Analysis of the Dynamics of Inflation Volatility in Nigeria: An Application of TGARCH (1, 1) Modeling.

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ABSTRACT

This study examines the dynamics of inflation volatility in Nigeria using monthly macroeconomic data from 2003M1 to 2023M12 within a multivariate regression framework. Particular attention is given to the asymmetric effects of shocks and a structural break identified in March 2022. The study employs the Threshold generalized autoregressive conditional heteroscedasticity (TGARCH) model selected over GARCH and EGARCH based on some selected information criteria and its ability to capture asymmetric volatility and structural breaks in the inflation series. The findings indicate that changes in global crude oil price, money supply and exchange rate from the previous month have a positive and statistically significant effect on current inflation, while imports exerts a negative significant effect. The study also confirms the existence of asymmetric volatility in inflation rates in Nigeria, indicating that negative shocks such as macroeconomic instability tend to have larger effect on inflation than positive shocks. Based on these findings and the scenario simulation analysis, the study recommends that the government implement policies aimed at improving exchange rate and money supply management as well as measures to cushion the economy against inflationary pressures arising from global oil price fluctuations. Additionally, *p*olicymakers should consider asymmetric responses of inflation to shocks when designing inflation targeting frameworks.

INTRODUCTION

Inflation is one of the major and ever-changing economic challenges facing nearly all global economies and its fluctuating nature makes it a crucial issue to address (Olatunji G.B. et al (2010). Inflation is a significant economic problem in Nigeria with serious consequence for the nation's economic growth and development. Opaluwa D et al (2010) described inflation as the general increase in the price of goods and services in an economy over a period of time. The volatility of inflation affects various aspects of the society ranging from consumer spending to business investments and is closely connected to the nation's economic framework due to its reliance on oil exports. As stated by Babatunde O. and Doguwa, S. (2012), inflation volatility is the fluctuations in the rate of inflation over time or the degree of uncertainty in inflation rate which can affect economic decisions and outcomes. The nation's inflation has been characterized by incessant fluctuations marked by considerable increase in prices, depreciation of the local currency and external disruptions. Among the harmful impacts of food inflation, the adverse effects of inflation volatility are especially worrisome. Significant volatility in inflation rate over time increases uncertainty regarding future price levels. Most economists and monetary policymakers prefer low and stable inflation as it allows faster labor market adjustments during recessions and reduces borrowing costs for businesses and boosting profits (Omotosho B. S. 2013). Inflation is a key economic factor that impacts consumer purchasing power, savings and investment. Inflation has been a long-standing problem in the country due to structural issues, policies inconsistency and external influences like rapid changes in oil prices.

Okon E. A. et al (2023) asserted that various forms of inflation that are prevalent in the nation's economy include demand pull inflation that occurs when the demand for goods and services exceeds supply and the cost push inflation attributed to increase in production cost leading to increase in prices. Other forms of inflation include imported inflation ascribed to rising prices of imported goods or depreciation of the local currency and the structural inflation caused by deep rooted supply side issues in the economy like poor infrastructure, insecurity and poor harvest.A study by Uche, C. and Yusuf I. (2022) identified exchange rate depreciation, fuel and energy

cost, food supply constraint, fiscal deficit and monetary policy challenges as the major factors responsible for the nation's inflation. The study believes that the ongoing inflationary trend in the country is caused by government's removal of fuel subsidy. In the early 1980s, the nation's economy faced internal and external unrest due to reduction of globally oil prices. To tackle the severe budget shortfalls from the economic crisis, the government initiated a structural adjustment program in 1986. During this period, factors like currency devaluation, rapid money supply growth, slow industrial and agricultural progress as well as heavy reliance on imports caused inflationary pressures (Emery K. M.1993). Numerous empirical studies over the years have identified the main causes of inflation volatility. These studies concentrated mainly on factors such as currency devaluation, change in consumer price index, global commodity market shock or disruptions, production input costs and change in producer price index as the core determinant of inflation volatility. However, recent studies have shown that these factors are not the only elements responsible for inflation volatility in the global economy. Other macroeconomic determinants of inflation as stated by Maryam M. N. and Benedict N. A. (2025) and Matthew O. G et al. (2018) include changes in interest rate, exchange rate fluctuation, crude oil prices volatility, money supply and level of import.

A number of studies that examined the determinants of inflation volatility include Babatunde S. O. and Sani I. D. (2012) that explored the dynamics of inflation volatility in Nigeria using the GARCH technique. The study revealed that policy shifts and lack of fiscal and monetary policy alignment greatly cause inflation volatility in the country. A related study by Chinanuife Emmanuel et al (2021) on oil price fluctuations and inflation in Nigeria finds that interest rates and GDP fluctuations have significant effect on inflation volatility. The nation's inflation rate has fluctuated significantly over the years. The country has witnessed both high and low inflationary rates. In the 1990s due to high fiscal expansion and monetary growth, the country experienced a rise in inflation rate. The inflation rate that was 44.59% in 1992 increased significantly to a record high of 72.84% in 1995.It decreases drastically to 6.62% in 1999 as a result of government fiscal and monetary tightening. It increased to 18.87% in 2001 due to expansion in government expenditure. It decreased to 5.39% in 2007 before rising to 13.74 in 2010. It fluctuated at an average of 11.75% between 2011 and 2020.The inflationary level increased further from 16.47 % in January 2021 to 18.35 % in December 2022 and 24.66% in December 2023. It attains a record high of 34.8% in December 2024 (NBS, 2025) due to rising food prices and monetary expansion. Some studies show that structural and institutional changes can also affect inflation. From the perspective of the transition economies or countries, DomacIlker et al. (2001) examined the influences of exchange rate regime on economic performance. The study indicates that fluctuations in the exchange rate regime, weak monetary policy frameworks and external shocks have positive significant effect on inflation volatility in Eastern Europe and former soviet states. Similarly, Catao L. and Terrones, M. (2005) examined fiscal deficits and inflation in both less developed and developed nations. The study reveals that fiscal imbalances especially in less developed countries have significant impact on higher inflation and inflation volatility. The study also affirms that Inflation volatility increased when fiscal deficits were financed by money creation.

