steady increase in government legislation spending on agriculture, reaching 89.06 in 2022Q4. This period shows a clear and continuous commitment to supporting agriculture. The graph indicates fluctuating levels of government legislation spending on agriculture over the years. There were periods of significant increases and decreases, and also periods of stability. The fluctuations may be influenced by various factors, including economic conditions, government policies, and agricultural needs.

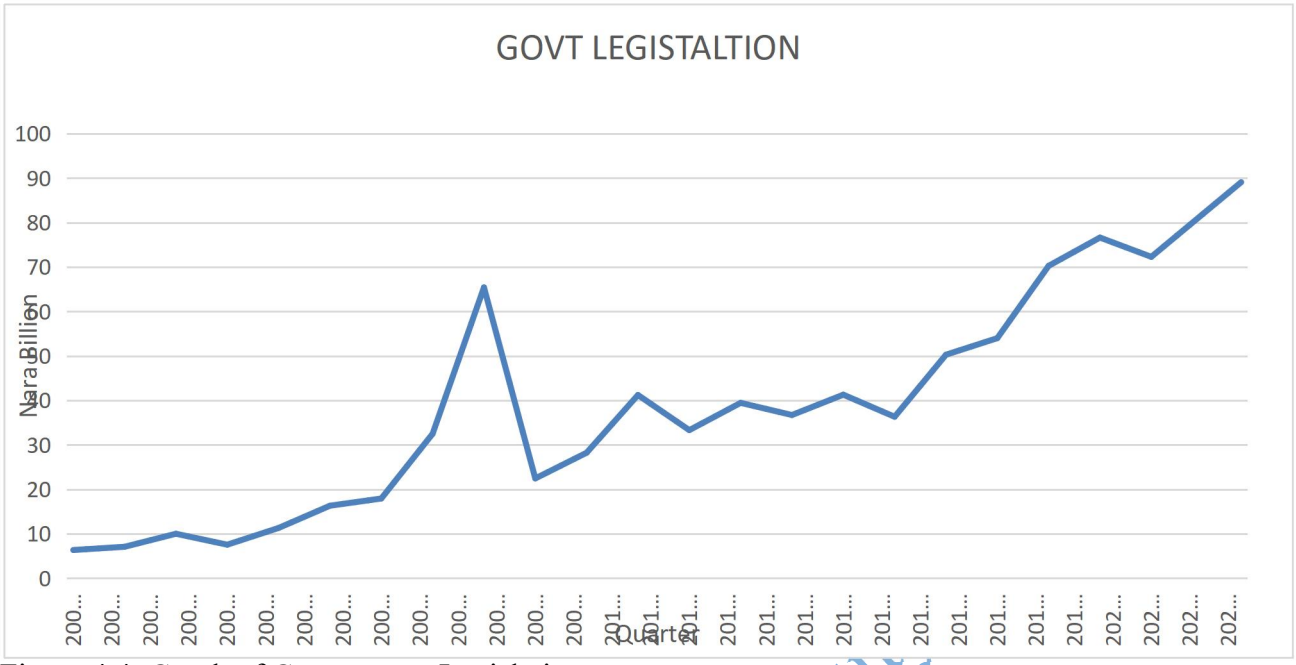

Figure 4.4: Graph of Government Legislation
Source: Author's Computation 2023.

The graph below illustrates the amount of rainfall in Nigeria over a specific time period, and it appears to provide yearly data over several years.

**From year 2000-2004,** rainfall levels exhibit some fluctuations, with both low and high values. There isn't a clear trend during this period, suggesting variable rainfall patterns.

**In the year 2005-2007**, rainfall levels continue to fluctuate but generally show higher values, indicating a relatively wetter period. Year **2008-2010**, rainfall levels are variable, with occasional spikes, but they generally show a decrease compared to the previous years. This suggests a drier period.

Rainfall levels in year 2011 - 2014 fluctuate but seem to be relatively consistent, with some variations. There isn't a strong upward or downward trend during this period. Year **2015-2017,** rainfall levels exhibit some fluctuations, and the values are generally lower compared to previous years, indicating a drier period. While in the year **2018-2022,** rainfall levels fluctuate, but there is a noticeable increase in rainfall from 2018 to 2019, after which they remain relatively stable at higher values compared to the previous years.

The graph shows that rainfall in Nigeria has varied over the years, with periods of wetter and drier conditions. There isn't a consistent trend, but some years stand out with either higher or lower rainfall levels. It's essential to consider these fluctuations when assessing their impact on agriculture (price), water resources, and other aspects of life in Nigeria.

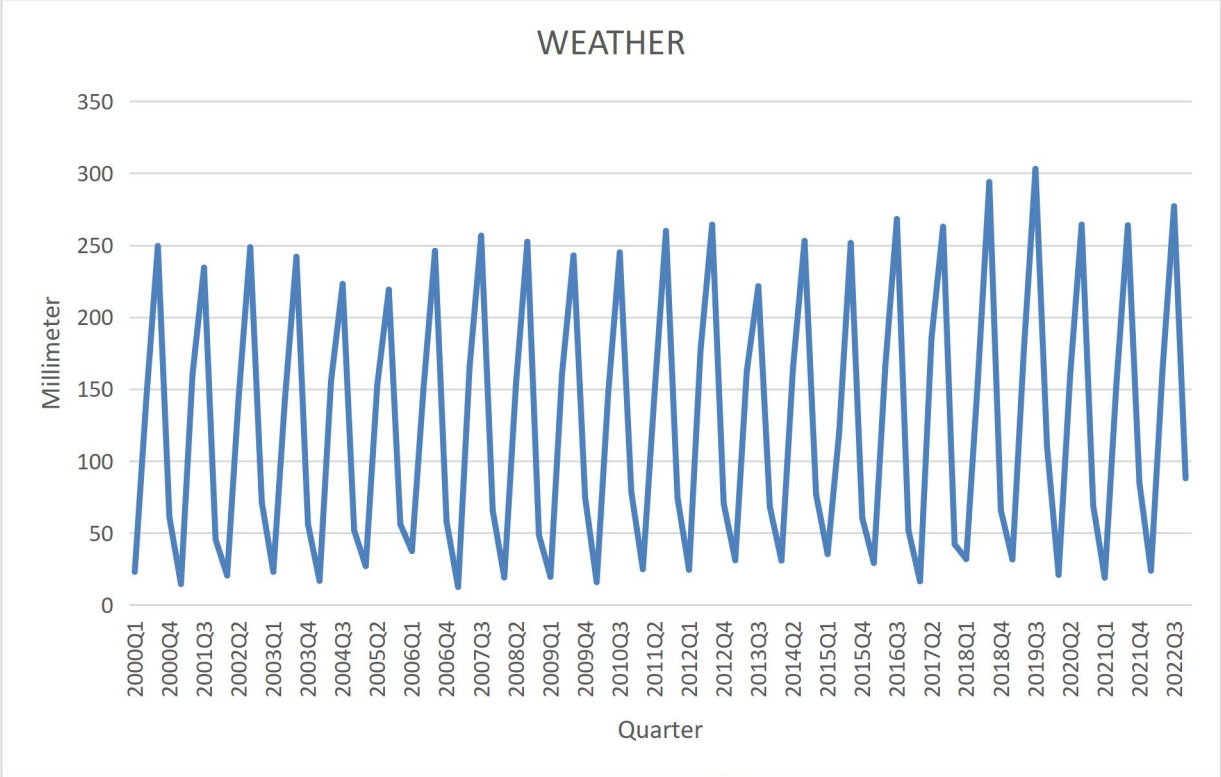


Figure 4.5: Graph of Weather Condition
Source: Author's Computation 2023.

The graph below illustrates the trends in the prices of other goods in Nigeria over a specific time period.

Prices gradually increased from 31.45 (2000Q1) to 68.78 (2005Q4), indicating a relatively stable and moderate rate of inflation during this period. Prices continued to rise, with noticeable fluctuations. There was a more significant increase in 2010, reaching 112.07 (2010Q4), suggesting a period of higher inflation. Price increases persisted, but the rate of growth appeared to slow down compared to the previous years. Prices reached 161.38 (2014Q4), reflecting a more moderate inflation rate.

Prices continued to increase at a gradual pace, reaching 255.25 (2018Q4). This period was characterized by relatively stable and modest inflation. Prices began to rise more rapidly, reaching 415.74 (2022Q4). This period represents a phase of accelerated inflation, indicating a potentially more challenging economic environment.

The graph shows different phases of inflation over the years, with periods of mild, moderate, and accelerated price increases. These trends can impact consumers, businesses, and the overall economy, with potential implications for purchasing power, cost of living, and economic stability.

Figure 4.6: Graph of price of other goods
Source: Author's Computation 2023.

The graph below shows consumer income over the years from 2000 to 2022.

Consumer income starts at around 1.16 million (2000Q1) and gradually increases over these years. Higher consumer income generally allows people to afford a better quality of life and can lead to increased spending on food, including more expensive or diverse food options. This could contribute to some upward pressure on food prices. Income continues to increase but faces fluctuations. However, there's a noticeable drop in income from 2008Q4 to 2009Q1. This could be due to economic challenges, such as the global financial crisis, which may lead consumers to cut back on discretionary spending, including spending on more expensive food items.

Income experiences significant growth, with a sharp increase from 2010 onwards. Higher income levels enable consumers to afford a wider range of food products, including premium and imported items, which can affect food prices by creating increased demand for such products. Income levels continue to rise, albeit with some fluctuations. Increased income can lead to consumers having more disposable income to spend on food, potentially contributing to a rise in food prices, especially for high-quality and specialty items.

**In the year 2017-2018,** income experiences further growth, which could lead to increased consumer demand for a variety of food products. This can create upward pressure on food prices. Year **2019-2022**, income levels continue to rise significantly, reaching the highest values in the graph. This indicates that consumers have more financial capacity to purchase food products, including premium and imported items. The increasing income levels can contribute to food price inflation, particularly for higher-end and specialty food items.

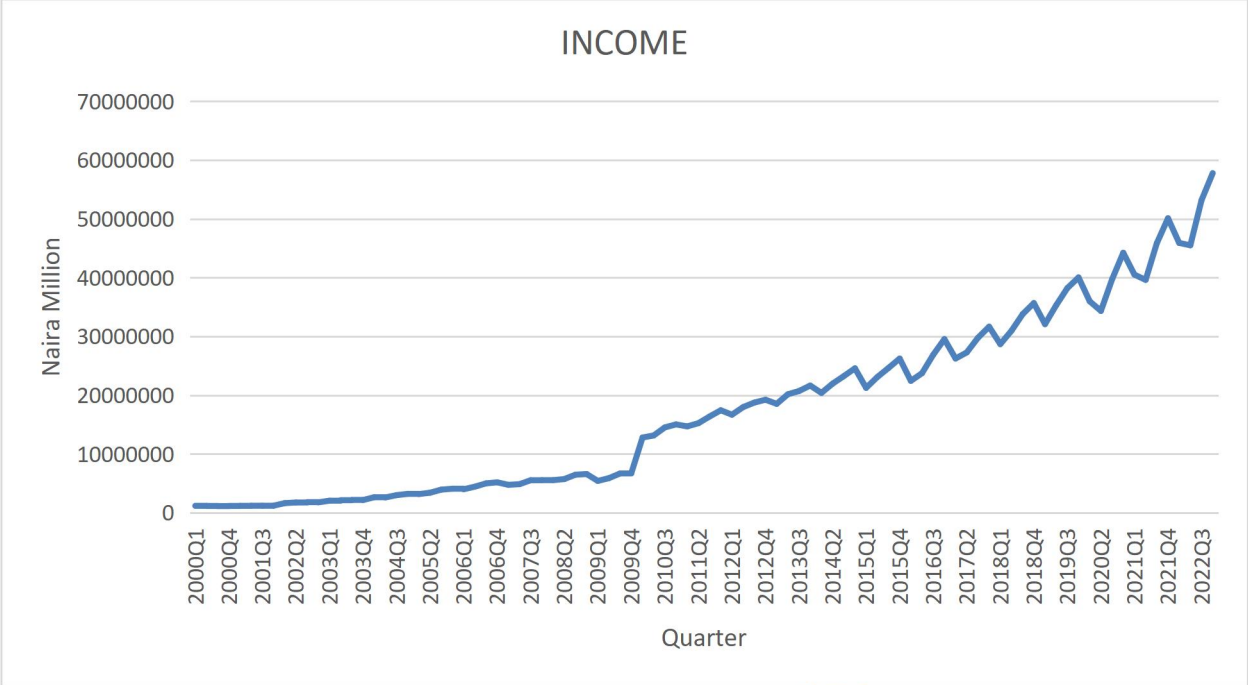


Figure 4.7: Graph of consumer income
Source: Author's Computation 2023.

## 4.2 Descriptive Analysis

Table 4.1 shows the descriptive statistics for each of the variables used in the Study. It reveals that LEXCHR (Log of Exchange Rate) has an average value of approximately 5.20, with a median value of around 5.04. It ranges from a minimum of 4.61 to a maximum of 6.10, showing some variability. The data is slightly positively skewed, with a skewness of 0.72, and exhibits heavier tails, indicated by a kurtosis of 2.09. The Jarque-Bera test rejects the hypothesis of normality, suggesting that the data may not be normally distributed. Also, LFUP (Log of Fuel Price) has an average value of about 4.22, closely matched by the median at 4.17 while it ranges from a minimum of 3.00 to a maximum of 5.30. It is observed that the data is slightly negatively skewed (skewness of -0.15) and also displays some heavy-tailedness (kurtosis of 1.73). The Jarque-Bera test rejects the normality assumption for this variable.

The variable LGL (Log of government legislation) has an average of 3.42 and a median of 3.63. Its values range from a minimum of 1.85 to a maximum of 4.49. This data is negatively skewed (skewness of -0.63) and exhibits heavy tails (kurtosis of 2.26). The Jarque-Bera test suggests non-normality. The LINC (Log of income of consumers) has an average of 16.13 and a median of 16.57. The data ranges from a minimum of 13.93 to a maximum of 17.87. It is slightly negatively skewed (skewness of -0.42) and shows some heavy-tailed behavior (kurtosis of 1.82). The Jarque-Bera test indicates a deviation from normality. The variable LPF (Log of price of food) has an average of 4.81 and a median of 4.80. It ranges from a minimum of 3.38 to a maximum of 6.36. The data is slightly positively skewed (skewness of 0.12) and exhibits some heavy tails (kurtosis of 2.01). The Jarque-Bera test does not strongly reject normality.

The LPO (Log of price for other commodity) has an average of 4.78 and a median of 4.79. Its values range from a minimum of 3.45 to a maximum of 6.03. This data is slightly negatively skewed (skewness of -0.08) and displays some heavy-tailed behavior (kurtosis of 1.98). The Jarque-Bera test does not strongly reject normality. The variable **LWEA** (Log of weather condition) has an average of 4.47 and a median of 4.74. It ranges from a minimum of 2.52 to a maximum of 5.71. The data is slightly negatively skewed (skewness of -0.43) and exhibits some heavy-tailed behavior (kurtosis of 1.85). The Jarque-Bera test rejects the hypothesis of normality for this variable.

These statistics provide insights into the central tendencies, spread, and distribution characteristics of each variable, and the Jarque-Bera test results indicate departures from a normal distribution for most of the variables.

**Table 4.1: Descriptive Statistics**

| | LEXCHR | LFUP | LGL | LINC | LPF | LPO | LWEA |
|---|---|---|---|---|---|---|---|
| Mean | 5.196 | 4.222 | 3.416 | 16.133 | 4.811 | 4.779 | 4.471 |
| Median | 5.043 | 4.174 | 3.630 | 16.575 | 4.796 | 4.789 | 4.745 |
| Maximum | 6.100 | 5.305 | 4.489 | 17.872 | 6.364 | 6.030 | 5.714 |
| Minimum | 4.605 | 2.996 | 1.846 | 13.933 | 3.384 | 3.448 | 2.521 |
| Std. Dev. | 0.438 | 0.686 | 0.767 | 1.208 | 0.803 | 0.701 | 0.942 |
| Skewness | 0.718 | -0.147 | -0.633 | -0.425 | 0.124 | -0.081 | -0.429 |
| Kurtosis | 2.085 | 1.730 | 2.260 | 1.819 | 2.007 | 1.982 | 1.854 |
| Jarque-Bera | 11.101 | 6.513 | 8.237 | 8.114 | 4.013 | 4.072 | 7.862 |
| Probability | 0.004 | 0.039 | 0.016 | 0.017 | 0.134 | 0.131 | 0.020 |
| Sum | 478.000 | 388.379 | 314.269 | 1484.218 | 442.605 | 439.629 | 411.340 |
| Sum Sq. Dev. | 17.481 | 42.809 | 53.463 | 132.798 | 58.630 | 44.694 | 80.680 |
| Observations | 92 | 92 | 92 | 92 | 92 | 92 | 92 |

Note: Std Dev. – Standard Deviation, Sum Sq Dev – Sum of Square Deviation

Source: Author's Computation 2023.

### 4.3 Correlation Analysis

The correlation matrix offers insights into the relationships between variables, showing the correlation coefficients between different variables. Correlation coefficients measure the strength and direction of the linear relationship between two variables.

From the correlation table, the coefficient between LEXCHR and LFUP is 0.912777, indicating a strong positive correlation. This means that as LEXCHR increases, LFUP tends to increase as well, and vice versa. Also correlation coefficient between LEXCHR and LGL is 0.777066, suggesting a moderately strong positive correlation. As LEXCHR increases, LGL tends to increase, and vice versa, but the relationship is not as strong as the first one. While the correlation coefficient between LEXCHR and LINC is 0.853805, indicating a strong positive correlation. When LEXCHR goes up, LINC tends to go up as well, and vice versa.

The correlation coefficient between LEXCHR and LPF is 0.94436, showing a very strong positive correlation. These two variables are highly positively related. While the correlation coefficient between LEXCHR and LPO is 0.926153, indicating a very strong positive correlation. The correlation coefficient between LEXCHR and LWEA is 0.081132, suggesting a weak positive correlation. The relationship between these two variables is not very strong.

The correlation coefficient between LFUP and LGL is 0.878218, indicating a strong positive correlation between these two variables. While the correlation coefficient between LFUP and LINC is 0.972244, showing a very strong positive correlation. The correlation coefficient between LFUP and LPF is 0.97203, indicating a very strong positive correlation. Also the

correlation coefficient between LFUP and LPO is 0.980899, suggesting a very strong positive correlation.

The correlation coefficient between LGL and LINC is 0.926806, indicating a very strong positive correlation. Also the correlation coefficient between LGL and LPF is 0.909577, showing a strong positive correlation. Likewise the correlation coefficient between LGL and LPO is 0.926126, indicating a very strong positive correlation.

The correlation coefficient between LINC and LPF is 0.966971, suggesting a very strong positive correlation. Likewise the correlation coefficient between LINC and LPO is 0.978879, indicating a very strong positive correlation. Also the correlation coefficient between LPF and LPO is 0.994074, showing an extremely strong positive correlation.

The correlation coefficient between LPO and LWEA is 0.090856, suggesting a weak positive correlation. The relationship between these two variables is not strong. Since LWEA is compared only with itself in the table, the correlation coefficient is 1, which is expected, as any variable will have a perfect correlation with itself.

The implication of this table is that, it provides insights into how strongly and in what direction each pair of variables is correlated. Strong positive correlations (close to 1) suggest that when one variable goes up, the other tends to go up as well, while strong negative correlations (close to -1) would indicate that when one variable goes up, the other tends to go down. Weak correlations (close to 0) imply that the two variables are not strongly related.

**Table 4.2 Correlation Analysis**

| | LEXCHR | LFUP | LGL | LINC | LPF | LPO | LWEA |
|---|---|---|---|---|---|---|---|
| LEXCHR | 1 | 0.912777 | 0.777066 | 0.853805 | 0.94436 | 0.926153 | 0.081132 |
| LFUP | | 1 | 0.878218 | 0.972244 | 0.97203 | 0.980899 | 0.095747 |
| LGL | | | 1 | 0.926806 | 0.909577 | 0.926126 | 0.087937 |
| LINC | | | | 1 | 0.966971 | 0.978879 | 0.097344 |
| LPF | | | | | 1 | 0.994074 | 0.102738 |
| LPO | | | | | | 1 | 0.090856 |
| LWEA | | | | | | | 1 |

**Source: Author's Computation 2023**

**Note**: LEXCHR (Log of Exchange Rate), LFUP (Log of Fuel price), LGL (Log of Government Legislation), LINC (Log of consumer Income), LPF (Log of Price of Food), LPO (Log of Prices of other Goods) and LWEA (Log of Weather Condition).

