Tijjani Mamman
Department of Economics,
Federal University of Lafia,
Lafia Nasarawa State, Nigeria
tmamman59@gmail.com

Musa Ibrahim
Department of Economics,
Federal University of Lafia,
Lafia Nasarawa State, Nigeria
mussbin13@gmail.com

INFLATION THRESHOLD AND INFLATION-GROWTH NEXUS IN NIGERIA

ABSTRACT

This study examines the inflation threshold and its effects on economic growth in Nigeria for the period 1980Q1-2022Q4. A non-dynamic threshold regression model developed by Khan and Senhadji (2001) was employed to identify the threshold effect of inflation on economic growth in Nigeria. The result indicates the existence of threshold effect of inflation on economic growth, established at 9.41%. In particular, holding inflation rate below or equal to the estimated threshold value, inflation has a significant positive effect on economic growth. Beyond the threshold level, inflation exerts a significant negative effect on economic growth. Precisely, the finding shows that economic growth would increase by 0.605% in response to a unit increase in the inflation rate. This reveals the desirability of inflation towards improving economic growth in this regime. Beyond the threshold level, inflation reduces the rate of economic growth by 0512% for every additional percentage increase in the inflation rate. Inflation rate in this regime is viewed as a disincentive and detrimental to economic growth due to its negative effects. The study recommends that government should maintain a relatively low and stable inflation rate and then choose an optimal inflation target consistent with steady and sustainable economic growth. That is, at most 9.41% inflation target.

Keywords: *Inflation Threshold; Economic Growth; Non-dynamic threshold regression model*
JEL CODES: C5, E52, E31 O55

1.0 introduction

Over the years, focus on achieving sustained macroeconomic stability has been the primary concern of most countries. Inflation and economic growth are fundamentally among the most essential macroeconomic indicators and are crucial in every strategic economic decision making. However, the perpetual high rate of inflation and low output growth experienced in most developing countries have caused serious threats to the macroeconomic stability of these countries. They could be a curse to the economy and even create unsatisfactory macroeconomic performance. Despite the several macroeconomic policy measures established in Nigeria over the years, the persistent economic problems entrenched in high rates of inflation and low output growth rendered the policy measures inappropriate and ineffective.

****Corresponding Author***:
Tijjani Mamman
Department of Economics,
Federal University of Lafia,
Lafia Nasarawa State, Nigeria
tmamman59@gmail.com

The continuous adverse inflationary trend and the volatility of output growth culminated in the poor performance of macroeconomic policies in Nigeria (Ogara et al., 2019). The motivation underlying this study is the growing concern over the continued uncertainties in achieving steady and sustained economic stability due to the poor performance of these macroeconomic policies. Therefore, policymakers need to understand the operating economic environment, the institutional framework to be adopted, and the choice and mix of the instruments to be used.

The combined effect of rising prices and slower growth rate produced the dissatisfaction that makes the situation a widely discussed problem. According to Orji et al. (2015), the concern is no longer with single-digit rates of inflation but with the benchmark desirable for any economy. Recent research results show that the inflationary threshold for Nigeria is between 14 to 18 per cent, though estimates vary depending on methodology and sample period.

Nigeria has experienced high volatility in inflation rates. Nigeria has experienced three major episodes of high inflation in excess of 30 per cent since 1981. For instance, the inflation rate increased to 40.7 per cent in 1984 from 23.2 per cent in 1983. The sharp increase in the inflation rate was attributable to the shocks which stemmed from the austerity measures introduced in 1983. Some of the factors adduced for this situation included import restrictions and foreign exchange constraints, which led to severe shortages in the supply of goods and services (Bawa & Abdullahi, 2021). Similarly, the expected devaluation of the Naira arising from debt agreements with the International Monetary Fund (IMF), excess money growth, increase in credit to the government, and worsening terms of external trade experienced by the country led to the inflationary pressures (Masha, 2000).