Inflation has continued to pose a significant threat to the country's economy, particularly as it contributes to the weakening of the national currency especially when combined with low foreign reserves or reduced oil exports. A weaker or depreciated currency for instance can lead to an increase in import cost which can result to imported inflation. The nation's inflation has caused a general rise in the prices of essential goods and services such as food, transportation, housing and healthcare. Food inflation is particularly high due to supply chain challenges and insecurity in farming regions in the northern parts of the country. This has worsened poverty and inequality among the citizenry. Some scholars believed that government's removal of fuel subsidies also contributed to present inflationary trend which has serious negative impact on the poor, the rural dwellers and the low-income earners or those with fixed income. Kanu, S. I. and Osuji J. I. (2024) explored the effect of fuel subsidy removal on inflation in Nigeria using vector error correction models. The study concludes that subsidy removal created significant increase in fuel price leading to inflation volatility. Similarly, Esekpa, O. I. et al (2024) asserted that government's removal of fuel subsidies led to increased in fuel prices resulting to persistent inflation, economic hardship and currency depreciation. The Nigeria government has been advised by experts to work on stabilizing prices by developing fiscal policies that are more responsible. Though the government has executed a combination of both the monetary, fiscal and structural policies to manage inflation, the results have not been satisfactory. External factors such as international commodity prices, exchange rate fluctuation and insecurity affecting food supply have made inflation difficult to fully control. However, there have been efforts to regulate

interest rates to help manage borrowing and spending costs. The government has also been actively trying to improve agricultural production so that food prices remain stable. Particularly, they have sought out partnerships and collaborations in various sectors to encourage more domestic production, believing to achieve equilibrium between supply and demand, as the consistent effort to balance these factors remains central to the monetary and fiscal authority's inflation management framework. To achieve a minimum or stable inflation, it is imperative to understand its determinants and control. Thus, this study seeks to examine the dynamics of inflation volatility in Nigeria over a period of 2003M1 – 2023M12.

Statement of problem

Inflation has remained one of the most persistent and complex macroeconomic issue in Nigeria over the years. The nation's inflation in has wide ranging effects both on the citizenry and long-term development plan of the country. The persistent and highly volatile inflation as witnessed in the country in recent years posed a serious concern that requires a well coordinated monetary and fiscal policies as well as structural policy. One of the main issues is that the nation's inflation is caused by both demand sideand supply side factors. According to Ogunmuyiwa M. S. (2020), the demand side factors comprise of excessive government spending, expansionary monetary policies and rising consumer demand that usually contribute to general price increases. Adebayo A. A. and Onanuga O. T. (2021) opined that the supply side issues include structural bottlenecks such as inadequate infrastructure, increasing food costs, agricultural insecurity and local currency devaluation. Maryam M. and Benedict A. (2025) claimed that the nation's inflation is also highly sensitive to external factors such as exchange rate and international oil price fluctuations. Over the years, the Nigerian government has adopted several policies and strategies to ensure stable inflation rate. For instance, the apex bank (CBN) through monetary tightening has continued to increase both the monetary policy rate (MPR) and the cash reserve ratio (CRR) in order to reduce the volume of money in circulation and restrict bank lending. Other measures adopted by the government include investing in transport infrastructure to lower goods transportation costs and improved security operations aimed at protecting agricultural regions and ensuring food supply stability. According to Olatunji, L. M. (2021), regardless the policy interventions by the Nigerian government, the country continues to experience high and volatile inflation rates that have hindered economic growth, weakened purchasing power and increased poverty levels. The volatility of the nation's inflation especially food inflation has a significant impact on the country's economic growth and development. And it is important to explore the underlying causes and effects of this volatility for effective policies formulation. Thus, this study seeks to examine the dynamics of Nigeria's inflation volatility.

Conceptual Framework

The conceptual framework formulated in this study seeks to integrate key economic theories and Nigeria specific factors to explain the causes of inflation and provide a basis for empirical analysis.

Inflation

Aberu, F. (2023) described inflation as the sustained increase in the general price level of goods and services in a country over time. It is one of the most persistent macroeconomic challenges facing the Nigerian economy. Inflation directly affects the cost of living, purchasing power, poverty levels and overall economic stability. Since the introduction of the structural adjustment program in 1986, the nation's economy has continued to experience rising inflation. The annual inflation rate has remained in double digits for several years and food inflation has been particularly severe. According to the National bureau of statistics (2025), headline inflation stood above 30% in the first half of 2025, with food inflation climbing even higher due to supply disruptions, prevailing insecurity and the depreciation of the local currency. Uche, C. and Yusuf I. (2022) analyzed the *s*tructural and policy induced causes of inflation in Nigeria identified exchange rate depreciation, fuel and energy cost, food supply constraint, fiscal deficit and monetary policy challenges as the core factors responsible for the nation's inflation. The Nation's inflation rate has fluctuated extensively from 2015 to date. The inflation rate which was 9% in 2015 increased to 18.35% in 2022 attained a record high of 34.8% in December 2024 before declining to 22.97% in May 2025 (NBS, 2025). Numerous empirical studies have been conducted on the impact of inflation and inflationary process in many countries, both developed and developing including Nigeria. From

the Argentina perspective, Gomez R. and Ortega J. (2022) evaluated the long term impact of hyperinflation on poverty, savings and income distribution. The study concludes that inflation eroded real incomes and worsened poverty. Likewise in Nigeria, Musa K. A. and Eze, A. C. (2022) explored the impact of inflation on employment and investment found thatrising inflation reduces investment levels and increases unemployment in the long run.

Money supply

Money supply is an important driver of economic activity and price levels in any economy. Money supply refers to the total sum of money available in an economy at a particular point in time. It consists of currency, demand deposits and time deposit assets. An increase in money supply can stimulate growth but extreme expansion can lead to inflation. Inflation control requires a careful management of the money supply by the monetary authority in order to achieve and maintain economic stability. Bakare A.S. (2011) viewed money supply as a critical factor influencing the level of economic activities and changes in its size affect investment growth and economic output. Since the sixteenth century, the classical quantity theory of money has explained how money supply affects inflation. Irvin Fisher (1911) opined that inflation has a positive significant relationship with increase in money supply given the output level. In Nigeria for instance, the monetary authority through the apex bank (CBN) uses various financial tools to regulate money supply and interest rates in order to achieve minimal inflation. These tools include the monetary policy rate, reserve requirements, open market operations, liquidity ratio and foreign exchange market interventions. The monetary policy rate (MPR) is especially critical in managing money supply and inflation. Recently, the CBN adjusted these tools in response to economic realities, such as increasing the MPR to curtail inflation. However, the country is also faced with challenges like external shocks and exchange rate volatility (Oladipo O.S. 2022). The issue of money supply and inflation has been widely studied by many scholars but the empirical results remain contradictory. While the study by Oyegun G. and Joshua D. (2024) did not find a strong correlation between money supply and inflation, the study by Azubike C. O. and Roland U. E (2025) discovered money supply to have significant effect on inflation within the studied period. The study by Matthew O. Gidigbi et al. (2018) on inflation and exchange rate volatility pass through in Nigeria from 1981 to 2015 indicates that the money supply has positive impact on inflation than exchange rate fluctuations. Money supply has been found to plays a significant role in inflationary trend in Nigeria.