## 4.4 Covariance Analysis

From the table below LEXCHR shows a weak positive correlation with LFUP (0.271) and LGL (0.258), suggesting a mild positive connection between these variables. LFUP exhibits moderate positive correlations with LGL (0.456) and LINC (0.797), indicating strong positive relationships. It also shows weak positive correlations with LEXCHR (0.271), LPF (0.529), and LPO (0.466). LGL has strong positive correlations with LINC (0.849) and a moderate positive correlation with LFUP (0.456), signifying significant positive associations. Additionally, LGL displays positive but weaker correlations with LEXCHR (0.258), LPF (0.554), and LPO (0.492).

LINC shows strong positive correlations with LFUP (0.797) and LGL (0.849), revealing a substantial positive relationship. It also demonstrates positive but weaker correlations with LEXCHR (0.447), LPF (0.927), and LPO (0.820). LPF has moderate positive correlations with LFUP (0.529) and LINC (0.927), indicating significant positive relationships. Though, it shows weak positive correlations with LEXCHR (0.329), LGL (0.554), and LPO (0.553). LPO displays moderate positive correlations with LFUP (0.466), LINC (0.820), LGL (0.492), and LPF (0.553), highlighting notable positive relationships. There is a weak positive correlation with LEXCHR (0.281). LWEA has very weak positive correlations with all other variables, suggesting a lack of strong associations with the other variables.

The implication of the correlation matrix table below, shows a strong positive relationships between LFUP and both LGL and LINC; a moderate positive correlations between LGL and LINC, as well as LFUP, a weak too mild positive associations for LEXCHR, LPF, and LPO with the other variables. LWEA shows very weak correlations with the other variables, indicating a lack of strong relationships.

| | LEXCHR | LFUP | LGL | LINC | LPF | LPO | LWEA |
|---|---|---|---|---|---|---|---|
| LEXCHR | 0.190006 | | | | | | |
| LFUP | 0.271409 | 0.46532 | | | | | |
| LGL | 0.258211 | 0.456679 | 0.581121 | | | | |
| LINC | 0.447141 | 0.796808 | 0.848837 | 1.443461 | | | |
| LPF | 0.328616 | 0.529326 | 0.553529 | 0.927435 | 0.637287 | | |
| LPO | 0.281383 | 0.46637 | 0.492078 | 0.819714 | 0.553118 | 0.485805 | |
| LWEA | 0.033118 | 0.061163 | 0.062776 | 0.109522 | 0.076805 | 0.059302 | 0.87696 |

**Table 4.3: Result of Covariance Analysis**
**Source: Author's Computation 2023**

## 4.5 Preliminary Tests

Some tests are carried out to ascertain the stationary and relationship of the variables used in this research. One of the tests is the unit root test, the test to determine whether a given time series is stationary or non-stationary. The other test carried out under this heading is the co-integration test. This is the test to investigate the long-term relationships between two or more non-stationary time series variables. The interpretations of the two tests are stated below;

### 4.2.1 Unit Root Test Results

Using the Augmented Dickey Fuller for testing, the table below presents the results of unit root tests for various variables used in this thesis, both at their levels and at their first differences. ADF Test at Level: For most of the variables, including LEXCHR, LFUP, LGL, LINC, LPF, LPO, and LWEA, the ADF (Augmented Dickey-Fuller) test statistics are less than the critical value at a 5% significance level (T-tab), suggesting that these variables have a unit root and are non-stationary when analyzed at their levels. The variables LEXCHR, LFUP, LGL, LINC, LPF, and LPO all have test statistics below their respective critical values, indicating they are integrated of order 1 (I(1)). LWEA also has a test statistic below the critical value, indicating it is I(1).

VFUP and VEXCHR, on the other hand, have test statistics much lower than the critical value at level, suggesting that they are integrated of order 0 (I(0)) and are stationary. ADF Test at First Difference: The test statistics for all variables in their first differences are significantly lower than the corresponding critical values, indicating that differencing the data once (i.e., taking the first difference) makes the variables stationary. Therefore, all the variables, including LEXCHR, LFUP, LGL, LINC, LPF, LPO, and LWEA, are integrated of order 1 (I(1)) when analyzed in their first differences.

The implication is that the unit root test results indicate that when the variables are analyzed at their levels, they have unit roots and are non-stationary (I(1)). However, differencing the data once makes them stationary, and all variables become integrated of order 1 (I(1)) in their first differences. Only VFUP and VEXCHR are integrated of order 0 (I(0)), which means they are stationary at their levels.

**Table 4.4 Results of UNIT ROOT TEST RESULT**

**FOR VARIABLES**

| VARIABLE | AT LEVEL | | AT FIRST DIFFERENCE | | Conclusion |
|---|---|---|---|---|---|
| | ADF Test | T-tab | ADF Test | T-tab | |
| LEXCHR | 0.614 | -2.584 | -7.92 | -3.505*** | I(1) |
| LFUP | -0.896 | -2.584 | -8.362 | -3.505*** | I(1) |
| LGL | -1.728 | -2.584 | -6.087 | -3.507*** | I(1) |
| LINC | -1.126 | -2.584 | -10.288 | -3.505*** | I(1) |
| LPF | 0.582 | -2.584 | -5.432 | -3.509*** | I(1) |
| LPO | -0.75 | -2.584 | -8.14 | -3.506*** | I(1) |
| LWEA | -2.804 | -2.585 | -5.046 | -3.514*** | I(1) |
| VFUP | -7.267 | -2.584 | | | I(0) |
| VEXCHR | -9.662 | -2.584 | | | I(0) |

**Source: Author's Computation 2023.**

## 4.6 Co-Integration Test

The results of the bounds co-integration test reveal evidence of co-integration, indicating the presence of long-term relationships among various sets of variables for different objectives.

**Objective one:** The F-statistic (8.771) is significantly higher than the critical values at 1%, 5%, and 10% significance levels for both integrated orders (I(0) and I(1)). This suggests that co-integration exists among these variables, indicating a long-term relationship among them.

**Objective Three:** Similar to the first objective, the F-statistic (8.049) surpasses the critical values for both integrated orders, implying co-integration among these variables, signifying a long-term connection.

**Objective 4 (+):** In this case, the F-statistic (4.788) exceeds the critical values at the 1% and 5% significance levels for both integrated orders (I(0) and I(1)), indicating evidence of co-integration among these variables, suggesting a long-term relationship.

**Objective 4 (-):** Once again, the F-statistic (3.675) surpasses the critical values for all significance levels, both I(0) and I(1), indicating the presence of co-integration among these variables, implying a long-term relationship or association exists among the variables.

The implication of these results demonstrates that co-integration exists in all the examined objectives, implying that there are long-term relationships among the respective sets of variables used in the model.

**Table: 4.5 Result of Co-integration Test Results**

| Model | F-Statistics | K | Bound Test | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1% I(0) | 1% I(1) | 5% I(0) | 5% I(1) | 10% I(0) | 10% I(1) |
| Objective 1; LEXCHR,LFUP,LGL,LINC,LPO,LWEA | 8.771 | 6 | 2.66 | 4.05 | 2.04 | 3.24 | 1.75 | 2.87 |
| Objective 3; LGL,LINC,LPO,LWEA,VFUP,VEXCHR | 8.049 | 6 | 2.66 | 4.05 | 2.04 | 3.24 | 1.75 | 2.87 |
| Objective 4 (+); LPF,LFUP,LEXCHR,LPO | 4.788 | 4 | 3.07 | 4.44 | 2.26 | 3.48 | 1.9 | 3.01 |
| Objective 4- ;LFUP,LEXCHR,LPO,LGL,LINC,LWEA | 3.675 | 6 | 2.66 | 4.05 | 2.04 | 3.24 | 1.75 | 2.87 |

**Source: Author's Computation 2023.**

### 4.6.1 Effect of fuel price and exchange rate on food price in Nigeria

The table below presents the coefficients, standard errors, and t-statistics for both the long run and short run for various variables to achieve objective one.

Exchange rate Coefficient is 0.582, in the long- run, a 1% increase in Exchange rate is associated with an expected 58.2% increase in the dependent variable. Fuel price Coefficient: -0.26, a 1% increase in fuel price is associated with an expected 26% decrease in the dependent variable, which is contrary to a priory expectation. LGL Coefficient: -0.339, a 1% increase in LGL is associated with an expected 33.9% decrease in the dependent variable. LINC Coefficient: -0.182, a 1% increase in LINC is associated with an expected 18.2% decrease in the dependent variable. LWEA Coefficient: -0.248, a 1% increase in LWEA is associated with an expected 24.8% decrease in the dependent variable. For all the variables stated above i.e. LEXCHR, LFUP, LGL, LINC and LWEA their relationship is not statistically significant except for LPO Coefficient: 1.842, a 1% increase in LPO is associated with an expected 184.20% increase in the dependent variable. This relationship is statistically significant.

In the short run, these coefficients represent the short-run impacts of LPF at different lags, with some having significant negative effects and others being less influential. The interpretation follows a similar pattern for the variable D(LEXCHR), D(LFUP), D(LGL), D(LINC), D(LPO), and D(LWEA) at various lags. Each coefficient represents the short-term percentage change in the dependent variable due to a 1% change in the corresponding independent variable at the specified lag.

The error correction term (ECM (-1)) reflects how deviations from the long-term equilibrium are corrected in the short run. A coefficient of -0.2 suggests that a 1% deviation from the

long-term relationship results in an expected 20% correction in the dependent variable in the following period. These short-run results provide insights into the immediate effects of past values of the variables on the dependent variable, considering their logarithmic form and lagged relationships.

**Table: 4.6**
**Result of the effect of Exchange rate and Fuel price on Food price in Nigeria.**

| | LONG | RUN | |
|---|---|---|---|
| Variable | Co-efficient | Standard error | T-Statistics |
| LEXCHR | 0.582 | 0.402 | 1.449 |
| LFUP | -0.26 | 0.224 | -1.164 |
| LGL | -0.339 | 0.179 | -1.898 |
| LINC | -0.182 | 0.095 | -1.914 |
| LPO | 1.842 | 0.319 | 5.779 |
| LWEA | -0.248 | 0.34 | -0.73 |
| | | | |
| | SHORT | RUN | |
| Δ(LPF(-1)) | -0.222 | 0.106 | -2.088 |
| Δ (LPF(-2)) | -0.164 | 0.104 | -1.578 |
| Δ (LPF(-3)) | -0.45 | 0.106 | -4.266 |
| Δ (LPF(-4)) | 0.14 | 0.083 | 1.679 |
| Δ (LPF(-5)) | 0.054 | 0.079 | 0.676 |
| Δ (LPF(-6)) | -0.585 | 0.077 | -7.598 |
| Δ (LPF(-7)) | -0.091 | 0.098 | -0.926 |
| Δ (LPF(-8)) | -0.105 | 0.099 | -1.066 |
| Δ (LPF(-9)) | -0.505 | 0.095 | -5.324 |
| Δ (LEXCHR) | -0.08 | 0.039 | -2.04 |
| Δ (LEXCHR(-1)) | -0.188 | 0.044 | -4.284 |
| Δ (LEXCHR(-2)) | -0.218 | 0.05 | -4.397 |
| Δ (LEXCHR(-3)) | -0.014 | 0.045 | -0.316 |
| Δ (LEXCHR(-4)) | -0.082 | 0.048 | -1.688 |
| Δ (LEXCHR(-5)) | -0.082 | 0.047 | -1.746 |
| Δ (LEXCHR(-6)) | -0.113 | 0.043 | -2.617 |
| Δ (LFUP) | 0.133 | 0.032 | 4.157 |
| Δ (LFUP(-1)) | 0.156 | 0.039 | 3.981 |
| Δ (LFUP(-2)) | 0.139 | 0.039 | 3.555 |
| Δ (LFUP(-3)) | 0.128 | 0.035 | 3.649 |
| Δ (LFUP(-4)) | 0.072 | 0.029 | 2.452 |
| Δ (LFUP(-5)) | 0.084 | 0.027 | 3.048 |
| Δ (LGL) | -0.17 | 0.046 | -3.697 |
| Δ (LGL(-1)) | 0.158 | 0.051 | 3.121 |
| Δ (LGL(-2)) | -0.043 | 0.047 | -0.931 |
| Δ (LGL(-3)) | 0.044 | 0.049 | 0.914 |
| Δ (LGL(-4)) | -0.081 | 0.065 | -1.243 |
| Δ (LGL(-5)) | 0.218 | 0.067 | 3.232 |
| Δ (LGL(-6)) | -0.157 | 0.063 | -2.474 |
| Δ (LGL(-7)) | -0.074 | 0.051 | -1.448 |
| Δ (LINC) | -0.008 | 0.03 | -0.266 |

| | | | |
|---|---|---|---|
| Δ (LINC(-1)) | 0.054 | 0.031 | 1.763 |
| Δ (LINC(-2)) | -0.02 | 0.033 | -0.628 |
| Δ (LINC(-3)) | 0.066 | 0.034 | 1.953 |
| Δ (LINC(-4)) | 0.094 | 0.025 | 3.762 |
| Δ (LINC(-5)) | 0.056 | 0.025 | 2.258 |
| Δ (LINC(-6)) | 0.06 | 0.02 | 2.964 |
| Δ (LINC(-7)) | 0.052 | 0.021 | 2.447 |
| Δ (LPO) | 0.013 | 0.126 | 0.101 |
| Δ (LPO(-1)) | -0.181 | 0.15 | -1.207 |
| Δ (LPO(-2)) | -0.691 | 0.131 | -5.283 |
| Δ (LPO(-3)) | -0.443 | 0.132 | -3.358 |
| Δ (LPO(-4)) | -0.466 | 0.107 | -4.35 |
| Δ (LPO(-5)) | -0.846 | 0.114 | -7.394 |
| Δ (LWEA) | -0.015 | 0.01 | -1.524 |
| Δ (LWEA(-1)) | 0.024 | 0.014 | 1.782 |
| Δ (LWEA(-2)) | 0.04 | 0.017 | 2.328 |
| Δ (LWEA(-3)) | 0.029 | 0.02 | 1.449 |
| Δ (LWEA(-4)) | 0.02 | 0.022 | 0.935 |
| Δ (LWEA(-5)) | 0.016 | 0.021 | 0.782 |
| Δ (LWEA(-6)) | -0.006 | 0.016 | -0.399 |
| Δ (LWEA(-7)) | -0.013 | 0.011 | -1.266 |
| ECM(-1) | -0.2 | 0.023 | -8.799 |

| | | | |
|---|---|---|---|
| R-squared | 0.930386 | Mean dependent var | 0.031229 |
| Adjusted R-squared | 0.80556 | S.D. dependent var | 0.028994 |
| S.E. of regression | 0.012785 | Akaike info criterion | -5.62785 |
| Sum squared resid | 0.00474 | Log likelihood | 283.7419 |
| Durbin-Watson stat | 2.201651 | | |

**SOURCE: Author's Computation 2023.**

### 4.6.2 Outcome of the post estimation test for objective one: Effect of fuel price and exchange rate on food price in Nigeria.

The post estimation test table shows the reliability and validity of the model. The normality value: 0.984 (0.611) indicates the residual normally distributed. Auto-correlation value: 3.137 (0.064) indicates no Auto-correlation detected. Heteroskedasticity value: 0.972 (0.553) indicates there is no heteroskedasticity. Omission of variable value: 2.000 (0.171) indicates no omitted variable. Stability; cumsum: see graph below. There is slight instability. Cumsum of squares: see graph below. There is stability

The table provides various statistical test results and their corresponding conclusions, which are crucial for assessing the quality and reliability of a statistical model or dataset. Some of the values are accompanied by p-values, which help determine the statistical significance of the results. Additionally, references to "graphs below" indicate that a visual inspection may be necessary for a more complete understanding of the assessments.

**Table: 4.7 Result of Post Estimation Test**

| Test | Statistics | Conclusion |
|---|---|---|
| Normality | 0.984 (0.611) | Residual normally distributed |
| Auto-correlation | 3.137 (0.064) | No Auto-correlation |
| Heteroskedasticity | 0.972 (0.553) | There is no heteroskedasticity |
| Omission of variable | 2.000 (0.171) | No omitted variable |
| Stability; cumsum | see graph below | There is sligt instability |
| cumsum of squares | see graph below | There is stability |