Crude oil Price

The Nigerian economy is heavily dependent on crude oil exports making the relationship between crude oil prices and domestic inflation both significant and complex. Crude oil both serves as the main source of government revenueandforeign exchange earnings in the country**.** Hence, fluctuations in global oil prices directly impact Nigeria's inflation rate through several economic transmission mechanisms. The relationship between crude oil price and inflation is complex and can be affected by many factors such as supply and demand, government actions and global economic trends. Zivkov D. and Manic S. (2019) affirmed that oil price fluctuations impact domestic inflation by directly raising refined oil product prices that influence the consumer price index and indirectly by altering the prices of goods and services that use oil-based inputs. The nation's inflation rate has increased significantly after the post Covid -19 periods. From 12.3% in January 2020, it climbed to 15.63% in 2021, 18.35% in 2022, 24.66% in 2023 and 34.8% in 2024.(NBS, 2024). At the same time, the average price of Brent crude oil per barrel fluctuated significantly from 2020 to 2024. From $41.96 per barrel in 2020, it rose to $70.86 in 2021. It increased further to $100.93 in 2022 before decreasing to $77.58 in 2023 and averaging $80.53 in 2024 (CBN, 2025).Studies by SaniBawa et al (2020) discovered that rising oil prices led to higher inflation, affecting both core and food inflation and conclude that oil price fluctuations have positive significant impact on the exchange rate and ultimately affect import prices in Nigeria. While positive oil price shocks tend to increase the money supply in oil-producing nations with intense impact on consumer prices, declining oil prices can diminish foreign income for oil producing countries like Nigeria, leading to currency devaluation and probably rising inflation (BalaU.and Chin. L.2018).

Exchange rate

A primary challenge in global economic policy especially in emerging economies is the impact of exchange rates fluctuation on inflation and economic activities. It is believed that exchange rate volatility can cause local economic imbalances and influence a nation's competitiveness.Iyoha M.A. (1996) described exchange rate as

the price of one currency in terms of another and it is use to define the global monetary framework. Exchange rate volatility has remained a problem in the nation's economy. The Nigerian government has adopted various exchange rate regimes in order to enhance the stability of the local currency and curb rising inflation. The monetary authority has historically maintained a dual exchange rate system comprises of a controlled CBN rate for government and priority sectors and a demand driven black market rate. However, in June 2023, the CBN floated the naira by allowing market forces to determine its value. This decision unified most exchange rates and sought to reduce the disparity between the official and black market rates. For instance in the year 2021, the Nigerian economy experienced both currency depreciation and rising inflation. The exchange rate between the local currency and the US Dollar changed from N380 in 2020 to N413 by the end of 2021.The average exchange rate for the year was N399 per USD compared to N356 in 2020.The overall inflation rate which reflects the general increase in prices was recorded at 15.63% in December 2021, marginally lower than the 15.75% recorded in December 2020. (NBS, 2024).Moser G.G (1995) in his study on the main determinants of inflation in Nigeria identified naira devaluation as a key factor responsible for rising inflation in the country. The study also noted that concurrent applications of both monetary and fiscal policies have significant influence on naira depreciation and rising inflation. Similar study by Alieu B.L (2019) shows no long-run relationship between exchange rate volatility and inflation. Maryam M. Ndume and Benedict N. Akanegbu (2025) investigated exchange rate volatility and inflation dynamics in Nigeria using structural VAR approach. The study reveals a strong link between exchange rate fluctuation and inflation volatility in Nigeria.

Interest Rate (MPR)

The relation between interest rates and inflation in Nigeria is critical for the growth of the economy. Most times the Central Bank of Nigeria uses the interest rates to control and maintain minimum inflation. Interest rates influence inflation by altering borrowing costs and money supply. Higher rates discourage borrowing and encourage saving thereby reducing spending and demand driven inflation. In contrast, lower interest rates boost borrowing and spending thus stimulating the economy but potentially increasing inflation if the economy is near full employment (Keynes, J. M.1936). In Nigeria, the monetary policy rate is the benchmark interest rate and it serves as a basis for both the lending and deposit rates. The nation has witnessed fluctuation of interest rate and inflation since 2021. The inflation rate has been rising. It reached a twenty-eight year high in June 2024. The apex Bank has been adjusting interest rates to control inflation. The monetary policy rate (MPR) increased from 11.5% in 2021 to 16.5% in 2022. It increased further from 17.5% in 2023 to a record high of 27.5% in 2024. (CBN statistical bulletin 2024). Various studies that have assessed the nexus between interest rates and inflation conclude that high-interest rate results to inflation. For instance, Olise A. C. and Ejedegba R. U. (2025) analyzed monetary policy and inflation dynamics in Nigeria from 1986 to 2023. The study concludes that monetary policy rate and money supply have positive significant impact on inflation in Nigeria within the studied period. Likewise, Musa, N. and Amuta, O. D. (2019) explored the impact of monetary policy on inflation in Nigeria from 1986 to 2019 using autoregressive distributed lag approach. The study found that interest rate and exchange rate have positive significant impact on inflation both in the short run and long run.

Import

The relationship between imports and inflation in Nigeria is intricate and it is influenced by several structural and external factors including exchange rate volatility, trade policies and the nation's dependency on foreign goods mostly for essential items and raw materials. Nigeria imports a major share of its consumption and industrial inputs such as refined petroleum products, machinery and equipment, pharmaceuticals and food items like rice, wheat and sugar. Due to limitation in local production, many companies in Nigeria depend extensively on imported materials. This import dependence makes the economy to be exposed to external shocks and global price movements. Oladipo, O.S. and Akinbobola, T.O. (2011) opined that one of the medium through which imports influence inflation in Nigeria is through cost inflation. When the local currency (naira) depreciates or there is an increase in global prices, the cost of imports increases. This often leads to higher prices for imported goods and local products that depend on foreign inputs. A study by Adeniran J.O. et al (2014) on theimpact of exchange rate fluctuation on the Nigerian economy also affirms that imports have a significant impact on the nation's inflation. This is seen in most less developed countries inclusive Nigeria when higher costs of imported petroleum products lead to increased transportation and production cost. Imported inflation occurs mainly when inflation from outside the country affects the local economy through trade. For instance, when global food prices

rise as witnessed during Covid-19 and the Russia-Ukraine conflict, the Nigerian economy experiences higher domestic food inflation. The naira's volatility also has a direct impact on import prices as weaker or depreciated naira often lead to higher cost of purchasing goods in foreign currencies.