**Source: Researcher's computation, 2023**

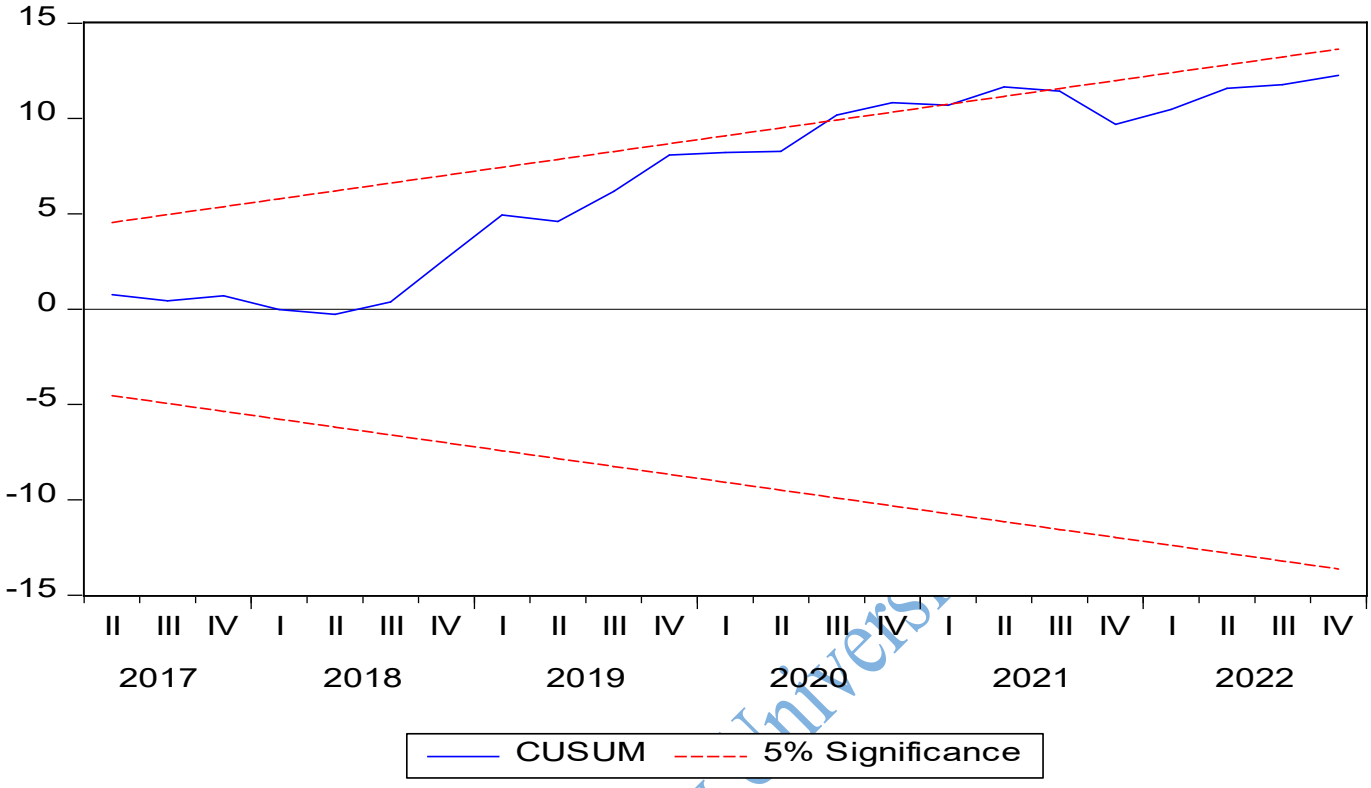


**Figure 4.8: Graph of CUSUM at 5% significance**
**Source: Author's computation 2023.**

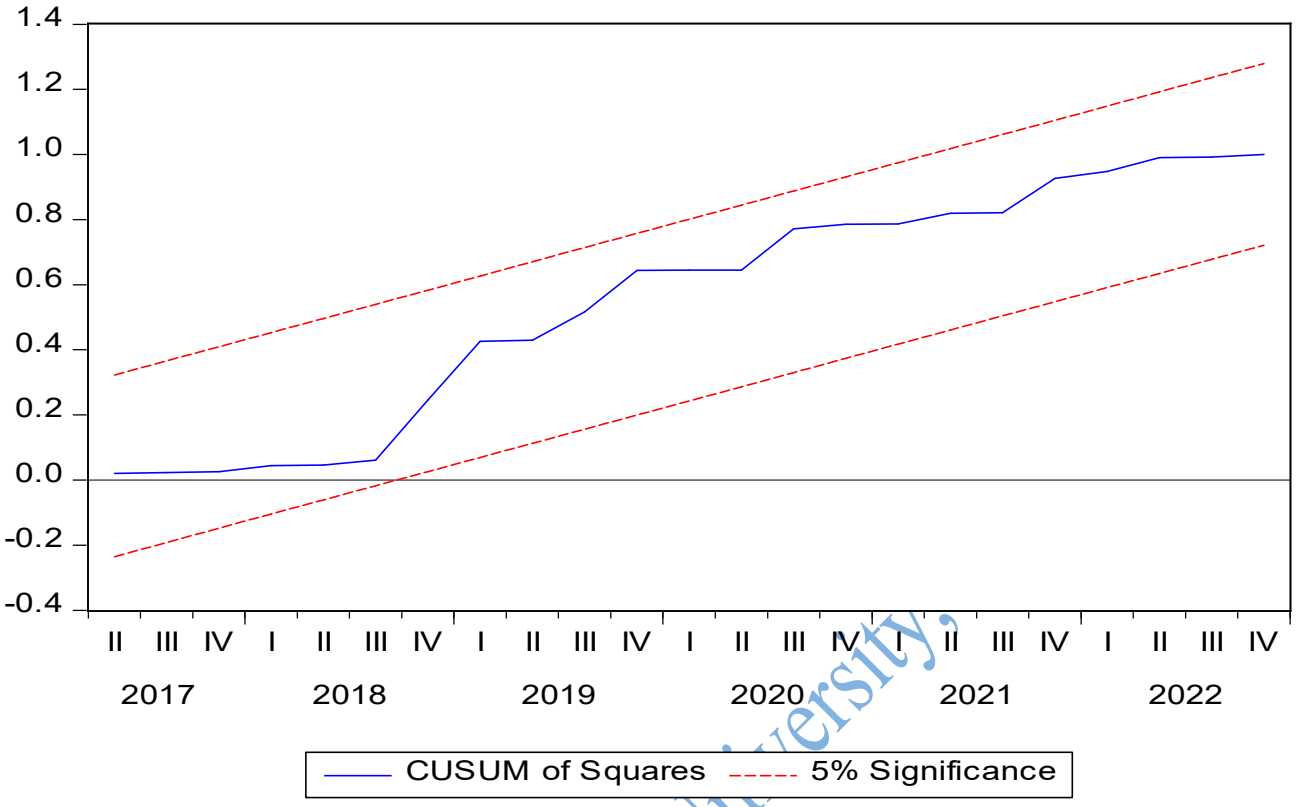


**Figure 4.9: Graph of CUSUM of squares at 5% significance**
**Source: Author's Computation 2023.**

### 4.7 Analyze the level of volatility in fuel price and exchange rate in Nigeria

#### 4.7.1 Result of Best Fitted Volatility Models for Exchange rate (LEXCHR)

The schedule below shows different volatility models with their respective log-likelihood values. The objective is to ascertain the best fitted volatility model for Exchange rate among the various values presented below;

ARCH(1) model: Log-likelihood = -3.852. This is an Autoregressive Conditional Heteroskedasticity (ARCH) model of order 1. It models the conditional variance of a time series based on its past squared observations. TGARCH(1, 2, 1) model: Log-likelihood = -3.619. This is a Threshold GARCH (TGARCH) model with orders 1, 2, and 1. It's a generalized version of the GARCH model that includes a threshold parameter. The TGARCH model allows for asymmetric volatility responses. TGARCH(3, 3, 1) model: Log-likelihood = -3.171. Similar to the previous model but with different order parameters. The use of a higher order might indicate a more complex model. EGARCH (1, 1, 1) model: Log-likelihood = -4.109. Exponential GARCH (EGARCH) is another extension of the GARCH model that allows for asymmetric volatility. This model has orders 1, 1, and 1. EGARCH(1, 2, 1) model: Log-likelihood = -4.118. Similar to the previous EGARCH model but with a different lag structure.

EGARCH(2, 2, 1) model: Log-likelihood = -4.31. This EGARCH model has different order parameters than the previous ones. EGARCH(2, 2, 2) model: Log-likelihood = -4.357. This EGARCH model has an additional parameter compared to the previous EGARCH(2, 2, 1) model. EGARCH(3, 3, 2) model: Log-likelihood = -4.33. Another EGARCH model with different order parameters, including an additional lag parameter. EGARCH(3, 3, 3) model: Log-likelihood = -4.611. Similar to the previous EGARCH models, but with higher-order

parameters. EGARCH(4, 3, 3) model: Log-likelihood = -4.629. This EGARCH model has a different order structure with a higher order for one of the parameters. EGARCH(4, 4, 3) model: Log-likelihood = -4.55. Another EGARCH model with a similar order structure but a different lag parameter.

The log-likelihood values serve as a measure of how well each model fits the observed data. A higher log-likelihood indicates a better fit. Therefore, based on the log-likelihood values, the EGARCH(4, 3, 3) model has the highest log-likelihood of -4.629, that provides the best fit among the models listed.

**Table 4.8 Best fitted volatility model for exchange rate (LEXCHR)**

RESULT OF BEST FITTED VOLATILITY MODELS FOR LEXCHR

| Model | AKAIKE Information Criterion (EXCHR) | Selected Model |
|---|---|---|
| ARCH (1) | -3.852 | |
| TGARCH (1 2 1) | -3.619 | |
| TGARCH (3 3 1 ) | -3.171 | |
| EGARCH (1 1 1 ) | -4.109 | |
| EGARCH (1 2 1) | -4.118 | |
| EGARCH (2 2 1) | -4.31 | |
| EGARCH (2 2 2) | -4.357 | |
| EGARCH (3 3 2) | -4.33 | |
| EGARCH (3 3 3) | -4.611 | |
| EGARCH (4 3 3) | -4.629 | BEST MODEL |
| EGARCH (4 4 3) | -4.55 | |

**Source**: **Author's Computation 2023.**

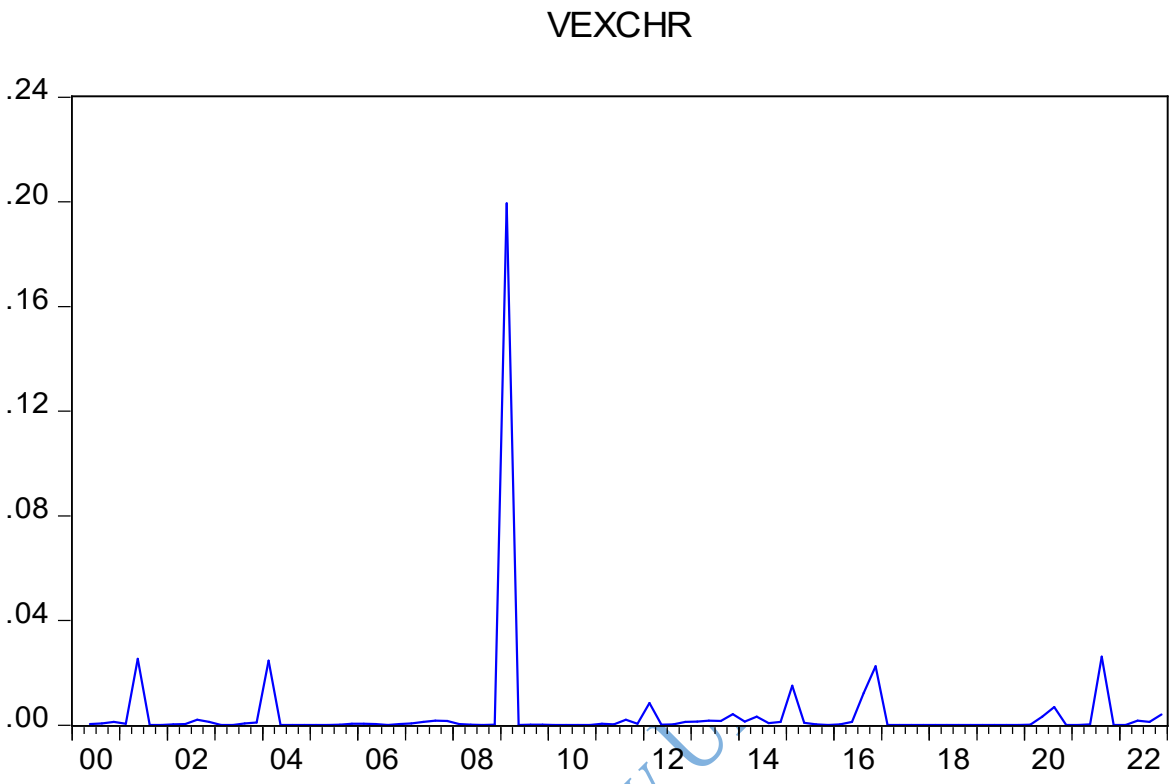


**Figure: 4.10: Graph of Exchange rate volatility 2000-2022**
**Source: Author's Computation 2023.**

### 4.7.2 **Result of best fitted volatility models for fuel price (LFUP)**

The schedule below consist of log-likelihood values associated with different GARCH(1,1) models applied to a model time series referred to as LFUP (Log of Fuel Price). These log-likelihood values are crucial in assessing how well each model fits the econometrics data. A higher log-likelihood value indicates a better fit, implying that the model can explain the variation and characteristics of the observed data more effectively. GARCH(1,1) model: Log-likelihood = -2.609, GARCH(1,1) model: Log-likelihood = -2.761, GARCH(1,1) model: Log-likelihood = -2.845, GARCH(1,1) model: Log-likelihood = -2.868, GARCH(1,1) model: Log-likelihood = -3.019, GARCH(1,1) model: Log-likelihood = -3.071.

To determine the best-fitted model for the LFUP data. The model with the highest log-likelihood value is selected. In this case, the GARCH(1,1) model with a log-likelihood of -3.071 stands out as the best-fitted model because it has the highest log-likelihood value. This suggests that it provides the most effective explanation and modeling of the LFUP time series data when compared to the other GARCH(1,1) models.

Table 4.9 **BEST FITTED VOLATILITY MODEL FOR LFUP**

| Model | AKAIKE Information Criterion (LFUP) | Selected Model |
|---|---|---|
| GARCH (1 1) | -2.609 | |
| | -2.761 | |
| | -2.845 | |
| | -2.868 | |
| | -3.019 | |
| | -3.071 | BEST MODEL |

**Source: Author's Computation 2023.**

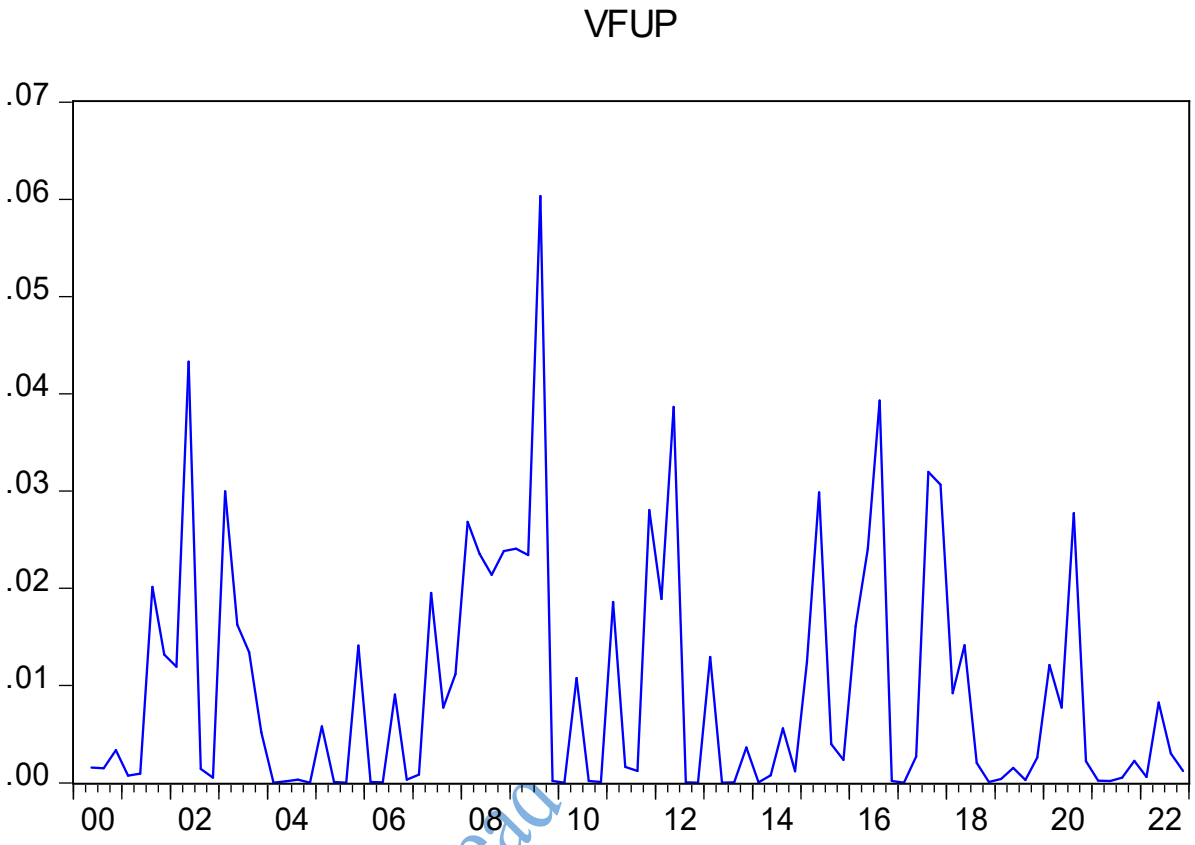


**Figure 4.11; Graph of fuel price volatility 2000-2022**
**Source: Author's Computation 2023.**

### 4.7.3 Outcome of post estimation test for objective two: Level of volatility in fuel price and exchange rate in Nigeria.

The result indicates normality for the variable VEXCHR. The test statistic is 3.086, and its associated p-value is 0.214. In this case, a p-value of 0.214 suggests that there is no strong evidence to reject the null hypothesis that VEXCHR follows a normal distribution at a typical significance level at 0.05. The result indicates a normality test for the variable VFUP. The test statistic is 5.859, and its associated p-value is 0.053. Similar to the previous case, a p-value of 0.053 suggests weak evidence against the null hypothesis that VFUP follows a normal distribution.

The result indicates a test for serial correlation in the variable VFUP. The test statistic is 6.106, and its associated p-value is 0.047. A p-value of 0.047 suggests some evidence against the null hypothesis of no serial correlation.

The result indicates a test for heteroskedasticity in the variable VEXCHR. The test statistic is 0.001, and its associated p-value is 0.980. A p-value of 0.980 suggests no evidence to reject the null hypothesis of heteroskedasticity (constant variance). The result indicates a test for heteroskedasticity in the variable VFUP. The test statistic is 2.143, and its associated p-value is 0.147. Similar to the previous case, a p-value of 0.147 suggests no strong evidence against the null hypothesis of heteroskedasticity for the VFUP variable.

VEXCHR and VFUP may be reasonably assumed to follow a normal distribution, as the p-values for their normality tests are greater than a typical significance level (e.g., 0.05). VFUP shows some evidence of serial correlation, as the p-value for its serial correlation test is less than 0.05. Both VEXCHR and VFUP are not exhibiting significant heteroskedasticity, as their p-values for heteroskedasticity tests are greater than 0.05.

Table 4.10 **Result of Post Estimation Test for Objective Two**

| **Result of Post Estimation Tests** | | |
|---|---|---|
| Test | Statistics | Conclusion |
| Normality (VEXCHR) | 3.086 (0.214) | Residual is normally distributed |
| Normality (VFUP) | 5.859 (0.053) | Residual is normally distributed |
| Serial Correlation (VFUP) | 6.106 (0.047) | There is Serial Correlation |
| Heteroskedasticity (VEXCHR) | 0.001 (0.980) | There is no heteroskedasticity |
| Heteroskedasticity (VFUP) | 2.143 (0.147) | There is no heteroskedasticity |

**Source:** Author's Computation 2023.

## 4.8 Examine the effect of the volatility in fuel price and exchange rate on food price in Nigeria.

The provided log values for both the long run and short run schedules contain regression coefficients, standard errors, and t-statistics for various variables.

The Government expenditure on Agriculture (LGL) is -1.150, with a standard error of 1.370. The t-statistics value of -0.839 suggests that this variable may not be statistically significant in the long run. Consumer Income (LINC) has -0.195, with a standard error of 0.225. The t-statistics of -0.864 indicate that LINC may also not be statistically significant in the long run. The Price of other goods (LPO) has 3.413, and its standard error is 2.408. The t-statistics value of 1.417 suggests that LPO might be statistically significant in the long run.

Weather Condition (LWEA) has -0.861 and a standard error of 1.249. The t-statistics value of -0.689 indicates that LWEA may not be statistically significant in the long run. The Volatility in Fuel Price (VFUP) is -5.186, with a standard error of 8.665. The t-statistics value of -0.598 suggests that VFUP may not be statistically significant in the long run. The volatility in Exchange rate (VEXCHR) has 23.384 and a standard error of 30.569. The t-statistics value of 0.765 suggests that VEXCHR may not be statistically significant in the long run.

The short run schedule includes lagged variables, changes in variables, and the error correction term (ECM). D(LPF(-1)) to D(LWEA(-7)), These represent lagged changes in various variables. For instance, D(LPF(-1)) has a coefficient of -0.003, with a standard error of 0.088 and a t-statistics value of -0.035. Similar interpretations can be made for other lagged variables. Negative coefficients may indicate a short-run negative relationship.ECM (Error Correction Term): Coefficient: -0.048, Standard Error: 0.006, T-Statistics: -8.077 The error correction term (ECM) has a coefficient of -0.048, a very small standard error of 0.006,

and a highly significant t-statistics value of -8.077. This suggests that the ECM is statistically significant in the short run and plays a vital role in adjusting the long-run equilibrium.

The implication is that in the long run, the analysis indicates that LPO might be statistically significant, while other variables are less likely to be statistically significant in the long run. In the short run, lagged changes in variables and the ECM appear to have more significant impacts on the model's dynamics, with the ECM being particularly important in correcting deviations from long-run equilibrium.