Theoretical Literature

This section examines the monetary theory of inflation and the structural theory of inflation. However, this study focused on the monetary theory of inflation.

Monetary theory of inflation

The monetary theory of inflation links inflation directly to the money supply in an economy. It argues that continual inflation is caused by excessive growth in the quantity of money relative to the growth of output. This theory has its roots in classical economics and was developed and formalized by monetarist economists like Milton Friedman (1968). The theory derives its origin from Fisher's equation as expressed below: MV = PQ

Where: M = Money supply, V = Velocity of money, P = Price level and Q = Real output

The theory believes that if the velocity of money *(*V*)* and real output *(*Q*)* are constant, an increase in the money supply (*M)* will lead to a proportional increase in the price level (*P*) which will result to an inflationary trend. The main assumptions of this theory include neutrality of money stock in the long run and constant velocity of money. Based on monetary theory, Stylianou T. et al (2024) explored the link between money supply and inflation in Pakistan. The study identified a positive relationship between money supply and inflation in Pakistan. From the Nigeria perspective, Olise A. C. and Ejedegba R. U. (2025) examined the relationship between monetary policy and inflation dynamics. The study's findings supported the monetary theory that inflation is primarily caused by changes in money supply. The monetary theory was heavily criticized by both the Keynesian and structuralist economists. While the Keynesian economists arguedthat inflation is not purely monetary that it can also result from demand pull or cost push factors. The structural economists opined that inflation is mainly caused by supply side constraints and institutional rigidities particularly in less developed economies.

Structural theory of inflation

The structural theory of inflation argues that inflation in less developed countries is not primarily caused by excess demand or expansion in money supply but by deep rooted structural rigidities prevalent in the economy. These rigidities limit the productive capacity of the economy and cause prices to rise even when demand or money supply is constant. This theory is closely linked with structuralist economists like Stretton Hugh and Myrdal Gunner (1995). The theory believes that structural rigidities such as poor infrastructure, low productivity, market rigidities; inelastic domestic supply, heavy reliance on imports and inefficient agricultural systems are responsible for inflation in less developed countries. From the view of supply side perspective, Ajayi O. (2014) explored structural challenges and inflation in Nigeria. The study concludes that structural bottlenecks such as poor transport systems, policy inconsistencies and low agricultural productivity are major factors responsible for inflation in the country. Tella, S. (2017) highlights institutional weaknesses, import dependence and market inefficiencies as causes of structural inflation in Nigeria. The structural economist believe that inflation can only be controlled in less developed economies through long term structural reforms and not just short term fiscal or monetary tightening. Their key recommendations include improving agricultural productivity and rural infrastructure; expansion of energy and transport systems; diversification of the economy to reduce import dependency and investment in human capital to improve labor productivity.

Empirical Review

The dynamics of inflation volatility is well studied by many scholars but the empirical results remain conflicting. For instance, Anachedo C. et al (2025) analyzed the impact of exchange rate fluctuations on inflation and interest rates in Nigeria from 1986 to 2023. Their findings show that exchange rate fluctuations have a negative significant impact on interest rates and a positive insignificant effect on inflation. The study recommends government interventions to curb excessive volatility and create conditions for gradual exchange rate adjustments driven by market fundamentals. In a related study, Nwaigwe, F. O. et al (2025) investigated the

connection between real exchange rate and inflation in Nigeria from 1986 to 2023 using the Mundell-Fleming and inflation targeting models. The study found a positive correlation between real exchange rate and inflation targeting. It recommends strengthening government policy coordination to ensure price stability in the country. Using the GARCH-MIDAS model, Assana U. B. et al (2024) examined the impact of inflation volatility on economic growth in seventeen (17) African countries. The results show that economic growth helps lessen inflation fluctuations in some selected African nations but has less impact in other sub-regions. The study concludes that region specific policies are vital to managing and addressing inflation volatility in different countries. Olabisi O. E and Akeju, K. F. (2024) appraised the effect of exchange rate instability and inflation on the Nigerian economy from 1985 to 2022. The findings show that exchange rate volatility and inflation have a negative significant effect on the growth of the Nigerian economy during the studied period. The study recommends that the Government should implement and execute policies aimed at strengthening the national currency. Utilizing the threshold autoregressive (TAR) approach, Valogo M.K. et al. (2023) explored the influence of exchange rates on inflation within Ghana's inflation targeting framework from 2002 to 2018. The findings revealed that when the exchange rate devalues beyond a 70% monthly threshold, it significantly contributes to inflation thereby supporting the importance of the threshold level. Paul G. Ekpeyong (2023) explored Nigeria's inflation dynamics from 1995 to 2022 using a GARCH model. The findings reveal that all three inflation variables display time varying volatility, showing fluctuations and uncertainties in prices over time. The study stresses the need to observe inflation dynamics and implement timely policies to maintain economic growth and development in the country. From the Sierra Leone perspective, Tarawalie and Kamara (2022) examined the link between inflation and economic growth from 1980 to 2020. Their findings show a nonlinear relationship. The study concludes that inflation only enhances economic growth when below 10.3%. Ighoroje, J.E. and Orife, C.O. (2022) analyzed the impact of exchange rate volatility on inflation in Nigeria from 1987 to 2019. The findings indicate that macroeconomic factors are not the major causes of inflation in Nigeria. The study suggests that in addition to using monetary and fiscal measures to control inflation and unemployment, the government should focus on diplomatic efforts to improve the nation's reputation and boost public trust. Similarly, Okeke C.C. et al. (2022) used an Auto regressive distributed lag model to investigate inflation drivers in Nigeria from 1981 to 2017. The study concludes that both demand pull and cost push factors are responsible for inflation in Nigeria. Azam and Khan (2022) evaluated the impact of inflation on the economic growth in twenty-seven countries comprising of sixteen less developed countries and eleven advanced countries from 1975 to 2018. The empirical results reveal that inflation has adverse effects in developed countries when it rises to 5.36%, compared to the 12.23% threshold in less developed nations. Eneh, O.M. and Amakor, I.C. (2021) employed OLS methods to examined foreign exchange systems and Nigeria's economic performance from 1990 to 2020. Findings indicate a weakly positive link between exchange rate systems and inflation, and a positive statistically insignificant relationship with current account balance at the 5% significance level. Using the ARDL approach, Inim et al. (2020) investigated factors beyond money supply affecting inflation in Nigeria from 1999 to 2018. The study found that inadequate infrastructure, exchange rates, political instability, corruption and double taxation were major causes of inflation during the studied period. The study recommends controlling these non-monetary inflation drivers; reviewing security spending and related strategies to achieve low single digit inflation and economic growth. Adaramola, A. O. and Dada, O. (2020) explored how inflation affects Nigeria's economic growth potential. The findings revealed that inflation and real exchange rate have a negative significant effect on economic growth, while interest rate and money supply have a positive significant effect. The study recommends that monetary authority should adopt a more practical approach in curtailing inflation in the country. Finally, Obinna Osuji (2020) assessed the impact of inflation on household consumption in Nigeria from 1981 to 2018 using the ordinary least squares method. The findings reveal a positive significant long run relationship between inflation and household spending in Nigeria. The study recommends that the government should ensure prices remain low and stable to mitigate inflation's negative impact on private consumption.