**Objective 3**
**Table 4.11:**

| | **LONG** | **RUN** | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| LGL | -1.150 | 1.370 | -0.839 |
| LINC | -0.195 | 0.225 | -0.864 |
| LPO | 3.413 | 2.408 | 1.417 |
| LWEA | -0.861 | 1.249 | -0.689 |
| VFUP | -5.186 | 8.665 | -0.598 |
| VEXCHR | 23.384 | 30.569 | 0.765 |

| **SHORT** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| Δ(LPF(-1)) | -0.003 | 0.088 | -0.035 |
| Δ (LPF(-2)) | -0.252 | 0.086 | -2.931 |
| Δ (LPF(-3)) | -0.466 | 0.084 | -5.566 |
| Δ (LPF(-4)) | 0.099 | 0.080 | 1.244 |
| Δ (LPF(-5)) | -0.074 | 0.076 | -0.969 |
| Δ (LPF(-6)) | -0.515 | 0.075 | -6.823 |
| Δ (LGL) | -0.117 | 0.045 | -2.597 |
| Δ (LGL(-1)) | 0.047 | 0.056 | 0.843 |
| Δ (LGL(-2)) | -0.034 | 0.054 | -0.634 |
| Δ (LGL(-3)) | 0.210 | 0.058 | 3.612 |
| Δ (LGL(-4)) | -0.080 | 0.060 | -1.332 |
| Δ (LGL(-5)) | 0.146 | 0.055 | 2.657 |
| Δ (LGL(-6)) | -0.150 | 0.056 | -2.661 |
| Δ (LGL(-7)) | 0.238 | 0.044 | 5.413 |
| Δ (LINC) | 0.205 | 0.032 | 6.346 |
| Δ (LINC(-1)) | 0.120 | 0.033 | 3.598 |
| Δ (LINC(-2)) | 0.107 | 0.033 | 3.221 |
| Δ (LINC(-3)) | 0.196 | 0.031 | 6.231 |
| Δ (LPO) | 0.043 | 0.080 | 0.530 |
| Δ (LPO(-1)) | 0.260 | 0.082 | 3.175 |
| Δ (LPO(-2)) | -0.324 | 0.097 | -3.340 |
| Δ (LPO(-3)) | 0.074 | 0.097 | 0.769 |
| Δ (LPO(-4)) | 0.084 | 0.097 | 0.871 |
| Δ (LPO(-5)) | -0.526 | 0.094 | -5.568 |
| Δ (LPO(-6)) | 0.422 | 0.084 | 5.043 |
| Δ (LWEA) | -0.006 | 0.008 | -0.713 |
| Δ (LWEA(-1)) | 0.023 | 0.012 | 1.908 |
| Δ (LWEA(-2)) | 0.026 | 0.014 | 1.885 |
| Δ (LWEA(-3)) | 0.010 | 0.015 | 0.690 |
| Δ (LWEA(-4)) | -0.014 | 0.015 | -0.936 |
| Δ (LWEA(-5)) | -0.010 | 0.014 | -0.743 |
| Δ (LWEA(-6)) | -0.021 | 0.011 | -1.932 |
| Δ (LWEA(-7)) | -0.013 | 0.008 | -1.534 |

| | | | |
|---|---|---|---|
| Δ (VFUP) | -0.006 | 0.149 | -0.038 |
| Δ (VFUP(-1)) | 0.463 | 0.149 | 3.107 |
| Δ (VEXCHR) | 0.203 | 0.103 | 1.980 |
| Δ (VEXCHR(-1)) | -0.637 | 0.148 | -4.287 |
| Δ (VEXCHR(-2)) | -0.230 | 0.138 | -1.666 |
| Δ (VEXCHR(-3)) | 0.347 | 0.123 | 2.825 |
| ECM | -0.048 | 0.006 | -8.077 |

| | | | |
|---|---|---|---|
| R-squared | 0.873599 | Mean dependent var | 0.03132 |
| Adjusted R-squared | 0.761562 | S.D. dependent var | 0.028687 |
| S.E. of regression | 0.014008 | Akaike info criterion | -5.39265 |
| Sum squared resid | 0.008634 | | |
| Log likelihood | 266.4913 | | |
| Durbin-Watson stat | 1.756882 | | |

### 4.8.1 Outcome of the post estimation test for objective three

Post-estimation test schedule provides results related to various statistical tests conducted on the model. The normality test result shows a p-value of 0.438 with a corresponding value of 0.803 in parentheses. This indicates that the residuals of the model appear to be normally distributed. Meaning, the assumption that the errors follow a normal distribution is not violated.

The serial-correlation test result displays a p-value of 0.913 with a corresponding value of 0.411 in parentheses. The high p-value suggests that there is no evidence of serial correlation in the residuals. In simpler terms, the errors do not exhibit a systematic pattern of correlation with one another. The heteroskedasticity test result shows a p-value of 0.889 with a corresponding value of 0.650 in parentheses. This result indicates that there is no evidence of heteroskedasticity in the residuals. Heteroskedasticity would imply that the variance of the errors varies systematically with the independent variables, but in this case, there is no such issue.

The test for the omission of variables yields a p-value of 2.996 with a corresponding value of 0.092 in parentheses. This result suggests that there is no omitted variable bias in the model. In other words, the model includes all the relevant variables necessary to explain the relationship being studied. The result indicates that stability is present, and further details are provided in a graph. However, "stability" generally implies that the model remains consistent over time or across different conditions.

The implication indicates that the model's residuals are normally distributed, there is no evidence of serial correlation or heteroskedasticity, and no variables appear to have been omitted. The model also demonstrates stability, which suggests that its relationship remains

consistent over time or across different conditions. These findings suggest that the model's specification is appropriate and that it provides a good fit for the data under consideration.

**Table 4.12 Result Post Estimation Test: Examine the effect of the volatility in fuel price and exchange rate on food prices in Nigeria.**

**Result of Post Estimation Tests**

| Test | Statistics | Conclusion |
|---|---|---|
| Normality | 0.438 (0.803) | Residual normally distributed |
| Serial-correlation | 0.913 (0.411) | There is Serial-correlation |
| Heteroskedasticity | 0.889 (0.650) | There is no heteroskedasticity |
| Omission of variable | 2.996 (0.092) | No omitted variable |
| Stability; cumsum | see graph below | There is stability |
| cumsum of squares | see graph below | There is stability |

**Source: Author's Computation 2023.**

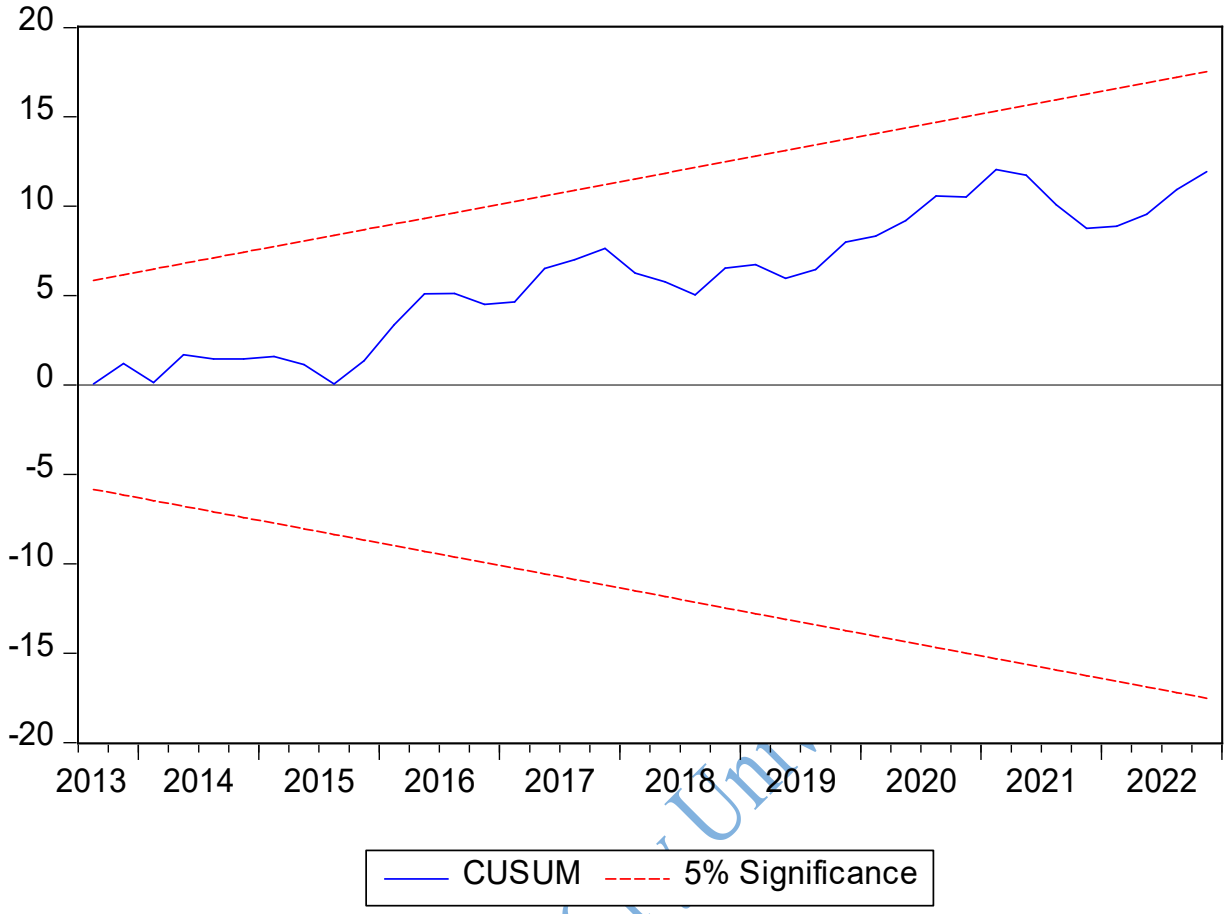


**Figure 4.12: Graph of CUSUM at 5% significance**
**Source: Author's computation 2023.**

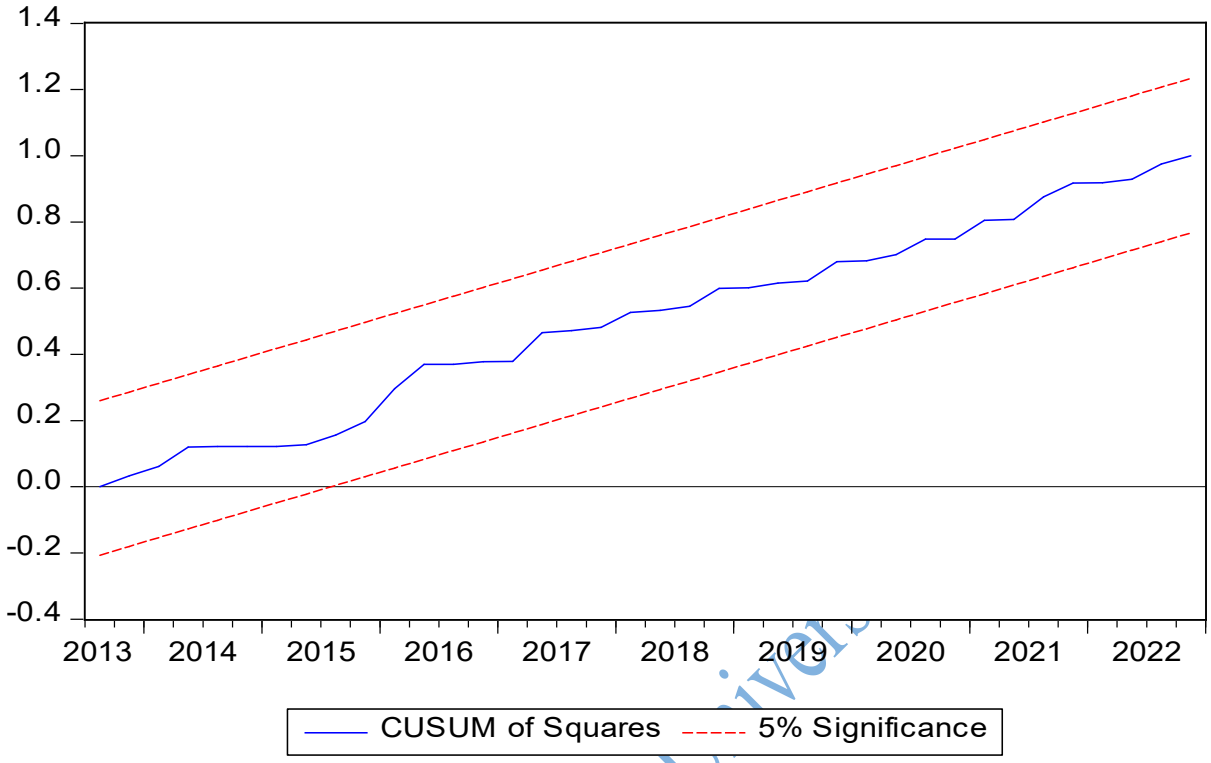


**Figure 4.13: Graph of CUSUM of squares at 5% significance.**
**Source: Author's computation 2023.**

## 4.9 Evaluate the asymmetric effect of volatility in fuel price and exchange rate on food price in Nigeria.

The schedule below shows the regression results for both the long run and short run analysis Part A for objective 4. In the long run, the variable VFUP has a coefficient of 95.66473. However, its high standard error of 211.0924 and a t-statistic of 0.453189 indicate that VFUP may not be statistically significant in explaining the dependent variable.

**VEXCHR_POS and VEXCHR_NEG:** Both variables have negative coefficients, -430.7591 and -435.2725, respectively. However, their high standard errors (924.8103 and 933.2502) and t-statistics (-0.465781 and -0.466405) suggest that they may not be statistically significant in the long run. LPO has a positive coefficient of 0.791458, and its standard error is relatively low at 0.416125. The t-statistic of 1.901972 suggests that LPO may be statistically significant in explaining the dependent variable in the long run.

In the short run, the analysis includes various lagged changes in the dependent variable (LPF) and the independent variables, as well as the error correction term (ECM) with a lag of -1. The significance of these variables varies: D(LPF(-1)) to D(LPF(-10)) have different coefficients and standard errors. Some are statistically significant e.g., D(LPF(-4), D(LPF(-5))) based on their t-statistics. D(VFUP) and its lagged values (D(VFUP(-1)) to D(VFUP(-9))) have coefficients with mixed levels of significance, with some being statistically significant and others not statistically significant, as indicated by their t-statistics. D(VEXCHR_POS) and its lagged values also have varying levels of significance, with some being statistically significant in the short run.

D(VEXCHR_NEG) and its lagged values follow a similar pattern, with some being statistically significant based on their t-statistics. D(LPO) and its lagged values have varying

levels of significance, with some being statistically significant. The ECM (-1) is statistically significant with a coefficient of -0.027452 and a t-statistic of -5.25568, suggesting it plays a significant role in the short-run relationship.

The implication in the long-run results suggests that LPO may be a statistically significant variable, while VFUP, VEXCHR_POS, and VEXCHR_NEG are not. In the short run, the significance of the variables varies, with some lagged changes, VFUP, and VEXCHR_POS being statistically significant, while others are not, as indicated by their t-statistics. The error correction term (ECM) is statistically significant and plays a role in the short-run relationship.

**Table: 4.13: Result of Asymmetric effect of volatility in fuel price and exchange rate on food price ion Nigeria (Positive)**

| **LONG** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| VFUP | 95.66473 | 211.0924 | 0.453189 |
| VEXCHR_POS | -430.7591 | 924.8103 | -0.465781 |
| VEXCHR_NEG | -435.2725 | 933.2502 | -0.466405 |
| LPO | 0.791458 | 0.416125 | 1.901972 |

| **SHORT** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| Δ(LPF(-1)) | 0.019288 | 0.141302 | 0.136501 |
| Δ (LPF(-2)) | -0.261009 | 0.14758 | -1.768596 |
| Δ (LPF(-3)) | -0.338242 | 0.130631 | -2.589296 |
| Δ (LPF(-4)) | 0.089266 | 0.095004 | 0.939605 |
| Δ (LPF(-5)) | 0.137772 | 0.083467 | 1.650627 |
| Δ (LPF(-6)) | -0.312864 | 0.081009 | -3.862076 |
| Δ (LPF(-7)) | -0.043284 | 0.079065 | -0.547447 |
| Δ (LPF(-8)) | 0.14276 | 0.092084 | 1.550317 |
| Δ (LPF(-9)) | -0.449293 | 0.098359 | -4.567881 |
| Δ (VFUP) | -0.038762 | 0.181922 | -0.213071 |
| Δ (VFUP(-1)) | -2.482846 | 0.499344 | -4.972215 |
| Δ (VFUP(-2)) | -2.078436 | 0.446479 | -4.655172 |
| Δ (VFUP(-3)) | -2.017737 | 0.398104 | -5.068367 |
| Δ (VFUP(-4)) | -1.471099 | 0.358121 | -4.107824 |
| Δ (VFUP(-5)) | -1.181456 | 0.317707 | -3.718697 |
| Δ (VFUP(-6)) | -1.055218 | 0.279492 | -3.775488 |
| Δ (VFUP(-7)) | -0.885736 | 0.2386 | -3.712228 |
| Δ (VFUP(-8)) | -0.773026 | 0.200971 | -3.846456 |
| Δ (VFUP(-9)) | -0.451248 | 0.177327 | -2.544722 |
| Δ (VEXCHR_POS) | 0.088165 | 0.054082 | 1.630196 |
| Δ (VEXCHR_POS(-1)) | 10.86803 | 2.439592 | 4.454855 |
| Δ (VEXCHR_POS(-2)) | 9.563443 | 2.286404 | 4.182743 |
| Δ (VEXCHR_POS(-3)) | 11.00426 | 1.965975 | 5.597358 |
| Δ (VEXCHR_POS(-4)) | 9.923883 | 1.903847 | 5.212542 |
| Δ (VEXCHR_POS(-5)) | 8.467345 | 1.802954 | 4.696374 |
| Δ (VEXCHR_POS(-6)) | 6.955907 | 1.659537 | 4.191475 |
| Δ (VEXCHR_POS(-7)) | 5.406597 | 1.406331 | 3.844469 |
| Δ (VEXCHR_POS(-8)) | 3.868187 | 1.106072 | 3.497228 |
| Δ (VEXCHR_POS(-9)) | 1.490143 | 0.757799 | 1.966411 |

| | | | |
|---|---|---|---|
| Δ (VEXCHR_NEG) | -1.098871 | 1.152991 | -0.953061 |
| Δ(VEXCHR_NEG(-1)) | 9.622969 | 2.298653 | 4.186351 |
| Δ(VEXCHR_NEG(-2)) | 11.02788 | 1.971413 | 5.593895 |
| Δ(VEXCHR_NEG(-3)) | 9.891945 | 1.905802 | 5.190437 |
| Δ(VEXCHR_NEG(-4)) | 8.52076 | 1.801724 | 4.729225 |
| Δ(VEXCHR_NEG(-5)) | 6.977066 | 1.659242 | 4.204972 |
| Δ(VEXCHR_NEG(-6)) | 5.360801 | 1.423316 | 3.766417 |
| Δ(VEXCHR_NEG(-7)) | 3.827081 | 1.098855 | 3.48279 |
| Δ(VEXCHR_NEG(-8)) | 1.571645 | 0.728469 | 2.157462 |
| Δ (LPO) | 0.123777 | 0.09876 | 1.25331 |
| Δ (LPO(-1)) | 0.455171 | 0.094914 | 4.795631 |
| Δ (LPO(-2)) | -0.381901 | 0.092579 | -4.125147 |
| Δ (LPO(-3)) | 0.171217 | 0.098774 | 1.733431 |
| Δ (LPO(-4)) | 0.126651 | 0.084426 | 1.500134 |
| Δ (LPO(-5)) | -0.35414 | 0.085011 | -4.165799 |
| Δ (LPO(-6)) | 0.390009 | 0.098925 | 3.942474 |
| Δ (LPO(-7)) | 0.131693 | 0.124096 | 1.061215 |
| Δ (LPO(-8)) | 0.419818 | 0.110088 | 3.813471 |
| Δ (LPO(-9)) | -0.140202 | 0.12076 | -1.160999 |
| Δ (LPO(-10)) | 0.325866 | 0.129526 | 2.515845 |
| ECM (-1) | -0.027452 | 0.005223 | -5.25568 |

| | | | |
|---|---|---|---|
| R-squared | 0.90658 | Mean dependent var | 0.032 |
| Adjusted R-squared | 0.753994 | S.D. dependent var | 0.027 |
| S.E. of regression | 0.013417 | Akaike info criterion | -5.515 |
| Sum squared resid | 0.005401 | | |
| Log likelihood | 270.6143 | | |
| Durbin-Watson stat | 1.957554 | | |