RESEARCH METHODOLOGY

The Economic Models

To clearly demonstrate the dynamics of inflation volatility in Nigeria, this study employed a single multivariate regression equation with inflation rate as the dependent variables and drivers of inflation such as money supply, exchange rate, import rate, crude oil price and interest rate as independent variables or regressors. The inflation

rate equation is designed following the analytical approach of Arshad H. et al (2023) who analyzed the causes of inflation volatility in Pakistan and Inim V.et al (2020) who investigated the factors affecting inflation in Nigeria. The functional form of the inflation rate model is specified as:

$$INF_t = f(MS_t, EXCR_t, IMPR_t, COP_t, INTR_t) \quad (3.1)$$

The linear econometric form of the functional model is specified as follows:

$$INF_t = a_0 + a_1 MS_t + a_2 EXCR_t + a_3 IMPR_t + a_4 COP_t + a_5 INTR_t + e_t \quad (3.3)$$

Where: INF is inflation rate; MS is money supply; EXCR is the exchange rate; IMPR is import rate; COP is crude oil price and INTR is interest rate. $a_0$is a constant term; a_1-a_5 are the coefficients of the explanatory variables; e_t refer to random error term.

Estimation Technique

The study employed the Threshold generalized autoregressive conditional heteroscedasticity (TGARCH) technique as introduced by Zakoian(1990) and GlostenJagannathan and Runkle (1993) to estimate the cointegrating regression model which handles series with asymmetric volatility.. TGARCH models are known to provide a more parsimonious and practical model for financial time series and it effectively captures volatility clustering in inflation data with fewer parameters than the ARCH model. Unlike ARCH/GARCH models which only account for symmetric effects, TGARCH is more suitable in this study due to strong evidence of asymmetry and structural breaks in Nigeria's inflation dataIt is also widely used in similar macroeconomic studies making it both a practical and empirically valid choice for analyzing inflation volatility in Nigeria. Engle R. F. (2001) stressed the usefulness of TGARCH models in risk management and forecasting especially in value at risk (VaR) calculations. TGARCH models are particularly effective for analyzing financial data such as exchange rates, inflation, money supply and stock prices that exhibit asymmetric qualities. The model for this study is expressed as TGARCH (1, 1) as follows:

Mean equation:

$$INF_t = a_0 + a_1 INF_{t-1} + a_2 MS_{t-1} + a_3 EXCR_{t-1} + a_4 IMPR_{t-1} + a_5 COP_{t-1} + a_6 INTR_{t-1} + e_t \quad (3.4)$$

Varianceequation:

$$h_t = \varphi_1 + \lambda_1 u^2_{t-1} + \lambda_2 h^2_{t-1} + \lambda_3 u^2_{t-1} D_{t-1}$$

Hence, INF = inflation rate; MS = money supply; EXCR = exchange rate; IMPR = import rate; COP = crude oil price and INTR= interest rate. $\lambda_1$andλ_2 represent the partial slope coefficients or parameters of the GARCH (1, 1). $a_0$andφ_1 are constant; a_1-a_6 are coefficients; u^2_{t-1} is ARCH term h^2_{t-1} is GARCH term and e_t is the error term. D is dummy variable. $\lambda_3$is the asymmetry or leverage term.

The sum of the ARCH and GARCH terms shows persistence of the volatility. If $\lambda_1 + \lambda_2 < 1$, it indicates that shocks will die out slowly, but if $\lambda_1 + \lambda_2 > 1$, it shows that shocks will die out quickly, (Bollerslev 1990).

Diagnostic Tests

The Unit Root Test

The study uses the Augmented Dickey-Fuller test with break developed by Dickey and Fuller in 1981 to analyze the time series and determine their integration level. A basic form of the unit root model with intercept and trend is stated as follows:

$$\Delta W_t = b_0 + b_1 W_{t-1} + \sum_{i=1}^{n} c_i \Delta W_{t-i} + u_t \quad (3.5)$$

Where: W_t = economic time series under investigation
b_1 and c_i = parameter estimate of the variables
n = optimal lag length
Δ= first difference operator
u_t = stochastic term

Results Analysis

Stationary Test

The Augmented Dickey Fuller (ADF) and Philips Perron (PP) tests were used to test for the stationarity properties of the data. The Augmented Dickey Fuller (ADF) breakpoint unit root test was undertaken to establish the existence of structural break in the series. The summary of the results is given in Table 4.1

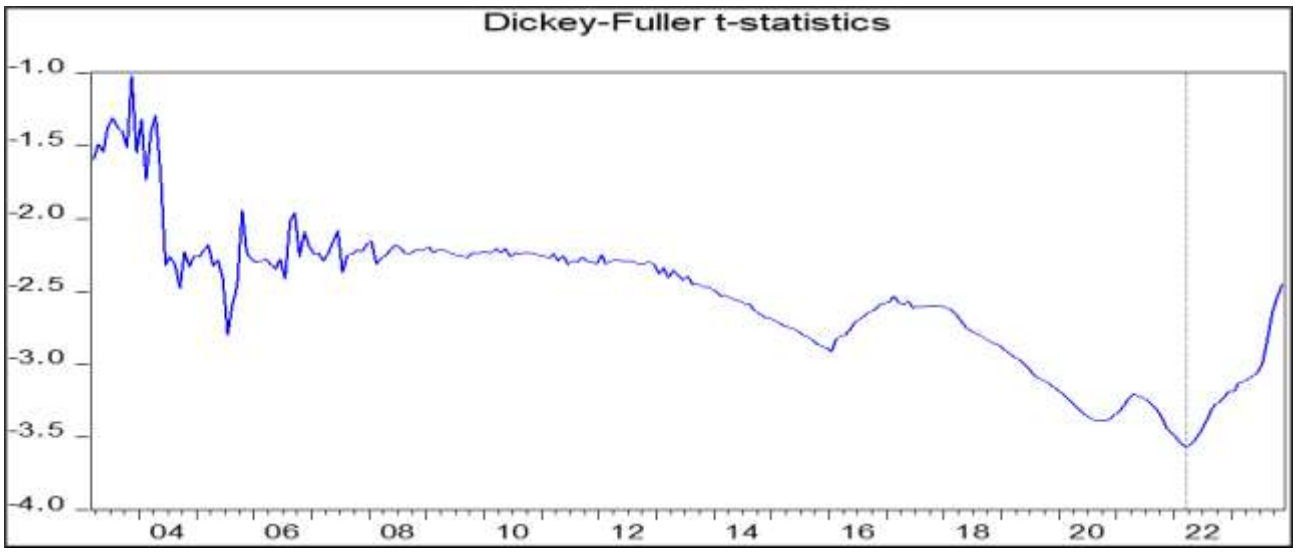
Table 4.1: Summary of unit root test results