**Table 4:14**
**Objective 4** **Negative**
**LONG** **RUN**

| Variables | Co-efficient | Standard error | T-Statistics |
|---|---|---|---|
| VFUP_POS | 19.15596 | 57.10479 | 0.335453 |
| VFUP_NEG | 22.27935 | 62.7553 | 0.355019 |
| VEXCHR | 0.339847 | 2.419928 | 0.140437 |
| LINC | -0.893004 | 1.721218 | -0.518821 |
| LPO | 4.928927 | 7.776695 | 0.633807 |
| LGL | -0.840696 | 1.82082 | -0.461713 |
| | | | |
| **SHORT** | **RUN** | | |
| Δ (LPF(-1)) | -0.050318 | 0.117332 | -0.428856 |
| Δ (LPF(-2)) | -0.015606 | 0.091811 | -0.169976 |
| Δ (LPF(-3)) | -0.270883 | 0.076527 | -3.539693 |
| Δ (LPF(-4)) | 0.078024 | 0.085405 | 0.913573 |
| Δ (LPF(-5)) | -0.080227 | 0.088482 | -0.906699 |
| Δ (LPF(-6)) | -0.517896 | 0.090708 | -5.709491 |
| Δ (VFUP_POS) | 0.505464 | 0.289849 | 1.743888 |
| Δ (VFUP_POS(-1)) | 0.1177 | 0.388741 | 0.302771 |
| Δ (VFUP_POS(-2)) | -1.372834 | 0.451086 | -3.043397 |
| Δ (VFUP_POS(-3)) | -1.552456 | 0.467138 | -3.323334 |
| Δ (VFUP_NEG) | -0.323904 | 0.383559 | -0.844471 |
| Δ (VFUP_NEG(-1)) | -1.20385 | 0.400972 | -3.002332 |
| Δ (VFUP_NEG(-2)) | -1.088363 | 0.357182 | -3.047085 |
| Δ (LINC) | 0.06014 | 0.028384 | 2.118838 |
| Δ (LINC(-1)) | 0.089306 | 0.032151 | 2.777694 |
| Δ (LINC(-2)) | 0.06 | 0.030774 | 1.949695 |
| Δ (LINC(-3)) | 0.10402 | 0.029858 | 3.483861 |
| Δ (LINC(-4)) | 0.026817 | 0.025407 | 1.055499 |
| Δ (LINC(-5)) | -0.015406 | 0.023964 | -0.642894 |
| Δ (LINC(-6)) | 0.02931 | 0.023868 | 1.228017 |
| Δ (LPO) | 0.031781 | 0.098623 | 0.322245 |
| Δ (LPO(-1)) | 0.283589 | 0.096987 | 2.924006 |
| Δ (LPO(-2)) | -0.332121 | 0.098097 | -3.38565 |
| Δ (LPO(-3)) | -0.047623 | 0.098714 | -0.482434 |
| Δ (LPO(-4)) | 0.175793 | 0.097025 | 1.811832 |
| Δ (LPO(-5)) | -0.395549 | 0.100681 | -3.928716 |
| Δ (LPO(-6)) | 0.31501 | 0.112465 | 2.800957 |
| Δ (LPO(-7)) | 0.294223 | 0.114299 | 2.574142 |
| Δ (LGL) | -0.068802 | 0.042984 | -1.600658 |
| Δ (LGL(-1)) | 0.054414 | 0.049423 | 1.100981 |

| | | | |
|---|---|---|---|
| Δ (LGL(-2)) | -0.037262 | 0.047202 | -0.789414 |
| Δ (LGL(-3)) | 0.055338 | 0.048184 | 1.148454 |
| Δ (LGL(-4)) | -0.095471 | 0.062997 | -1.515489 |
| Δ (LGL(-5)) | 0.165747 | 0.060683 | 2.731328 |
| Δ (LGL(-6)) | -0.09088 | 0.052912 | -1.717588 |
| Δ (LGL(-7)) | 0.099829 | 0.040689 | 2.453494 |
| ECM (-1) | -0.029642 | 0.005458 | -5.43064 |

| | | | |
|---|---|---|---|
| R-squared | 0.809773 | Mean dependent var | 0.0313 |
| Adjusted R-squared | 0.664067 | S.D. dependent var | 0.0287 |
| S.E. of regression | 0.016627 | Akaike info criterion | -5.0553 |
| Sum squared resid | 0.012993 | | |
| Log likelihood | 249.3233 | | |
| Durbin-Watson stat | 2.022547 | | |

## 4.10 Outcome of post estimation result for: Asymmetric effect of volatility in fuel price and exchange rate on food price in Nigeria.

The schedule below contains the results of various post-estimation tests

The test for normality yields a statistic of 0.734, with a p-value of 0.693. Based on this result, we can conclude that the residuals are normally distributed. In other words, the errors from the regression model follow a normal distribution, which is a desirable characteristic for regression analysis. The test for serial correlation reports a statistic of 0.175 and a p-value of 0.840. This indicates that there is no evidence of serial correlation in the residuals. In simpler terms, the errors do not show a systematic pattern of correlation with each other, which is an important assumption for regression analysis.

The test for heteroskedasticity provides a statistic of 0.521 and a p-value of 0.977. This suggests that there is no significant heteroskedasticity in the residuals. Heteroskedasticity occurs when the variability of the errors is not constant across different levels of the independent variables. In this case, the data does not exhibit such a pattern. The test for the omission of variables yields a statistic of 6.042 with a very low p-value of 0.021. This suggests that variables are omitted from the model. In other words, the current regression model may not include all the relevant independent variables needed to explain the variation in the dependent variable. This implies that the model may benefit from including additional variables to improve its explanatory power.

The stability of the model is assessed based on cumulative sums (cumsum) and cumulative sums of squares. Both of these measures indicate that there is stability in the model. This means that the relationships between the variables in the model remain relatively constant over time, which is a positive characteristic for long-term predictions.

Implication of this regression model appears to meet several important assumptions and tests. The residuals are normally distributed, there is no evidence of serial correlation, and there is no significant heteroskedasticity. However, the test for the omission of variables suggests that there may be important factors missing from the model. Despite this, the model demonstrates stability in its relationships over time.

**Table: 4.15 Result of Post Estimation Test: Objective Four**

**Result of Post Estimation Tests**

| Test | Statistics | Conclusion |
|---|---|---|
| Normality | 0.734 (0.693) | Residual normally distributed |
| Serial-correlation | 0.175 (0.840) | No Serial-correlation |
| Heteroskedasticity | 0.521 (0.977) | There is no heteroskedasticity |
| Omission of variable | 6.042 (0.021) | Variables are omitted |
| Stability; cumsum | see graph below | There is stability |
| cumsum of squares | see graph below | There is stability |

**Source**: Author's Computation 2023

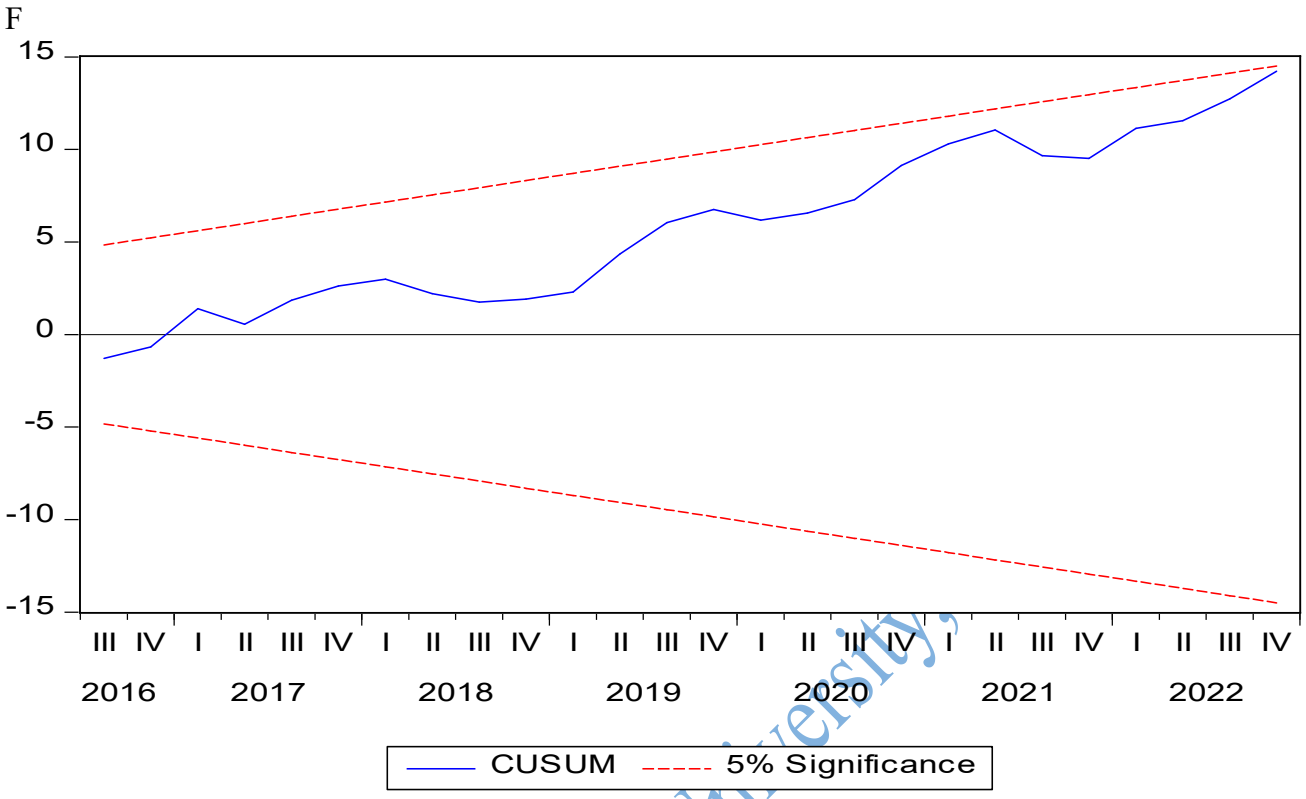


**Figure 4.14: Graph of CUSUM at 5% significance**

**Source: Author's computation 2023.**

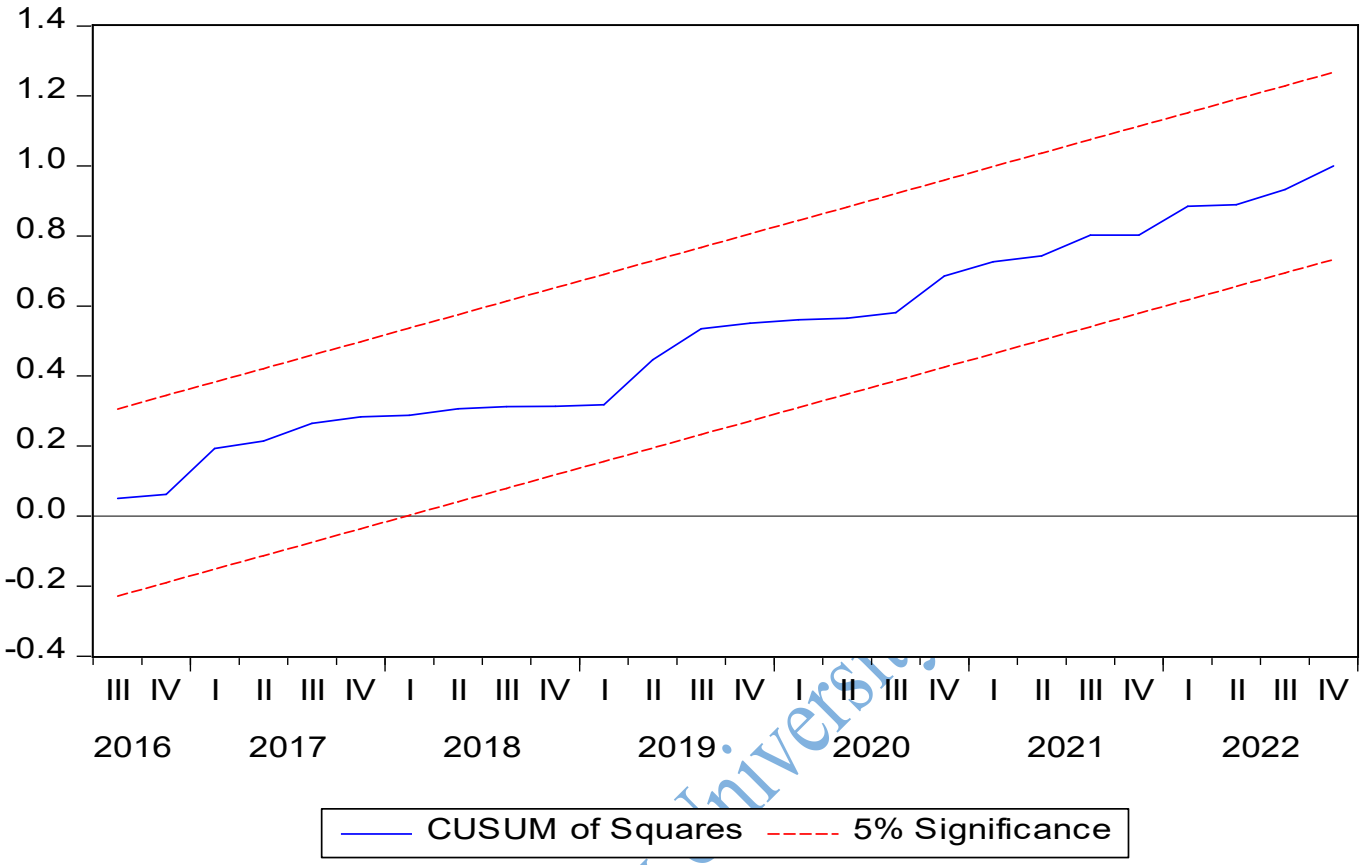


**Figure 4.15: Graph of CUSUM of squares at 5% significance**

**Source: Author's computation 2023.**

## 4.11 Asymmetric effect of volatility in fuel price and exchange rate on food prices in Nigeria (Negative asymmetric outcome)

This schedule provides the estimated coefficients, standard errors, and t-statistics for a set of variables in both the long run and short run.

In the long run, VFUP_POS has a coefficient of 19.15596 with a standard error of 57.10479, resulting in a t-statistic of 0.335453. This coefficient suggests that, in the long run, a one-unit increase in VFUP_POS is associated with a slight increase in the dependent variable. However, the t-statistic indicates that this relationship is not statistically significant. Similar to VFUP_POS, VFUP_NEG has a positive coefficient of 22.27935 and a standard error of 62.7553. The t-statistic of 0.355019 implies that this variable also has a non-significant effect on the dependent variable in the long run. VEXCHR exhibits a very small coefficient of 0.339847 and a relatively low standard error of 2.419928. The t-statistic of 0.140437 suggests that VEXCHR has a negligible impact on the dependent variable in the long run, and this relationship is not statistically significant.

In the long run, LINC has a negative coefficient of -0.893004 with a standard error of 1.721218. The t-statistic of -0.518821 indicates that a one-unit increase in LINC is associated with a decrease in the dependent variable. However, the negative impact is not statistically significant. LPO's coefficient is 4.928927, and it has a high standard error of 7.776695. The t-statistic of 0.633807 suggests a positive impact on the dependent variable in the long run. While the coefficient is positive, the t-statistic still indicates a lack of statistical significance. In the long run, LGL exhibits a negative coefficient of -0.840696 with a standard error of 1.82082. The t-statistic of -0.461713 implies that a one-unit increase in LGL is associated with a decrease in the dependent variable, but this relationship is not statistically significant.

The short-run coefficients represent the immediate impact of lagged variables on the dependent variable. D(LPF(-1)) has a coefficient of -0.050318, with a standard error of 0.117332 and a t-statistic of -0.428856. This indicates that a one-unit change in D(LPF) from the previous period results in a small immediate decrease in the dependent variable. The negative impact is present, but the t-statistic suggests that it is not statistically significant. The other coefficients in the short-run can be interpreted similarly, where the t-statistics determine whether the immediate relationships are statistically significant.

**Table: 4.16**
**Objective 4**

| **LONG** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| VFUP_POS | 19.15596 | 57.10479 | 0.335453 |
| VFUP_NEG | 22.27935 | 62.7553 | 0.355019 |
| VEXCHR | 0.339847 | 2.419928 | 0.140437 |
| LINC | -0.893004 | 1.721218 | -0.518821 |
| LPO | 4.928927 | 7.776695 | 0.633807 |
| LGL | -0.840696 | 1.82082 | -0.461713 |

| **SHORT** | **RUN** | | |
|---|---|---|---|
| Δ(LPF(-1)) | -0.050318 | 0.117332 | -0.428856 |
| Δ(LPF(-2)) | -0.015606 | 0.091811 | -0.169976 |
| Δ (LPF(-3)) | -0.270883 | 0.076527 | -3.539693 |
| Δ (LPF(-4)) | 0.078024 | 0.085405 | 0.913573 |
| Δ (LPF(-5)) | -0.080227 | 0.088482 | -0.906699 |
| Δ (LPF(-6)) | -0.517896 | 0.090708 | -5.709491 |
| Δ (VFUP_POS) | 0.505464 | 0.289849 | 1.743888 |
| Δ (VFUP_POS(-1)) | 0.1177 | 0.388741 | 0.302771 |
| Δ (VFUP_POS(-2)) | -1.372834 | 0.451086 | -3.043397 |
| Δ (VFUP_POS(-3)) | -1.552456 | 0.467138 | -3.323334 |
| Δ (VFUP_NEG) | -0.323904 | 0.383559 | -0.844471 |
| Δ (VFUP_NEG(-1)) | -1.20385 | 0.400972 | -3.002332 |
| Δ (VFUP_NEG(-2)) | -1.088363 | 0.357182 | -3.047085 |
| Δ (LINC) | 0.06014 | 0.028384 | 2.118838 |
| Δ (LINC(-1)) | 0.089306 | 0.032151 | 2.777694 |
| Δ (LINC(-2)) | 0.06 | 0.030774 | 1.949695 |
| Δ (LINC(-3)) | 0.10402 | 0.029858 | 3.483861 |
| Δ (LINC(-4)) | 0.026817 | 0.025407 | 1.055499 |
| Δ (LINC(-5)) | -0.015406 | 0.023964 | -0.642894 |
| Δ (LINC(-6)) | 0.02931 | 0.023868 | 1.228017 |
| Δ (LPO) | 0.031781 | 0.098623 | 0.322245 |
| Δ (LPO(-1)) | 0.283589 | 0.096987 | 2.924006 |

| | | | |
|---|---|---|---|
| Δ (LPO(-2)) | -0.332121 | 0.098097 | -3.38565 |
| Δ (LPO(-3)) | -0.047623 | 0.098714 | -0.482434 |
| Δ (LPO(-4)) | 0.175793 | 0.097025 | 1.811832 |
| Δ (LPO(-5)) | -0.395549 | 0.100681 | -3.928716 |
| Δ (LPO(-6)) | 0.31501 | 0.112465 | 2.800957 |
| Δ (LPO(-7)) | 0.294223 | 0.114299 | 2.574142 |
| Δ (LGL) | -0.068802 | 0.042984 | -1.600658 |
| Δ (LGL(-1)) | 0.054414 | 0.049423 | 1.100981 |
| Δ (LGL(-2)) | -0.037262 | 0.047202 | -0.789414 |
| Δ (LGL(-3)) | 0.055338 | 0.048184 | 1.148454 |
| Δ (LGL(-4)) | -0.095471 | 0.062997 | -1.515489 |
| Δ (LGL(-5)) | 0.165747 | 0.060683 | 2.731328 |
| Δ (LGL(-6)) | -0.09088 | 0.052912 | -1.717588 |
| Δ (LGL(-7)) | 0.099829 | 0.040689 | 2.453494 |
| ECM (-1) | -0.029642 | 0.005458 | -5.43064 |

| | | | |
|---|---|---|---|
| R-squared | 0.809773 | Mean dependent var | 0.03132 |
| Adjusted R-squared | 0.664067 | S.D. dependent var | 0.028687 |
| S.E. of regression | 0.016627 | Akaike info criterion | -5.05532 |
| Sum squared resid | 0.012993 | | |
| Log likelihood | 249.3233 | | |
| Durbin-Watson stat | 2.022547 | | |

### 4.7.4 Outcome of post estimation for negative asymmetric effect of volatility in fuel price and exchange rate on food price in Nigeria.

The schedule below shows the post-estimation tests regression model.

Test Statistics: 1.982, P-value: 0.371 signifies that the test for normality assesses whether the residuals (the differences between observed and predicted values) follow a normal distribution. In this case, the p-value is 0.371, which is greater than the typical significance level of 0.05. Therefore, the conclusion is that the residual is not normally distributed. This suggests that the model might not be the best fit for the data, and the assumption of normally distributed residuals may not hold.

Test Statistics: 1.764, P-value: 0.185. The test shows: Serial correlation, also known as autocorrelation, tests whether there is a pattern or relationship between the residuals over time. A p-value of 0.185 is greater than 0.05, indicating no significant evidence of serial correlation in the residuals. This is a positive outcome as it suggests that the model doesn't suffer from this issue.

Test Statistics: 1.978, P-value: 0.016. Heteroskedasticity examines whether the variance of the residuals is constant across different levels of the independent variables. In this case, the p-value is 0.016, which is less than 0.05. This suggests that there is evidence of heteroskedasticity, meaning that the variance of the residuals is not constant..

Test Statistics: 1.381, P-value: 0.247. This test checks whether there are omitted variables in the model, which could lead to omitted variable bias. The p-value of 0.247 is greater than 0.05, indicating no strong evidence of omitted variables in the model. This is a favorable result as it suggests that the model captures the relevant variables adequately.

Stability; cumsum, unfortunately, the result states "see graph below," which means that there is slight instability in the variables. Cumsum of Squares, shows stability in the Variables.

Implication shows that these post-estimation tests help evaluate the validity and reliability of a regression model. They provide insights into the normality of residuals, presence of serial correlation, heteroskedasticity, omitted variables, and the model's stability.

**Table 4.17 Result of post estimation test for objective four.**

**Result of Post Estimation Tests**

| Test | Statistics | Conclusion |
|---|---|---|
| Normality | 1.982 (0.371) | Residual is not normally distributed |
| Serial-correlation | 1.764 (0.185) | No Serial-correlation |
| Heteroskedasticity | 1.978 (0.016) | There is heteroskedasticity |
| Omission of variable | 1.381 (0.247) | No omitted variables |
| Stability; cumsum | see graph below | There is instability |
| cumsum of squares | see graph below | There is stability |

**Source: Author's computation 2023.**

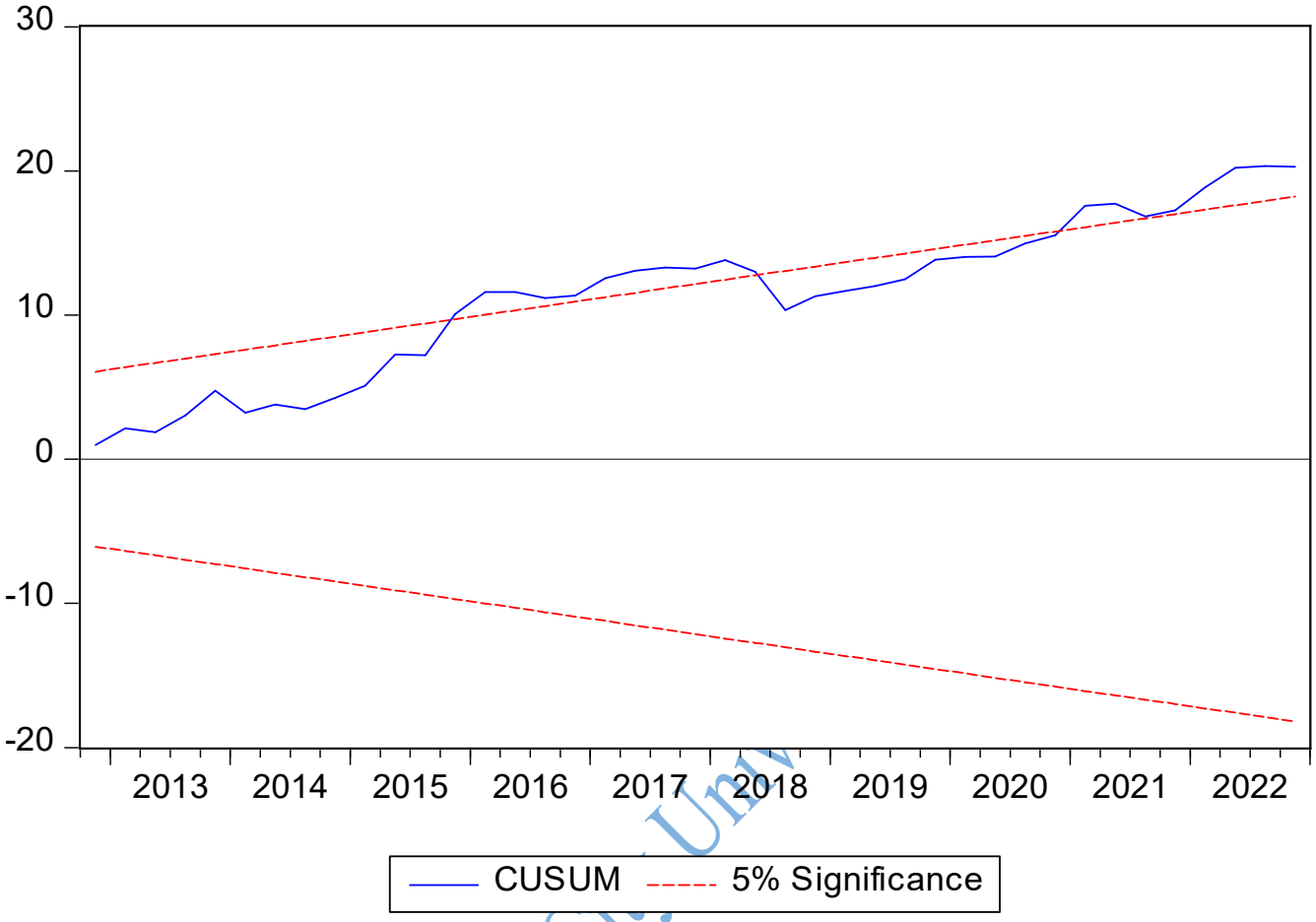


**Figure 4.16: Graph of CUSUM of 5% significance**
**Source: Author's computation 2023.**

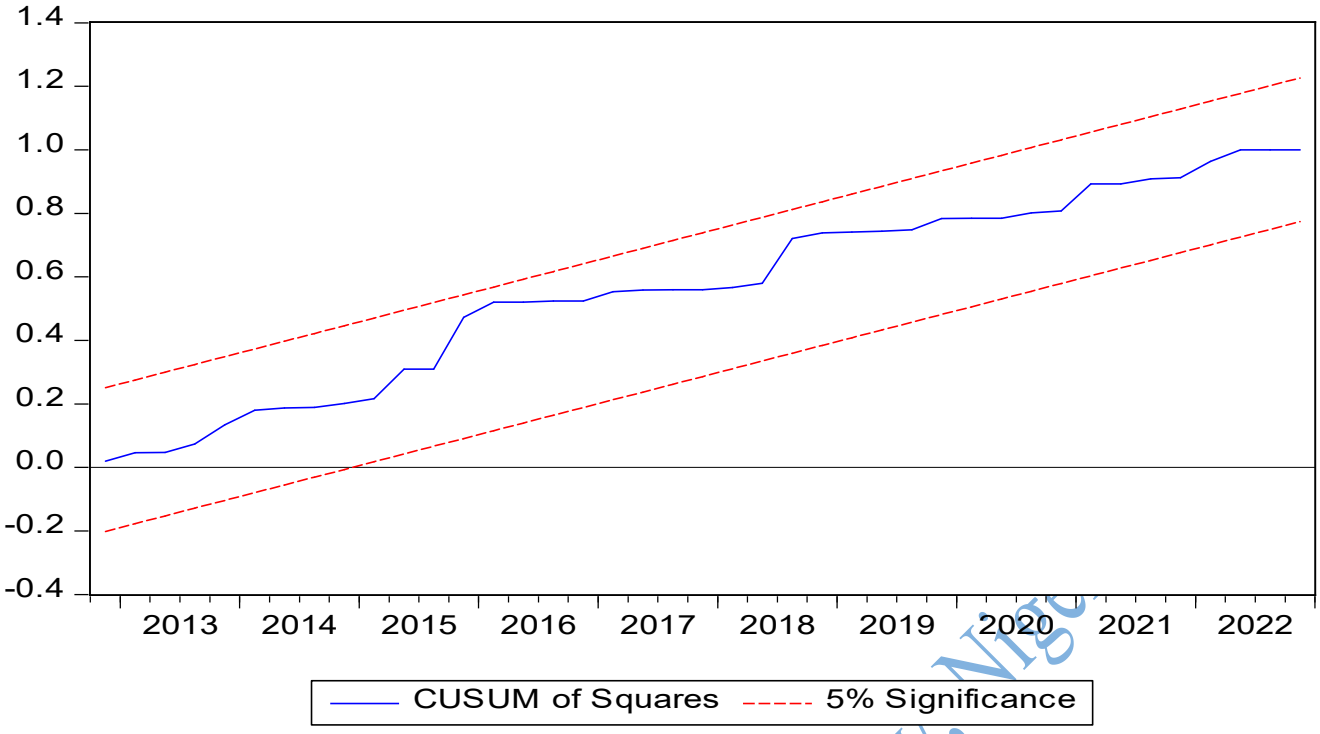


**Figure 4.17: Graph for CUSUM of squares at 5% significance**

**Source: Author's computation 2023.**

## 4.12Discussion of Findings

### 4.12.1 Effect of volatility in fuel price and exchange rate to food price in Nigeria

From the analysis done on objective one, it reveals the complex dynamics between the independent and dependent variables. While some independent variables, like LEXCHR and LPO, have positive long-term impacts, others, such as LFUP, LGL, LINC, and LWEA, have negative long-term impacts. Additionally, short-term effects of LPF at various lag periods are both positive and negative, and the system shows self-correction when deviations from the long-term equilibrium occur.

The findings show that Exchange rate and Price of other goods has a positive and significant impact on the Price of food in Nigeria. This falls within the theoretical expectations of existing studies and theories which states with regards to exchange rate, that high rate of exchange automatically leads to high prices of food, since Nigeria is an import dependent Nation. Looking at Nigeria as a Nation, the rate of exchange is astronomical, which implies any further increase in exchange rate, the food price will automatically increase in proportion to the increase in the rate of exchange.[1]

The fuel price (LFUP), weather condition (LWEA) and Government legislation (LGL) which is government expenditures on Agriculture depicting negative long-term impacts also falls within theoretical expectations of some existing studies which states that high price of fuel does not automatically lead to an increase in food price vice versa.[2]

From the study, it can be deduced that the effect of volatility in fuel price has a negative relationship in food price in Nigeria. This stipulate that a percentage increase in the price of fuel has an inverse relationship in the price of food in Nigeria vis-à-vis Government legislation on Agriculture and weather condition. While a percentage increase in the rate of

exchange (LEXCHR) and price of other commodities (LPO) has a positive relationship (increase) in the price of food in Nigeria.

### 4.12.2 Level of volatility in fuel price and exchange rate in Nigeria.

The analysis of the study indicates that Government legislation (LGL) and Consumer Income (LINC), these variables exhibit relatively low long-term volatility. While they have negative coefficients, their lack of statistical significance suggests that they have limited influence on the long-term behavior or trends of the dependent variable (Food price).

Price of other goods (LPO) shows moderate long-term volatility. With a statistically significant positive coefficient, it may contribute to some degree of long-term volatility in the dependent variable. Weather Condition (LWEA), Fuel Price Volatility (VFUP) and Exchange rate Volatility (VEXCHR). These variables demonstrate relatively low long-term volatility. Despite their negative coefficients, they are not statistically significant, indicating that their impact on long-term trends is limited.

The study indicates that Long-term volatility is generally low for most of the variables, with some exceptions. LPO stands out as having a moderate long-term impact.[3] Short-term volatility is characterized by short-term negative effects from lagged variables, potentially leading to fluctuations. The ECM serves as a crucial stabilizing factor in the short run, contributing to short-term stability and equilibrium correction.

### 4.12.3 Examine the effect of volatility in fuel price and exchange rate on food price.

**The analysis from the study shows that volatility in Fuel Prices (VFUP),** when fuel prices go up, logically it's expected that food prices will go up; but in this case the reverse is the case, as this relationship might not be very strong or reliable. In other words, changes in fuel prices may not have a big impact on food prices as per the analysis of the study. **Exchange Rates (VEXCHR),** when the exchange rate changes, it's expected that food prices might go up as per expectations, but again, this relationship might not be very strong or reliable. Changes in exchange rates may not have a big impact on food prices which applying logical sense is not suppose to be.[4]

**Other Factors LGL, LINC, LWEA, LPO used in the study** may also not have a strong or reliable impact on food prices in the long run. They might affect food prices, but the analysis suggests that their influence is not statistically significant, meaning they may not be major drivers of food price changes.

In a nutshell, the analysis is saying that these factors may not be very good at predicting or explaining why food prices go up or down. Other factors or reasons might be more important in determining food prices.

In the long-run the analysis is saying that these factors may not be very good at predicting or explaining why food prices go up or down. Other factors or reasons might be more important in determining food prices.

In short run the log-transformed variables show that volatility in fuel prices (VFUP) and exchange rates (VEXCHR) might have some influence on food prices, but these relationships may not be statistically significant. This means that changes in fuel price and exchange rate volatility may not be reliable predictors of food price changes.

### 4.12.4 Asymmetric effect of volatility in fuel price and exchange rate on food price.

The analysis for asymmetric effect between fuel price (VFUP) and exchange rate (VEXCHR) in the long run shows that there is a positive relationship between volatility in fuel prices (VFUP) and food prices, but this relationship may not be statistically significant due to the T-Statistics value of 0.453189. An increase in fuel price volatility is associated with higher food prices, but this connection might not be very reliable or strong (not statistically significant).

There are negative relationships between both positive and negative exchange rate volatility (VEXCHR_POS and VEXCHR_NEG) and food prices, but these relationships may also not be statistically significant. When exchange rates become more stable, food prices tend to go down, but this effect might not be very strong or reliable (not statistically significant) or when exchange rates become more volatile, food prices also tend to go down, but this relationship might not be very reliable or strong (not statistically significant).[5]

LPO which is an additional variable has a positive relationship with food prices and is statistically significant. An increase in LPO is linked to higher food prices, and this connection might be more reliable and statistically significant.

The low T-Statistics values in the long run for VFUP, VEXCHR_POS, and VEXCHR_NEG indicate a lack of statistical significance, meaning that the observed relationships may not be reliable or strong enough to draw firm conclusions about their effects on food prices.

In the short run the analysis suggests that the relationship between volatility in fuel price (VFUP), exchange rate (VEXCHR), and other factors with food prices is complex and can change over time. Different patterns of volatility can lead to both increases and decreases in food prices. Additionally, the presence of a highly significant ECM implies strong short-term corrections in food prices to maintain long-term equilibrium.

The second part of the analysis for examining the symmetric effect of volatility in fuel price and exchange rate on food price states that;

When fuel price volatility is positive (VFUP_POS) in the long run, it has a small positive effect on food prices, but this effect is not very strong or reliable due to low T-Statistics. When fuel price volatility is negative (VFUP_NEG), it also has a small positive effect on food prices, but this effect is not very strong or reliable due to low T-Statistics.

The overall volatility in exchange rates (VEXCHR) has a small positive effect on food prices, but this effect is not very strong or reliable due to low T-Statistics.

Other variables like LINC, LPO, and LGL have small effects on food prices, but these effects are not very strong or reliable due to low T-Statistics as well.

The analysis suggests that there are some small and potentially positive effects of different types of volatility in fuel prices and exchange rates on food prices. However, these effects are not very strong or statistically significant. Other factors might also influence food prices, and the relationships between these variables are not very clear or consistent.

In the short run, the analysis depicts that Changes in fuel price volatility (VFUP) have both positive and negative coefficients at different time lags. The impact of VFUP on food prices varies over time, and some periods show a positive effect, while others show a negative effect. Volatility in Fuel Price (VFUP_POS and VFUP_NEG). When fuel price volatility is positive (VFUP_POS), it generally has a positive effect on food prices, especially at longer lags. When fuel price volatility is negative (VFUP_NEG), it has a mixed impact on food prices, and the effect is not consistent.

Other Variables (LINC, LPO, LGL**).** These variables also have both positive and negative coefficients at different time lags, indicating varying effects on food prices over time. The ECM (-1) has a negative coefficient, suggesting it plays a significant role in correcting deviations from the long-term equilibrium in food prices. This correction is strong and statistically significant.

The analysis demonstrates that the relationships between fuel price volatility, exchange rate, and other factors with food prices are complex and asymmetric. The effects can vary over time, and the ECM plays a crucial role in maintaining the long-term equilibrium in food prices.

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# Chapter 5

# Conclusion

## 5.1 Summary of Findings

In the analysis of objective one, the study explores complex relationships affecting food prices in Nigeria. Exchange rate positively impacts food prices, aligning with expectations due to Nigeria's import-dependent nature. Fuel prices surprisingly have a negative impact, contradicting common assumptions. Government expenditures on agriculture and adverse weather conditions also negatively influence food prices. Short-term effects exist, and the system self-corrects to maintain long-term equilibrium.

For the second objective, low long-term volatility is observed in government legislation and consumer income, suggesting their limited impact on food prices. The price of other goods has a statistically significant positive coefficient, indicating its contribution to long-term volatility in food prices.

The third objective reveals that changes in fuel prices and exchange rates may not reliably predict food price changes in the long run. Other examined factors like government legislation, consumer income, weather conditions, and the price of other goods also lack statistically significant impact on long-term food prices.

The fourth objective explores the symmetric effects of volatility in fuel prices and exchange rates. Fuel price volatility, whether positive or negative, has a small positive impact on food prices. Exchange rate volatility also has a small positive effect. However, these effects are not strong or

reliable predictors of food price changes, as indicated by low T-Statistics for all examined variables.

## 5.2 Conclusion

This study provides insight on the relationship among Fuel price, Exchange rate, Price of other goods, Government Legislation, weather Condition and Consumer income as its affects Food Price in Nigeria, from the period of 2000 to 2022. The findings from the study provide valuable insights into the intricate relationships that influence food prices in Nigeria. The analysis conducted as part of this study revealed several key aspects related to the impact of various factors on food prices, both in the long term and short term.

**Exchange Rate (LEXCHR):** One of the significant findings is that the exchange rate has a positive long-term impact on the price of food in Nigeria. This means that when the exchange rate increases, food prices also tend to rise. This finding aligns with theoretical expectations and reflects Nigeria's import-dependent nature. A higher exchange rate makes it more expensive to import food, leading to increased food prices. This finding is consistent with existing research and theories linking exchange rates to food prices.

**Price of Other Goods (LPO):** Another important finding is that the price of other goods has a positive and significant impact on food prices. This means that when the prices of other goods increase, food prices also tend to rise. This finding is in line with theoretical expectations and previous research.

**Fuel Price (LFUP):** Contrary to common assumptions, the study found that fuel prices have a negative long-term impact on food prices. High fuel prices do not automatically result in higher

food prices. The relationship between fuel prices and food prices is more complex and influenced by various factors. High fuel prices may be mitigated by other dynamics, and their impact on food prices may not be as straightforward as initially assumed.

**Government Expenditures (LGL) on Agriculture:** Increased government spending on agriculture was found to have a negative long-term impact on food prices. This indicates that higher government spending in the agricultural sector does not necessarily lead to higher food prices. This finding is consistent with existing studies that emphasize the need to consider multiple factors when analyzing the relationship between government policies and food prices.

**Weather Conditions (LWEA):** The study revealed that weather conditions also have a negative long-term impact on food prices. This suggests that adverse weather conditions, such as droughts or flooding, can negatively affect food prices. This finding highlights the complex nature of the relationship between weather and food prices.

**Short-Term Effects:** The study identified short-term effects of food prices at various lag periods. These short-term effects were both positive and negative, indicating that food prices can respond to various factors in the short term. The presence of a highly significant Error Correction Mechanism (ECM) implies strong short-term corrections in food prices to maintain long-term equilibrium. This means that when food prices deviate from their expected long-term trajectory, mechanisms are in place to help bring them back into balance.

In conclusion, the analysis of the study indicates that the price of food in Nigeria is influenced by a combination of factors. Exchange rates and the price of other goods have a positive and significant impact on food prices, aligning with theoretical expectations. Conversely, fuel prices,

government legislation on agriculture, and adverse weather conditions have negative long-term impacts, challenging conventional assumptions. These findings emphasize the need to consider the multifaceted nature of these relationships when analyzing the dynamics of food prices in Nigeria.

**With response to objective Two, Volatility Level in Fuel Price and Exchange Rate. Fuel Price Volatility (VFUP), and Exchange Rate Volatility (VEXCHR):** These variables demonstrate low long-term volatility, and despite their negative coefficients, they are not statistically significant. This implies that their impact on long-term trends in food prices is limited. Variations in weather conditions, fuel price fluctuations, and exchange rate changes do not have a significant influence on the long-term behavior of food prices in the context of the study.