Unit root test results for Inflation rate					
Variable	Levels test results		First Difference test results		
	t-stat.	5% critical value	t-stat.	5% critical value	Order of integration
ADF	1.05	3.43	8.46	3.43	I(1)
PHILIP PERON	2.58	3.43	13.25	3.43	I(1)
ADF BREAK POINT TEST	3.57	4.44	14.28	4.44	I(1)

Source: Author's computation from E-views 12

The unit root tests depicted in Table 4.1 show that inflation rate in Nigeria is not stationary at level but at first difference. The Augmented Dickey Fuller (ADF) breakpoint test revealed the presence of structural break in the series as shown in the critical value (see figure 4.1). The structural break point is March 2022, which coincides with the Russia-Ukraine war that started in late February 2022, causing sudden increases in global oil, fertilizer and wheat prices. Nigeria is an importer of wheat from Ukraine. Also, post COVID-19 global logistics bottlenecks and local insecurity in agricultural regions worsened supply side inflation in the country.

Figure 4.1: Augmented Dickey Fuller (ADF) breakpoint Test



Source: Author's computation from E-views 12

Test for ARCH Effect

It is significant to conduct Engle (1982) test for ARCH effects to ensure that the data can fit into the model. Table 4.2 presents the result of the ARCH effect test.

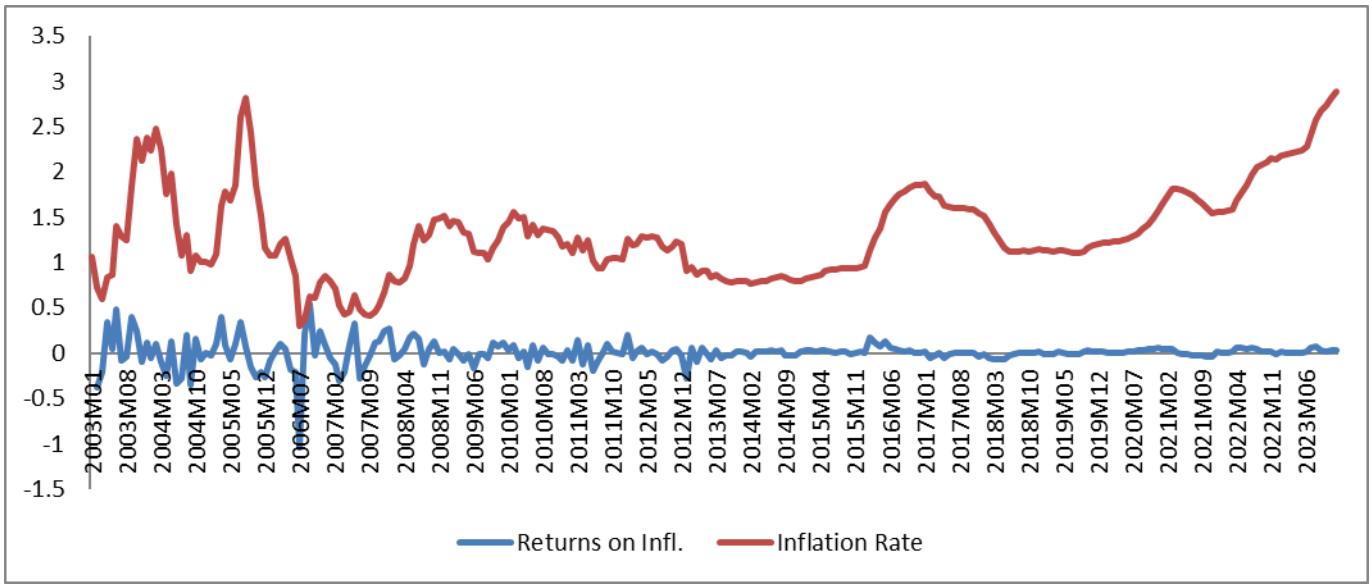
Table 4.2: Heteroscedasticity Test: (The ARCH-LM test)

F-statistic	70.84796	Prob. F(2,243)	0
Obs*R-squared	90.60974	Prob. Chi-Square (2)	0

Source: Author's computation from E-views 12

Table 4.2 shows evidence of ARCH effect. The F-Statistics and Obs*R-squared probability value is significant. The plot of the residual graph presented below in fig. 4.2 further establishes the presence of ARCH effect. Following the evidence of arch effect, the family of the generalized autoregressive conditional heteroscedasticity (GARCH 1 1, EGARCH and TGARCH) models was estimated.

Fig. 4.2: Residual graphof Inflation rate and returns



Source: Author's computation from E-views 12

Estimation of the GARCH (1 1), EGARCH (1,1) and TGARCH (1,1)models

Table 4.3: Empirical results of inflation volatility models with structural breaks

VARIABLES	**GARCH (1,1)**		**TGARCH (1,1)**		**EGARCH (1,1)**	
	Coefficient	**Prob.**	**Coefficient**	**Prob.**	**Coefficient**	**Prob.**
Mean equation						
C	-12.1261	0	-11.6795	0	-18.3967	0.0113
IMPORT RATE (-1)	-4.67E-11	0	-4.75E-11	0	-3.94E-11	0
EXCHANGE_RATE(-1)	0.03072	0.0241	0.027681	0.0422	0.031747	0.3459
MONEY SUPPLY M2(-1)	1.80E-06	0	1.80E-06	0	1.17E-06	0.0007
INTEREST_RATE (-1)	0.015714	0.7866	0.015373	0.804	0.032976	0.9259