**Considering objective three, Asymmetric Effect of Volatility in Fuel Price and Exchange Rate.** The analysis for the third objective suggests that the factors examined in the study, including fuel prices, exchange rates, and other variables, may not be reliable predictors or explanations for why food prices rise or fall in the long run. While fuel prices and exchange rates may have some influence on food prices, their impact is not statistically significant. In the short run, short-term changes in fuel prices and exchange rate volatility may not be reliable indicators of food price fluctuations. The second part of the fourth objective focuses on the symmetric effect of volatility in fuel price and exchange rates. It was found that these factors have some small and potentially positive effects on food prices in the long run. However, these effects are not strong or statistically significan t, indicating that other factors may be at play. The relationships between these variables and food prices are complex and can vary over time.

## 5.3 Recommendation

The following recommendations arising from the empirical findings of this study are stated as follows;

Policy Considerations: Policymakers should closely monitor and manage exchange rates and the prices of other goods, as these variables have a significant positive impact on food prices in the long term. Measures to stabilize exchange rates and control price fluctuations in other goods can help mitigate food price inflation and ensure food affordability for the population. It is essential to align policies that support exchange rate stability and consider the interconnectedness of goods prices in the market.

Fuel Price Management: Recognize that high fuel prices do not necessarily lead to higher food prices. Energy and pricing policies should be informed by a nuanced understanding of the complex relationship between fuel prices and food prices. Government interventions, such as the local refineries to be repaired and working at full capacity, instead of importing refined oil from abroad. It's believed, if our refineries are working at full capacity, fuel price will reduced and will be domestically sourced instead of importing.

Government Expenditure: Government spending on agriculture should be guided by a comprehensive understanding of the factors influencing food prices. Increased government spending in the agricultural sector may not always lead to higher food prices. Policymakers should adopt a balanced approach that considers multiple factors, including market dynamics and the overall economic environment, when formulating agricultural expenditure policies.

Weather Risk Management: Given the negative impact of adverse weather conditions on food prices, strategies for managing weather-related risks in agriculture should be developed and implemented. Investments in climate-resilient agriculture, early warning systems, and insurance mechanisms can help mitigate the impact of extreme weather events on food prices.

Short-Term Corrections: Acknowledge the presence of a highly significant Error Correction Mechanism (ECM) in the market. This mechanism plays a crucial role in correcting deviations from long-term equilibrium in food prices. Policymakers and market regulators should support and maintain the effectiveness of this mechanism to ensure short-term stability and equilibrium correction in food prices.

Further Research: Recognize the complexity and dynamic nature of the relationships between various factors and food prices. Further research and analysis are essential to gain a deeper understanding of these relationships. More comprehensive data collection and advanced modeling techniques may provide additional insights into the dynamics of food pricing in Nigeria.

These recommendations emphasize the need for a holistic and multifaceted approach to understanding and managing food price dynamics in Nigeria. Policymakers, researchers, and stakeholders should consider the interplay of various variables and the evolving nature of these relationships when making informed decisions and formulating policies related to food pricing in Nigeria.

## 5.4 Contribution to Knowledge

The confirmation of a positive long-term impact of the exchange rate on food prices in Nigeria aligns with theoretical expectations but adds empirical evidence to support this relationship. This contributes to a deeper understanding of the specific dynamics between exchange rates and food prices in the context of a country with an import-dependent nature like Nigeria. The recommendation to focus on diversifying food sources domestically provides practical guidance for policymakers in similar economies. This insight emphasizes the importance of reducing reliance on imports, especially in the context of exchange rate fluctuations. This contributes to discussions on improving food security and sustainability in import-dependent nations. The confirmation of a positive and significant impact of the price of other goods on food prices adds to the understanding of inflation dynamics. This finding suggests that a broader economic context, beyond the food sector alone, influences food prices. This contributes to discussions on the interconnectedness of different sectors in an economy. The discovery of a negative long-term impact of fuel prices on food prices challenges common assumptions and highlights the need for nuanced analysis. This finding contributes to a more comprehensive understanding of the factors influencing food prices, especially in economies where fuel prices are often considered a key driver of inflation.



## 5.5 Suggestion for Further Studies

Future studies and research can be carried out on the followings below:

Regional Analysis: Explore food price dynamics across different regions in Nigeria to account for regional variations.

Supply Chain Analysis: Investigate the impact of supply chain factors, like transportation and distribution, on food prices.

Macroeconomic Variables: Study how broader economic factors interact with the variables in this thesis to affect food prices.

Consumer Behavior: Examine how consumer preferences and behaviors influence food prices.

Policy Impact Analysis: Evaluate the effectiveness of government policies and interventions on food prices.

Climate-Resilient Agriculture: Analyze the adoption of climate-resilient agricultural practices in reducing food price volatility.

International Trade Impact: Investigate the influence of international trade agreements and policies on food prices in Nigeria.

Social and Economic Impact: Assess the consequences of food price fluctuations on various population segments and income distribution.

Advanced Modeling: Employ more sophisticated econometric models to capture complex relationships among variables.

Longitudinal Studies: Conduct long-term studies to identify trends and cyclical patterns in food prices.

Comparative Analysis: Compare findings with other countries or regions to understand global and regional trends. These further studies aim to enhance our understanding of food price

dynamics in Nigeria and provide a holistic view of the factors influencing this crucial aspect of the economy.

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**APPENDIX**

Descriptive Statistics

| | LEXCHR | LFUP | LGL | LINC | LPF | LPO | LWEA |
|---|---|---|---|---|---|---|---|
| Mean | 5.195650 | 4.221509 | 3.415968 | 16.13280 | 4.810925 | 4.778573 | 4.471086 |
| Median | 5.042686 | 4.174387 | 3.629498 | 16.57483 | 4.796354 | 4.789201 | 4.744818 |
| Maximum | 6.099676 | 5.304896 | 4.489344 | 17.87216 | 6.363528 | 6.030055 | 5.713926 |
| Minimum | 4.605070 | 2.995732 | 1.846213 | 13.93296 | 3.384479 | 3.448307 | 2.520539 |
| Std. Dev. | 0.438285 | 0.685881 | 0.766490 | 1.208024 | 0.802677 | 0.700816 | 0.941593 |
| Skewness | 0.717472 | -0.14718 | -0.63274 | -0.42477 | 0.123580 | -0.08076 | -0.42918 |
| Kurtosis | 2.085270 | 1.730242 | 2.260123 | 1.818923 | 2.007080 | 1.982072 | 1.853680 |
| Jarque-Bera | 11.10054 | 6.512560 | 8.237198 | 8.113880 | 4.013419 | 4.072022 | 7.861530 |
| Probability | 0.003886 | 0.038531 | 0.016267 | 0.017302 | 0.134430 | 0.130548 | 0.019629 |
| Sum | 477.9998 | 388.3788 | 314.2691 | 1484.218 | 442.6051 | 439.6287 | 411.3399 |
| Sum Sq. Dev. | 17.48054 | 42.80943 | 53.46311 | 132.7984 | 58.63042 | 44.69408 | 80.68029 |
| Observations | 92 | 92 | 92 | 92 | 92 | 92 | 92 |

Correlation Analysis

| | LEXCHR | LFUP | LGL | LINC | LPF | LPO | LWEA |
|---|---|---|---|---|---|---|---|
| LEXCHR | 1 | 0.912777 | 0.777066 | 0.853805 | 0.94436 | 0.926153 | 0.081132 |
| LFUP | | 1 | 0.878218 | 0.972244 | 0.97203 | 0.980899 | 0.095747 |
| LGL | | | 1 | 0.926806 | 0.909577 | 0.926126 | 0.087937 |
| LINC | | | | 1 | 0.966971 | 0.978879 | 0.097344 |
| LPF | | | | | 1 | 0.994074 | 0.102738 |
| LPO | | | | | | 1 | 0.090856 |
| LWEA | | | | | | | 1 |

**Covariance Analysis**

| | LEXCHR | LFUP | LGL | LINC | LPF | LPO | LWEA |
|---|---|---|---|---|---|---|---|
| LEXCHR | 0.190006 | | | | | | |
| LFUP | 0.271409 | 0.46532 | | | | | |
| LGL | 0.258211 | 0.456679 | 0.581121 | | | | |
| LINC | 0.447141 | 0.796808 | 0.848837 | 1.443461 | | | |
| LPF | 0.328616 | 0.529326 | 0.553529 | 0.927435 | 0.637287 | | |
| LPO | 0.281383 | 0.46637 | 0.492078 | 0.819714 | 0.553118 | 0.485805 | |
| LWEA | 0.033118 | 0.061163 | 0.062776 | 0.109522 | 0.076805 | 0.059302 | 0.87696 |

**UNIT ROOT TEST RESULT FOR VARIABLES**

| VARIABLE | AT LEVEL | | AT FIRST DIFFERENCE | | Conclusion |
|---|---|---|---|---|---|
| | ADF Test | T-tab | ADF Test | T-tab | |
| LEXCHR | 0.614 | -2.584 | -7.92 | -3.505 | I(1) |
| LFUP | -0.896 | -2.584 | -8.362 | -3.505 | I(1) |
| LGL | -1.728 | -2.584 | -6.087 | -3.507 | I(1) |
| LINC | -1.126 | -2.584 | -10.288 | -3.505 | I(1) |
| LPF | 0.582 | -2.584 | -5.432 | -3.509 | I(1) |
| LPO | -0.75 | -2.584 | -8.14 | -3.506 | I(1) |
| LWEA | -2.804 | -2.585 | -5.046 | -3.514 | I(1) |
| VFUP | -7.267 | -2.584 | | | I(0) |
| VEXCHR | -9.662 | -2.584 | | | I(0) |

Co-Integration Test result for Variables

| Model | F-Statistics | K | Bound Test | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | 1% | 1% | 5% | 5% | 10% | 10% |
| | | | I(0) | I(1) | I(0) | I(1) | I(0) | I(1) |
| Objective 1; LEXCHR,LFUP,LGL,LINC,LPO,LWEA | 8.771 | 6 | 2.66 | 4.05 | 2.04 | 3.24 | 1.75 | 2.87 |
| Objective 3; LFP,LGL,LINC,LPO,LWEA,VFUP,VEXCHR | 8.049 | 6 | 2.66 | 4.05 | 2.04 | 3.24 | 1.75 | 2.87 |
| Objective 4; LFP,LFUP,LEXCHR,LPO | 4.788 | 4 | 3.07 | 4.44 | 2.26 | 3.48 | 1.9 | 3.01 |
| Objective 4; LFP,LFUP,LEXCHR,LPO,LGL,LINC,LWEA | 3.675 | 6 | 2.66 | 4.05 | 2.04 | 3.24 | 1.75 | 2.87 |

**Table: 4.6**
**Result of the effect of Exchange rate and Fuel price on Food price in Nigeria.**

| | LONG | RUN | |
|---|---|---|---|
| Variable | Co-efficient | Standard error | T-Statistics |
| LEXCHR | 0.582 | 0.402 | 1.449 |
| LFUP | -0.26 | 0.224 | -1.164 |
| LGL | -0.339 | 0.179 | -1.898 |
| LINC | -0.182 | 0.095 | -1.914 |
| LPO | 1.842 | 0.319 | 5.779 |
| LWEA | -0.248 | 0.34 | -0.73 |
| | | | |
| | SHORT | RUN | |
| Δ(LPF(-1)) | -0.222 | 0.106 | -2.088 |
| Δ (L#PF(-2)) | -0.164 | 0.104 | -1.578 |
| Δ (LPF(-3)) | -0.45 | 0.106 | -4.266 |
| Δ (LPF(-4)) | 0.14 | 0.083 | 1.679 |
| Δ (LPF(-5)) | 0.054 | 0.079 | 0.676 |
| Δ (LPF(-6)) | -0.585 | 0.077 | -7.598 |
| Δ (LPF(-7)) | -0.091 | 0.098 | -0.926 |
| Δ (LPF(-8)) | -0.105 | 0.099 | -1.066 |
| Δ (LPF(-9)) | -0.505 | 0.095 | -5.324 |
| Δ (LEXCHR) | -0.08 | 0.039 | -2.04 |
| Δ(LEXCHR(-1)) | -0.188 | 0.044 | -4.284 |
| Δ(LEXCHR(-2)) | -0.218 | 0.05 | -4.397 |
| Δ(LEXCHR(-3)) | -0.014 | 0.045 | -0.316 |
| Δ(LEXCHR(-4)) | -0.082 | 0.048 | -1.688 |
| Δ(LEXCHR(-5)) | -0.082 | 0.047 | -1.746 |
| Δ(LEXCHR(-6)) | -0.113 | 0.043 | -2.617 |
| Δ (LFUP) | 0.133 | 0.032 | 4.157 |
| Δ (LFUP(-1)) | 0.156 | 0.039 | 3.981 |
| Δ (LFUP(-2)) | 0.139 | 0.039 | 3.555 |
| Δ (LFUP(-3)) | 0.128 | 0.035 | 3.649 |
| Δ (LFUP(-4)) | 0.072 | 0.029 | 2.452 |
| Δ (LFUP(-5)) | 0.084 | 0.027 | 3.048 |
| Δ (LGL) | -0.17 | 0.046 | -3.697 |
| Δ (LGL(-1)) | 0.158 | 0.051 | 3.121 |
| Δ (LGL(-2)) | -0.043 | 0.047 | -0.931 |
| Δ (LGL(-3)) | 0.044 | 0.049 | 0.914 |
| Δ (LGL(-4)) | -0.081 | 0.065 | -1.243 |
| Δ (LGL(-5)) | 0.218 | 0.067 | 3.232 |
| Δ (LGL(-6)) | -0.157 | 0.063 | -2.474 |

| | | | |
|---|---|---|---|
| Δ (LGL(-7)) | -0.074 | 0.051 | -1.448 |
| Δ (LINC) | -0.008 | 0.03 | -0.266 |
| Δ (LINC(-1)) | 0.054 | 0.031 | 1.763 |
| Δ (LINC(-2)) | -0.02 | 0.033 | -0.628 |
| Δ (LINC(-3)) | 0.066 | 0.034 | 1.953 |
| Δ (LINC(-4)) | 0.094 | 0.025 | 3.762 |
| Δ (LINC(-5)) | 0.056 | 0.025 | 2.258 |
| Δ (LINC(-6)) | 0.06 | 0.02 | 2.964 |
| Δ (LINC(-7)) | 0.052 | 0.021 | 2.447 |
| Δ (LPO) | 0.013 | 0.126 | 0.101 |
| Δ (LPO(-1)) | -0.181 | 0.15 | -1.207 |
| Δ (LPO(-2)) | -0.691 | 0.131 | -5.283 |
| Δ (LPO(-3)) | -0.443 | 0.132 | -3.358 |
| Δ (LPO(-4)) | -0.466 | 0.107 | -4.35 |
| Δ (LPO(-5)) | -0.846 | 0.114 | -7.394 |
| Δ (LWEA) | -0.015 | 0.01 | -1.524 |
| Δ LWEA(-1)) | 0.024 | 0.014 | 1.782 |
| Δ LWEA(-2)) | 0.04 | 0.017 | 2.328 |
| Δ LWEA(-3)) | 0.029 | 0.02 | 1.449 |
| Δ LWEA(-4)) | 0.02 | 0.022 | 0.935 |
| Δ LWEA(-5)) | 0.016 | 0.021 | 0.782 |
| Δ LWEA(-6)) | -0.006 | 0.016 | -0.399 |
| Δ LWEA(-7)) | -0.013 | 0.011 | -1.266 |
| ECM(-1) | -0.2 | 0.023 | -8.799 |

| | | | |
|---|---|---|---|
| R-squared | 0.930386 | Mean dependent var | 0.031229 |
| Adjusted R-squared | 0.80556 | S.D. dependent var | 0.028994 |
| S.E. of regression | 0.012785 | Akaike info criterion | -5.62785 |
| Sum squared resid | 0.00474 | Log likelihood | 283.7419 |
| Durbin-Watson stat | 2.201651 | | |

| | **LONG** | **RUN** | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| LGL | -1.150 | 1.370 | -0.839 |
| LINC | -0.195 | 0.225 | -0.864 |
| LPO | 3.413 | 2.408 | 1.417 |
| LWEA | -0.861 | 1.249 | -0.689 |
| VFUP | -5.186 | 8.665 | -0.598 |
| VEXCHR | 23.384 | 30.569 | 0.765 |

| **SHORT** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| Δ (LPF(-1)) | -0.003 | 0.088 | -0.035 |
| Δ (LPF(-2)) | -0.252 | 0.086 | -2.931 |
| Δ (LPF(-3)) | -0.466 | 0.084 | -5.566 |
| Δ (LPF(-4)) | 0.099 | 0.080 | 1.244 |
| Δ (LPF(-5)) | -0.074 | 0.076 | -0.969 |
| Δ (LPF(-6)) | -0.515 | 0.075 | -6.823 |
| Δ (LGL) | -0.117 | 0.045 | -2.597 |
| Δ (LGL(-1)) | 0.047 | 0.056 | 0.843 |
| Δ (LGL(-2)) | -0.034 | 0.054 | -0.634 |
| Δ (LGL(-3)) | 0.210 | 0.058 | 3.612 |
| Δ (LGL(-4)) | -0.080 | 0.060 | -1.332 |
| Δ (LGL(-5)) | 0.146 | 0.055 | 2.657 |
| Δ (LGL(-6)) | -0.150 | 0.056 | -2.661 |
| Δ (LGL(-7)) | 0.238 | 0.044 | 5.413 |
| Δ (LINC) | 0.205 | 0.032 | 6.346 |
| Δ (LINC(-1)) | 0.120 | 0.033 | 3.598 |
| Δ (LINC(-2)) | 0.107 | 0.033 | 3.221 |
| Δ (LINC(-3)) | 0.196 | 0.031 | 6.231 |
| Δ (LPO) | 0.043 | 0.080 | 0.530 |
| Δ (LPO(-1)) | 0.260 | 0.082 | 3.175 |
| Δ (LPO(-2)) | -0.324 | 0.097 | -3.340 |
| Δ (LPO(-3)) | 0.074 | 0.097 | 0.769 |
| Δ (LPO(-4)) | 0.084 | 0.097 | 0.871 |
| Δ (LPO(-5)) | -0.526 | 0.094 | -5.568 |
| Δ (LPO(-6)) | 0.422 | 0.084 | 5.043 |
| Δ (LWEA) | -0.006 | 0.008 | -0.713 |
| Δ (LWEA(-1)) | 0.023 | 0.012 | 1.908 |
| Δ (LWEA(-2)) | 0.026 | 0.014 | 1.885 |
| Δ (LWEA(-3)) | 0.010 | 0.015 | 0.690 |
| Δ (LWEA(-4)) | -0.014 | 0.015 | -0.936 |

| | | | |
|---|---|---|---|
| Δ (LWEA(-5)) | -0.010 | 0.014 | -0.743 |
| Δ (LWEA(-6)) | -0.021 | 0.011 | -1.932 |
| Δ (LWEA(-7)) | -0.013 | 0.008 | -1.534 |
| Δ (VFUP) | -0.006 | 0.149 | -0.038 |
| Δ (VFUP(-1)) | 0.463 | 0.149 | 3.107 |
| Δ (VEXCHR) | 0.203 | 0.103 | 1.980 |
| Δ (VEXCHR(-1)) | -0.637 | 0.148 | -4.287 |
| Δ (VEXCHR(-2)) | -0.230 | 0.138 | -1.666 |
| Δ (VEXCHR(-3)) | 0.347 | 0.123 | 2.825 |
| ECM | -0.048 | 0.006 | -8.077 |

| | | | |
|---|---|---|---|
| R-squared | 0.873599 | Mean dependent var | 0.03132 |
| Adjusted R-squared | 0.761562 | S.D. dependent var | 0.028687 |
| S.E. of regression | 0.014008 | Akaike info criterion | -5.39265 |
| Sum squared resid | 0.008634 | | |
| Log likelihood | 266.4913 | | |
| Durbin-Watson stat | 1.756882 | | |

**Result of Post Estimation Tests**

| Test | Statistics | Conclusion |
|---|---|---|
| Normality | 0.438 (0.803) | Residual normally distributed |
| Serial-correlation | 0.913 (0.411) | There is Serial-correlation |
| Heteroskedasticity | 0.889 (0.650) | There is no heteroskedasticity |
| Omission of variable | 2.996 (0.092) | No omitted variable |
| Stability; cumsum | see graph below | There is stability |
| cumsum of squares | see graph below | There is stability |