PRICE_OF_CRUDE (-1)	0.002023	0	0.002022	0	0.002266	0
DUMMY_VARIABLE	-1402.79	0.0935	-1403.32	0.0027	-1383.19	0
DUMMY EXC. RATE	-1.45493	0.1955	-1.45583	0.1058	-1.49681	0
DUMMY IMPORT RATE	-2.30E-11	0.678	-2.32E-11	0.5622	-1.72E-11	0.0024
DUMMY MONEY SUP.	5.45E-05	0.0045	5.45E-05	0.0009	5.46E-05	0
DUMMY PCO	0.001546	0.8594	0.001537	0.7882	0.000862	0.1537
DUMMY INT. RATE	-24.3697	0.7528	-24.4228	0.568	-22.0286	0.0233
Variance Equation						
C	1.964874	0.1201	2.613694	0.1175	5.349522	0
RESID(-1)^2 (ARCH)	0.4727	0	0.301268	0.0288	0.767087	0
GARCH(-1)	0.52984	0	0.398431	0	-0.094826	0.1759
Assymetric Term			0.398431	0.0245	-0.39305	0
Observations	252		252			252
DIAGNOSTICS						
Akaike info criterion	8.140413		8.022335		8.804612	
Schwarz criterion	8.352919		8.249007		9.031285	
Hannan-Quinn criter.	8.22596		8.113584		8.895862	
ARCH/LM TEST						
F-statistic		0.73		0.5683		0.4384
Obs*R-squared		0.7288		0.5665		0.4364

Source: Author's computation from E-views 12

Results from table from table 4.3 confirms that the T-GARCH is the best fitted for the inflation dynamics model than the GARCH (1, 1) and EGARCH (1, 1) based on its minimum AIC, SIC and Hannan-Quinn criteria values. This result is consistent with the findings of Omotosho, Babatunde S. and Sani I. Doguwa (2012). The asymmetric term (γ) is positive and statistically significant at the 5% level. This shows the existence of asymmetric volatility in inflation rates in Nigeria. It implies that negative shocks such as macroeconomic instability, exchange rate depreciation and external supply-side shocks tend to have larger effect on inflation than positive shocks, indicative of the presence of leverage effect.Also, the significant of the GARCH term shows that inflation volatility is highly persistent, indicating shocks have long-lasting effects.

Table 4.4: Scenario Simulation for Inflation volatility

Scenario Simulation for inflation							
Scenario	**Value**	**Excrate_%**	**Crude oil price_Δ**	**MS(M2)_%**	**IMPORT_%**	**MPR_Δ(pp)**	**Impact on Inflation (pp)**
Base line		0	0	0	0	0	0
A. MPR hike	0.015373	0	0	0	0	3	4.60%
B. Exchange rate depreciation	0.027681	25	0	0	0	0	69.20%

C. Oil price crash	0.002022	0	-30	0	0	0	-6%
D. Money supply surge	1.80E-06	0	0	10	0	0	0.002%
E. Imports decline	-4.75E-11	0	0	0	-10	0	4.75E-10
G. All shocks		25	-30	10	-10	3	67.80%

Source: Author's computation from E-views 12

To complement the regression estimates, the study carried out a scenario simulation exercise. This approach applies the estimated coefficients of the regressors to hypothetical but policy relevant shocks to macroeconomic variables such as monetary policy rate, exchange rate, oil price, money supply and imports. The objective is to quantify how inflation would respond under different conditions or scenarios. Scenario simulations indicate that a 300 basis point increase in the monetary policy rate would raise inflation by approximately 4.6%, while 25% exchange rate depreciation would increase inflation by 69.2%. A decrease in crude oil price by 30% will reduce inflation rate by 6%. Combined shocks such as tight monetary policy with a fall in crude oil price will drastically reduce inflation in Nigeria.

Post Estimation Diagnostics Tests for the TGARCH Model

The post diagnostic tests explored in this study include Heteroscedasticity test, auto correlation test and conditional variance analysis.

Heteroscedasticity ARCH- LM test

Table 4.5: Heteroscedasticity Test: (The ARCH-LM test)

F-statistic	0.326346	Prob. F(1,248)	0.5683
Obs*R-squared	0.328546	Prob. Chi-Square(1)	0.5665

Source: Author's computation from E-views 12

Table 4.4 indicates no evidence of ARCH effect. The F-Statistics and Obs*R-squared probability value is insignificant. It shows the issue of heteroscedasticity has been addressed by the mode.

Autocorrelation test

Table 4.6: Autocorrelation test result for the TGARCH model

Autocorrelation test result for the model						
Sample: 2003M1: 2023M12						
Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
.|. |	.|. |	1	-0.036	-0.036	0.3337	0.563
.|. |	.|. |	2	-0.036	-0.037	0.6557	0.72
.|. |	.|. |	3	-0.044	-0.047	1.157	0.763
.|. |	.|. |	4	-0.037	-0.042	1.5001	0.827