**Objective 4**

| **LONG** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| VFUP | 95.66473 | 211.0924 | 0.453189 |
| VEXCHR_POS | -430.7591 | 924.8103 | -0.465781 |
| VEXCHR_NEG | -435.2725 | 933.2502 | -0.466405 |
| LPO | 0.791458 | 0.416125 | 1.901972 |

| **SHORT** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| Δ (LPF(-1)) | 0.019288 | 0.141302 | 0.136501 |
| Δ (LPF(-2)) | -0.261009 | 0.14758 | -1.768596 |
| Δ (LPF(-3)) | -0.338242 | 0.130631 | -2.589296 |
| Δ (LPF(-4)) | 0.089266 | 0.095004 | 0.939605 |
| Δ (LPF(-5)) | 0.137772 | 0.083467 | 1.650627 |
| Δ (LPF(-6)) | -0.312864 | 0.081009 | -3.862076 |
| Δ (LPF(-7)) | -0.043284 | 0.079065 | -0.547447 |
| Δ (LPF(-8)) | 0.14276 | 0.092084 | 1.550317 |
| Δ (LPF(-9)) | -0.449293 | 0.098359 | -4.567881 |
| Δ (VFUP) | -0.038762 | 0.181922 | -0.213071 |
| Δ (VFUP(-1)) | -2.482846 | 0.499344 | -4.972215 |
| Δ (VFUP(-2)) | -2.078436 | 0.446479 | -4.655172 |
| Δ (VFUP(-3)) | -2.017737 | 0.398104 | -5.068367 |
| Δ (VFUP(-4)) | -1.471099 | 0.358121 | -4.107824 |
| Δ (VFUP(-5)) | -1.181456 | 0.317707 | -3.718697 |
| Δ (VFUP(-6)) | -1.055218 | 0.279492 | -3.775488 |
| Δ (VFUP(-7)) | -0.885736 | 0.2386 | -3.712228 |
| Δ (VFUP(-8)) | -0.773026 | 0.200971 | 3.846456 |

| | | | |
|---|---|---|---|
| Δ (VFUP(-9)) | -0.451248 | 0.177327 | -2.544722 |
| Δ (VEXCHR_POS) | 0.088165 | 0.054082 | 1.630196 |
| Δ (VEXCHR_POS(-1)) | 10.86803 | 2.439592 | 4.454855 |
| Δ (VEXCHR_POS(-2)) | 9.563443 | 2.286404 | 4.182743 |
| Δ (VEXCHR_POS(-3)) | 11.00426 | 1.965975 | 5.597358 |
| Δ (VEXCHR_POS(-4)) | 9.923883 | 1.903847 | 5.212542 |
| Δ (VEXCHR_POS(-5)) | 8.467345 | 1.802954 | 4.696374 |
| Δ (VEXCHR_POS(-6)) | 6.955907 | 1.659537 | 4.191475 |
| Δ (VEXCHR_POS(-7)) | 5.406597 | 1.406331 | 3.844469 |
| Δ (VEXCHR_POS(-8)) | 3.868187 | 1.106072 | 3.497228 |
| Δ (VEXCHR_POS(-9)) | 1.490143 | 0.757799 | 1.966411 |
| Δ (VEXCHR_NEG) | -1.098871 | 1.152991 | -0.953061 |
| Δ(VEXCHR_NEG(-1)) | 9.622969 | 2.298653 | 4.186351 |
| Δ(VEXCHR_NEG(-2)) | 11.02788 | 1.971413 | 5.593895 |
| Δ(VEXCHR_NEG(-3)) | 9.891945 | 1.905802 | 5.190437 |
| Δ(VEXCHR_NEG(-4)) | 8.52076 | 1.801724 | 4.729225 |
| Δ(VEXCHR_NEG(-5)) | 6.977066 | 1.659242 | 4.204972 |
| Δ(VEXCHR_NEG(-6)) | 5.360801 | 1.423316 | 3.766417 |
| Δ(VEXCHR_NEG(-7)) | 3.827081 | 1.098855 | 3.48279 |

| | | | |
|---|---|---|---|
| Δ(VEXCHR_NEG(-8)) | 1.571645 | 0.728469 | 2.157462 |
| Δ (LPO) | 0.123777 | 0.09876 | 1.25331 |
| Δ (LPO(-1)) | 0.455171 | 0.094914 | 4.795631 |
| Δ (LPO(-2)) | -0.381901 | 0.092579 | -4.125147 |
| Δ (LPO(-3)) | 0.171217 | 0.098774 | 1.733431 |
| Δ (LPO(-4)) | 0.126651 | 0.084426 | 1.500134 |
| Δ (LPO(-5)) | -0.35414 | 0.085011 | -4.165799 |
| Δ (LPO(-6)) | 0.390009 | 0.098925 | 3.942474 |
| Δ (LPO(-7)) | 0.131693 | 0.124096 | 1.061215 |
| Δ (LPO(-8)) | 0.419818 | 0.110088 | 3.813471 |
| Δ (LPO(-9)) | -0.140202 | 0.12076 | -1.160999 |
| Δ (LPO(-10)) | 0.325866 | 0.129526 | 2.515845 |
| ECM (-1) | -0.027452 | 0.005223 | -5.25568 |

| | | | |
|---|---|---|---|
| R-squared | 0.90658 | Mean dependent var | 0.032202 |
| Adjusted R-squared | 0.753994 | S.D. dependent var | 0.027052 |
| S.E. of regression | 0.013417 | Akaike info criterion | -5.51536 |
| Sum squared resid | 0.005401 | | |
| Log likelihood | 270.6143 | | |
| Durbin-Watson stat | 1.957554 | | |

**Table 4:14**
**Objective 4 A**

| **LONG** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| VFUP_POS | 19.15596 | 57.10479 | 0.335453 |
| VFUP_NEG | 22.27935 | 62.7553 | 0.355019 |
| VEXCHR | 0.339847 | 2.419928 | 0.140437 |
| LINC | -0.893004 | 1.721218 | -0.518821 |
| LPO | 4.928927 | 7.776695 | 0.633807 |
| LGL | -0.840696 | 1.82082 | -0.461713 |
| **SHORT** | **RUN** | | |
| Δ (LPF(-1)) | -0.050318 | 0.117332 | -0.428856 |
| Δ (LPF(-2)) | -0.015606 | 0.091811 | -0.169976 |
| Δ (LPF(-3)) | -0.270883 | 0.076527 | -3.539693 |
| Δ (LPF(-4)) | 0.078024 | 0.085405 | 0.913573 |
| Δ (LPF(-5)) | -0.080227 | 0.088482 | -0.906699 |
| Δ (LPF(-6)) | -0.517896 | 0.090708 | -5.709491 |
| Δ (VFUP_POS) | 0.505464 | 0.289849 | 1.743888 |
| Δ (VFUP_POS(-1)) | 0.1177 | 0.388741 | 0.302771 |
| Δ (VFUP_POS(-2)) | -1.372834 | 0.451086 | -3.043397 |
| Δ (VFUP_POS(-3)) | -1.552456 | 0.467138 | -3.323334 |
| Δ (VFUP_NEG) | -0.323904 | 0.383559 | -0.844471 |
| Δ (VFUP_NEG(-1)) | -1.20385 | 0.400972 | -3.002332 |
| Δ (VFUP_NEG(-2)) | -1.088363 | 0.357182 | -3.047085 |
| Δ (LINC) | 0.06014 | 0.028384 | 2.118838 |
| Δ (LINC(-1)) | 0.089306 | 0.032151 | 2.777694 |
| Δ (LINC(-2)) | 0.06 | 0.030774 | 1.949695 |
| Δ (LINC(-3)) | 0.10402 | 0.029858 | 3.483861 |
| Δ (LINC(-4)) | 0.026817 | 0.025407 | 1.055499 |
| Δ (LINC(-5)) | -0.015406 | 0.023964 | -0.642894 |

| | | | |
|---|---|---|---|
| Δ (LINC(-6)) | 0.02931 | 0.023868 | 1.228017 |
| Δ (LPO) | 0.031781 | 0.098623 | 0.322245 |
| Δ (LPO(-1)) | 0.283589 | 0.096987 | 2.924006 |
| Δ (LPO(-2)) | -0.332121 | 0.098097 | -3.38565 |
| Δ (LPO(-3)) | -0.047623 | 0.098714 | -0.482434 |
| Δ (LPO(-4)) | 0.175793 | 0.097025 | 1.811832 |
| Δ (LPO(-5)) | -0.395549 | 0.100681 | -3.928716 |
| Δ (LPO(-6)) | 0.31501 | 0.112465 | 2.800957 |
| Δ (LPO(-7)) | 0.294223 | 0.114299 | 2.574142 |
| Δ (LGL) | -0.068802 | 0.042984 | -1.600658 |
| Δ (LGL(-1)) | 0.054414 | 0.049423 | 1.100981 |
| Δ (LGL(-2)) | -0.037262 | 0.047202 | -0.789414 |
| Δ (LGL(-3)) | 0.055338 | 0.048184 | 1.148454 |
| Δ (LGL(-4)) | -0.095471 | 0.062997 | -1.515489 |
| Δ (LGL(-5)) | 0.165747 | 0.060683 | 2.731328 |
| Δ (LGL(-6)) | -0.09088 | 0.052912 | -1.717588 |
| Δ (LGL(-7)) | 0.099829 | 0.040689 | 2.453494 |
| ECM (-1) | -0.029642 | 0.005458 | -5.43064 |

| | | | |
|---|---|---|---|
| R-squared | 0.809773 | Mean dependent var | 0.03132 |
| Adjusted R-squared | 0.664067 | S.D. dependent var | 0.028687 |
| S.E. of regression | 0.016627 | Akaike info criterion | -5.05532 |
| Sum squared resid | 0.012993 | | |
| Log likelihood | 249.3233 | | |
| Durbin-Watson stat | 2.022547 | | |

**Table 4:14**
**Objective 4 A**

| **LONG** | **RUN** | | |
|---|---|---|---|
| Variables | Co-efficient | Standard error | T-Statistics |
| VFUP_POS | 19.15596 | 57.10479 | 0.335453 |
| VFUP_NEG | 22.27935 | 62.7553 | 0.355019 |
| VEXCHR | 0.339847 | 2.419928 | 0.140437 |
| LINC | -0.893004 | 1.721218 | -0.518821 |
| LPO | 4.928927 | 7.776695 | 0.633807 |
| LGL | -0.840696 | 1.82082 | -0.461713 |
| **SHORT** | **RUN** | | |
| Δ(LPF(-1)) | -0.050318 | 0.117332 | -0.428856 |
| Δ (LPF(-2)) | -0.015606 | 0.091811 | -0.169976 |
| Δ (LPF(-3)) | -0.270883 | 0.076527 | -3.539693 |
| Δ (LPF(-4)) | 0.078024 | 0.085405 | 0.913573 |
| Δ (LPF(-5)) | -0.080227 | 0.088482 | -0.906699 |
| Δ (LPF(-6)) | -0.517896 | 0.090708 | -5.709491 |
| Δ (VFUP_POS) | 0.505464 | 0.289849 | 1.743888 |
| Δ (VFUP_POS(-1)) | 0.1177 | 0.388741 | 0.302771 |
| Δ (VFUP_POS(-2)) | -1.372834 | 0.451086 | -3.043397 |
| Δ (VFUP_POS(-3)) | -1.552456 | 0.467138 | -3.323334 |
| Δ (VFUP_NEG) | -0.323904 | 0.383559 | -0.844471 |
| Δ (VFUP_NEG(-1)) | -1.20385 | 0.400972 | -3.002332 |
| Δ (VFUP_NEG(-2)) | -1.088363 | 0.357182 | -3.047085 |
| Δ (LINC) | 0.06014 | 0.028384 | 2.118838 |
| Δ (LINC(-1)) | 0.089306 | 0.032151 | 2.777694 |
| Δ (LINC(-2)) | 0.06 | 0.030774 | 1.949695 |
| Δ (LINC(-3)) | 0.10402 | 0.029858 | 3.483861 |
| Δ (LINC(-4)) | 0.026817 | 0.025407 | 1.055499 |
| Δ (LINC(-5)) | -0.015406 | 0.023964 | -0.642894 |

| | | | |
|---|---|---|---|
| Δ (LINC(-6)) | 0.02931 | 0.023868 | 1.228017 |
| Δ (LPO) | 0.031781 | 0.098623 | 0.322245 |
| Δ (LPO(-1)) | 0.283589 | 0.096987 | 2.924006 |
| Δ (LPO(-2)) | -0.332121 | 0.098097 | -3.38565 |
| D(LPO(-3)) | -0.047623 | 0.098714 | -0.482434 |
| D(LPO(-4)) | 0.175793 | 0.097025 | 1.811832 |
| D(LPO(-5)) | -0.395549 | 0.100681 | -3.928716 |
| D(LPO(-6)) | 0.31501 | 0.112465 | 2.800957 |
| D(LPO(-7)) | 0.294223 | 0.114299 | 2.574142 |
| D(LGL) | -0.068802 | 0.042984 | -1.600658 |
| D(LGL(-1)) | 0.054414 | 0.049423 | 1.100981 |
| D(LGL(-2)) | -0.037262 | 0.047202 | -0.789414 |
| D(LGL(-3)) | 0.055338 | 0.048184 | 1.148454 |
| D(LGL(-4)) | -0.095471 | 0.062997 | -1.515489 |
| D(LGL(-5)) | 0.165747 | 0.060683 | 2.731328 |
| D(LGL(-6)) | -0.09088 | 0.052912 | -1.717588 |
| D(LGL(-7)) | 0.099829 | 0.040689 | 2.453494 |
| ECM (-1) | -0.029642 | 0.005458 | -5.43064 |

| | | | |
|---|---|---|---|
| R-squared | 0.809773 | Mean dependent var | 0.03132 |
| Adjusted R-squared | 0.664067 | S.D. dependent var | 0.028687 |
| S.E. of regression | 0.016627 | Akaike info criterion | -5.05532 |
| Sum squared resid | 0.012993 | | |
| Log likelihood | 249.3233 | | |
| Durbin-Watson stat | 2.022547 | | |

**Result of Post Estimation Tests Objective Four (+)**

| Test | Statistics | Conclusion |
|---|---|---|
| Normality | 0.734 (0.693) | Residual normally distributed |
| Serial-correlation | 0.175 (0.840) | No Serial-correlation |
| Heteroskedasticity | 0.521 (0.977) | There is no heteroskedasticity |
| Omission of variable | 6.042 (0.021) | Variables are omitted |
| Stability; cumsum | see graph below | There is stability |
| cumsum of squares | see graph below | There is stability |

**Source: Author's Computation 2023**

| **Objective 4** | **(-)** | | |
|---|---|---|---|
| **LONG** | **RUN** | | |
| Variables | Co-efficient | Standard error | T-Statistics |
| VFUP_POS | 19.15596 | 57.10479 | 0.335453 |
| VFUP_NEG | 22.27935 | 62.7553 | 0.355019 |
| VEXCHR | 0.339847 | 2.419928 | 0.140437 |
| LINC | -0.893004 | 1.721218 | -0.518821 |
| LPO | 4.928927 | 7.776695 | 0.633807 |
| LGL | -0.840696 | 1.82082 | -0.461713 |
| **SHORT** | **RUN** | | |
| Δ (LPF(-1)) | -0.050318 | 0.117332 | -0.428856 |
| Δ (LPF(-2)) | -0.015606 | 0.091811 | -0.169976 |
| Δ (LPF(-3)) | -0.270883 | 0.076527 | -3.539693 |
| Δ (LPF(-4)) | 0.078024 | 0.085405 | 0.913573 |
| Δ (LPF(-5)) | -0.080227 | 0.088482 | -0.906699 |
| Δ (LPF(-6)) | -0.517896 | 0.090708 | -5.709491 |
| Δ (VFUP_POS) | 0.505464 | 0.289849 | 1.743888 |
| Δ (VFUP_POS(-1)) | 0.1177 | 0.388741 | 0.302771 |
| Δ (VFUP_POS(-2)) | -1.372834 | 0.451086 | -3.043397 |
| Δ (VFUP_POS(-3)) | -1.552456 | 0.467138 | -3.323334 |
| Δ (VFUP_NEG) | -0.323904 | 0.383559 | -0.844471 |
| Δ (VFUP_NEG(-1)) | -1.20385 | 0.400972 | -3.002332 |
| Δ (VFUP_NEG(-2)) | -1.088363 | 0.357182 | -3.047085 |
| Δ (LINC) | 0.06014 | 0.028384 | 2.118838 |
| Δ (LINC(-1)) | 0.089306 | 0.032151 | 2.777694 |
| Δ (LINC(-2)) | 0.06 | 0.030774 | 1.949695 |
| Δ (LINC(-3)) | 0.10402 | 0.029858 | 3.483861 |
| Δ (LINC(-4)) | 0.026817 | 0.025407 | 1.055499 |
| Δ (LINC(-5)) | -0.015406 | 0.023964 | -0.643 |

| | | | |
|---|---|---|---|
| | | | 0.642894 |
| Δ (LINC(-6)) | 0.02931 | 0.023868 | 1.228017 |
| Δ (LPO) | 0.031781 | 0.098623 | 0.322245 |
| Δ (LPO(-1)) | 0.283589 | 0.096987 | 2.924006 |
| Δ (LPO(-2)) | -0.332121 | 0.098097 | -3.38565 |
| Δ (LPO(-3)) | -0.047623 | 0.098714 | -0.482434 |
| Δ (LPO(-4)) | 0.175793 | 0.097025 | 1.811832 |
| Δ (LPO(-5)) | -0.395549 | 0.100681 | -3.928716 |
| Δ (LPO(-6)) | 0.31501 | 0.112465 | 2.800957 |
| Δ (LPO(-7)) | 0.294223 | 0.114299 | 2.574142 |
| Δ (LGL) | -0.068802 | 0.042984 | -1.600658 |
| Δ (LGL(-1)) | 0.054414 | 0.049423 | 1.100981 |
| Δ (LGL(-2)) | -0.037262 | 0.047202 | -0.789414 |
| Δ (LGL(-3)) | 0.055338 | 0.048184 | 1.148454 |
| Δ (LGL(-4)) | -0.095471 | 0.062997 | -1.515489 |
| Δ (LGL(-5)) | 0.165747 | 0.060683 | 2.731328 |
| Δ (LGL(-6)) | -0.09088 | 0.052912 | -1.717588 |
| Δ (LGL(-7)) | 0.099829 | 0.040689 | 2.453494 |
| ECM (-1) | -0.029642 | 0.005458 | -5.43064 |

| | | | |
|---|---|---|---|
| R-squared | 0.809773 | Mean dependent var | 0.03132 |
| Adjusted R-squared | 0.664067 | S.D. dependent var | 0.028687 |
| S.E. of regression | 0.016627 | Akaike info criterion | -5.05532 |
| Sum squared resid | 0.012993 | | |
| Log likelihood | 249.3233 | | |
| Durbin-Watson stat | 2.022547 | | |

**BIO-DATA**

A. Personal Data

Full Names: Lamina Ibukunolu Bethel

Address: Block 43, Goshen Estate, Redemption Camp, Mowe, Ogun State.

Date and Place of Birth: 11th June, 1974, Mushin, Lagos-State.

Nationality: Nigerian

B. Name and Address of Next of Kin: Dr. Lamina Miriam Yejide. Block 43, Goshen Estate, Redemption Camp, Mowe, Ogun State.

C. Educational Background

Educational Institutions Attended with Dates and Qualifications

| | |
|---|---|
| Lead City University Ibadan, Oyo State (M.sc Economics) | In view |
| Lagos State University, Ojo Lagos (B.sc Economics) | 2004-2009 |
| Kosofe College Ketu, Lagos | 1987 – 1993 |
| Anglican Primary Sch Odo-Ogun | 1989 – 1995 |

D. Working Experience with Dates

| | |
|---|---|
| Michelin Tyre Service Company Limited | 2009 – 2020 |
| Majoe Bureau De Change | 2008 – 2009 |
| The Redeemed Christian Church of God | 2007 – 2008 |

E. Award and Fellowship: Long Service Award

F. Membership of academic Professional Bodies: Nil

G. Publication (if any): Nil

H. Referees

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Signature

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Date

**University Compliance Certification**

This is to certify that this Thesis written by: Lamina, Ibukunolu Bethel with Matric No. LCU/PG/002191 in the Department of Economics, Faculty of Environment Management and Social Sciences, Lead City University, Ibadan is in full compliance with the Approved University format and style.

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Name Date