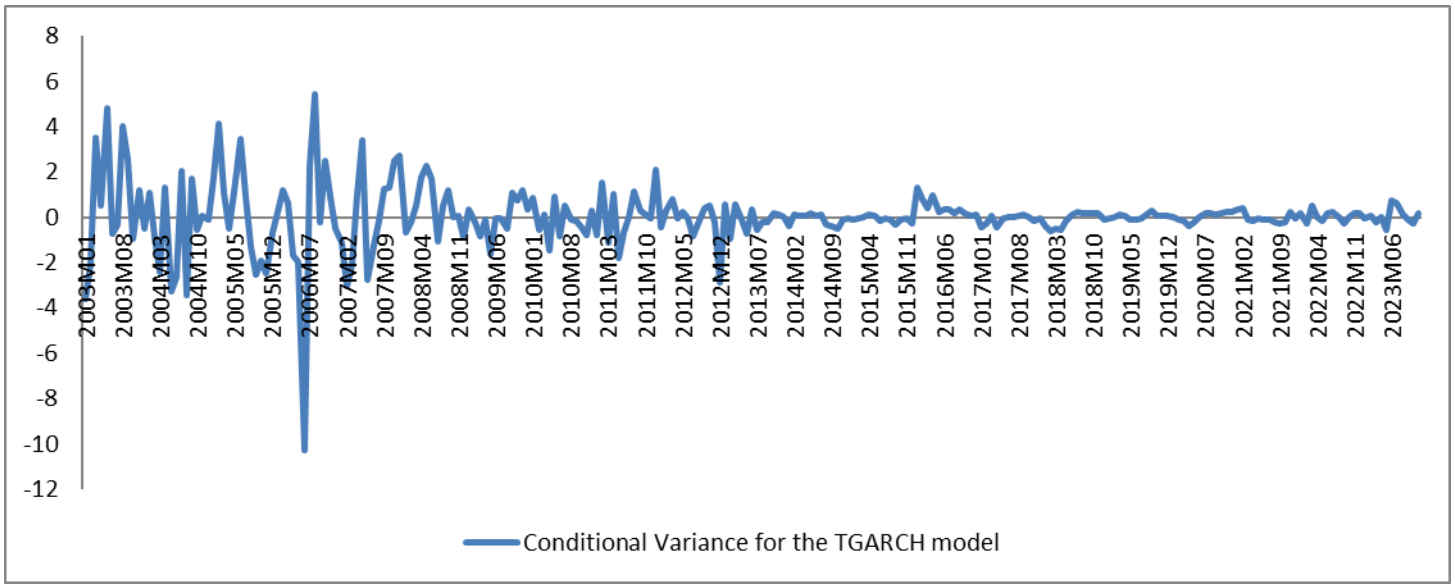
.|. |	.|. |	5	-0.011	-0.017	1.53	0.91
*|. |	*|. |	6	-0.067	-0.073	2.6793	0.848
.|. |	.|. |	7	-0.004	-0.014	2.6826	0.913
.|. |	.|. |	8	-0.042	-0.052	3.1408	0.925
.|. |	.|. |	9	-0.022	-0.036	3.2693	0.953
.|. |	.|. |	10	-0.031	-0.045	3.5175	0.967
.|. |	.|. |	11	-0.026	-0.041	3.6952	0.978
.|** |	.|* |	12	0.216	0.2	16.056	0.189
.|. |	.|. |	13	-0.017	-0.011	16.13	0.242
.|. |	.|. |	14	-0.062	-0.062	17.158	0.248
.|. |	.|. |	15	-0.037	-0.032	17.52	0.289
.|. |	.|. |	16	0.025	0.026	17.686	0.343
.|. |	.|. |	17	0.006	-0.001	17.695	0.408
.|. |	.|. |	18	-0.033	-0.019	17.999	0.456
.|. |	.|. |	19	-0.028	-0.037	18.213	0.508
.|. |	.|. |	20	0.036	0.043	18.567	0.55
.|. |	.|. |	21	-0.032	-0.032	18.85	0.595
.|. |	.|. |	22	0.028	0.035	19.072	0.641
.|. |	.|. |	23	-0.012	-0.007	19.114	0.695
.|. |	.|. |	24	0.001	-0.053	19.114	0.746
.|. |	.|. |	25	0.03	0.029	19.375	0.779
.|. |	.|. |	26	-0.052	-0.026	20.142	0.785
.|. |	.|. |	27	-0.001	0.002	20.142	0.825
.|. |	*|. |	28	-0.054	-0.074	20.985	0.826
.|. |	*|. |	29	-0.044	-0.066	21.533	0.839
.|. |	.|. |	30	-0.03	-0.03	21.787	0.862
.|. |	.|. |	31	-0.03	-0.028	22.043	0.882
.|. |	.|. |	32	0.045	0.003	22.635	0.889
.|. |	.|. |	33	0.015	0.017	22.704	0.911
.|. |	.|. |	34	-0.019	-0.052	22.814	0.928
.|. |	.|. |	35	0.005	-0.001	22.822	0.944
.|. |	.|. |	36	-0.039	-0.046	23.279	0.95

Source: Author's computation from E-views 12

Table 4.5 shows evidence of no serial correlation at five percent (5%) critical level.

Conditional Variance of the Model

Fig.4.3: Conditional Variance of the Inflation Rate Model



Source: Author's computation from E-views 12

RESULT DISCUSSION, CONCLUSION AND RECOMMENDATIONS

Empirical Result Discussion

The TGARCH (1, 1) model results presented in Table 4.3 reveal that imports in the preceding month have a negative significant effect on current inflation. This indicates that a unit increase in imports in the previous month reduces inflation rate by 4.7% in the current period. The findings further reveal a positive and statistically significant relationship between exchange rate in the previous month and the current rate of inflation. It shows that a unit increase in exchange rate in the previous month increases inflationby 3% in the current period. This finding agrees with the result of Omotor D. G. (2008) that found a positive significant relationship between exchange rate and inflation in Nigeria. The results also indicate a positive statistically significant relationship between previous month money supply and current inflation. It shows that increases in the money supply lead to rising inflation, consistent with Quantity theory of money. Similarly, the findings indicate that previous month crude oil price has a positive significant influence on current inflation. The result affirms that a unit increase in previous month crude oil price increase current inflationby 0.02%. This finding agrees with the a priori expectation and the result obtained by Aliyu S. U. R. (2009). Lastly, the results indicate a positive statistically insignificant relationship between previous month interest rate and current inflation.

From the variance equation of theTGARCH (1, 1) model presented in table 4.3, the sum of the coefficients of lagged squared error (Arch term) and lagged conditional variance (Garch term) is about 0.7. This shows that inflation volatility is highly persistent, indicating shocks have long-lasting effects.

Conclusion

This study presented interesting outcomes about inflation dynamics in Nigeria. Given that the variable (inflation rate) displays a structural break, the series was tested and found to be significant and was accounted for in the model. The time varying properties of inflation rate in Nigeria was empirically analyzed using the GARCH (1, 1), EGARCH (1, 1) and TGARCH (1, 1) and it was discovered that asymmetric TGARCH model fitted better than other methods based on the selected information criteria. The findings offer important understanding of the relationship between inflation and different economic variables. In the mean equation, major macroeconomic

variables like exchange rate, crude oil price and money supply in previous month were found to have positive significant effect on current inflation, showing that external and monetary factors continue to drive price movements in Nigeria. Conversely, imports had a negative significant effect. The asymmetric term was found to be positive and statistically significant at the 5% level. This affirms the existence of asymmetric volatility in inflation rates in Nigeria, indicating that negative shocks such as macroeconomic instability, exchange rate depreciation and increase in MPR tend to have larger effect on inflation than positive shocks. Based on the empirical findings, the study concludes that there is presence of asymmetric volatility in inflation rate in Nigeria.

Recommendations

Based on the findings, the following recommendations are provided for policy actions:

1. Money supply management: The CBN should adopt policies and measures to monitor the growth of money supply (M2) in order to control inflation.

2. Exchange rate management: Exchange rate stabilization policy should be adopted to control inflation volatility.

3. Economic diversification: Given the sensitivity of inflation to crude oil prices, the government should prioritize policies that will diversify the economy away from oil dependency in order to reduce inflation risk
4. Policymakers need to consider asymmetric responses of inflation to shocks especially negative economic events when designing inflation targeting models.

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