Meanwhile, output growth deteriorated as economic growth declined by 1.1 per cent in 1984. Even though inflation decelerated to 4.7 per cent in 1985, it increased to 56.0 and 50.5 per cent in 1988 and 1989 respectively. This was attributed to the fiscal expansion that accompanied the 1988 budget and its initial financing by credit from the Central Bank of Nigeria, fuel price adjustments in 1988, and a significant depreciation of the naira exchange rate emanating from the implementation of the Structural Adjustment Programme (SAP) (Masha, 2000; Mordi et al., 2007). Although inflation declined to 7.5 per cent in 1990, it rose to 44.8, 57.2, and 57.0 per cent respectively in 1992, 1993, and 1994. It reached an all-time high of 72.8 per cent in 1995. This was due to excess money supply, scarce foreign exchange and severe shortages in commodity supply, as well as continual labour and political unrest following the annulment of the June 1993 elections (Mordi et al., 2007). In view of the excessive inflationary pressure, GDP growth averaged only 1.5 per cent during the period 1992 to 1995. Since 1996, however, the inflation rate has been below 30 per cent, averaging 12.7 per cent between 1996 and 2009, whereas GDP growth averaged 5.4% during the same period. During the period 2008 to 2011, the rate of inflation stood at 12%. During the periods of 2012, 2017, and 2021, the rate of inflation averaged 12.22%, 16.52%, and 16.95%, respectively. The rate continued to climb to 27.33% by 2023 from 16.95% in 2021 and 18.85% in 2022. In essence, inflation is an issue that is central to achieving and maintaining a steady rate of economic growth in an economy.

A low and stable inflation rate is an essential component in maintaining high and steady economic growth. A high rate of inflation often hampers economic activities and output growth through various channels, including increased uncertainty, distorted price signals, and reduced investment incentives. Although the question about the precise relationship between inflation and growth remains debatable, the turning point of inflation at which the sign and magnitude of the relationship switches is essential for policy formulation.

The precise inflation threshold level (Azam et al., 2020), beyond which inflation becomes detrimental to growth, is essential for effective public policy formulation. Thus, the threshold level helps policymakers to maintain a steady price level within a range that supports rather than undermines economic growth.

Nevertheless, how much inflation rate can be regarded as "high" or "tolerable" for sustainable growth? Empirical investigations of such inflation threshold levels have been a subject for a good area for research. Several studies have been carried out to assess whether there exists an inflation threshold beyond which inflation is harmful to growth. This study, therefore, investigates further the inflationary threshold effects on economic growth in Nigeria over the period 1980-2022.

The study is organized into five sections. Following the introduction, section two presents a review of the relevant theoretical and empirical literature. Section three describes the methodology, including the sources of data, model specification and estimation techniques. Section four reports and discusses the empirical results in line with the study's objectives. Section five wraps up the study by summarizing the main findings and offering policy recommendations based on the findings.

2. Literature Review

This section consists of the review of related literature and theoretical framework. The purpose of the reviews is to bond this study with the previous related studies carried out in the area.

2.1 Theoretical Literature

2.1.1 Growth Theory

There are divergent views about the theoretical linkages between inflation and economic growth. Some authors claimed that money and capital are substitutes; an increase in capital accumulation by shifting a portfolio from money to capital is favourable to economic growth (Tobin, 1965; Gregorio, 1996). Therefore, a positive relationship exists between inflation and economic growth. Others argued in favour of a negative relationship between inflation and growth. Inflation reduces the level of capital returns; as such, it weakens economic expansion since it serves as a disincentive to investment (Sanga & Gui-Diby, 2020). Some theories, such as the New Classical and the New Keynesians, were highlighted in the study conducted by Getachew et al. (2018), which served as the basis that described the relationship between inflation and economic growth.

According to the new classical growth theory, the relationship between inflation and economic growth, based on rational expectations and continuous market clearing practices, can be explained by the inter-temporal substitution method and the surprise model. The inter-temporal substitution approach suggested that informed workers provide more labour when the real wage increases, while they have more leisure when the real wage falls. It is expected that productivity will be high, stimulating higher output growth when workers supply more labour (Lucas & Rapping, 1969; Lucas, 1996).

According to Lucas (1973), the surprise approach focuses more on the commodity market than the labour market. When the price of a firm's product increases, the firm rationally decides to increase its output. Therefore, the New Classical approach posits that whenever there is a sudden increase in wage or price, the increase surprises labour and firms, which prompts them to offer more of their services and products. Accordingly, such surprises are hoped to have a positive impact on output growth in the economy in the short run until economic agents adjust their expectations. Such surprises are typically related to an unannounced increase in money supply that causes the general price increase. Even with the unannounced increase in money supply, the output might deviate from its natural rate only for the short run, while in the long run (Lucas, 1996), it will be back to its natural rate when workers realise that the price increase is in absolute terms.

Unlike Keynesians, the New Classical assumed wages and prices to be fully flexible so that there would be zero sacrifice ratios for reducing inflation if future inflation is anticipated. This means if a contractionary monetary policy is announced, inflation can be reduced in the short run without any tradeoff. Supply-side policies play a more significant role in achieving higher economic growth than monetary policy (Lucas, 1996).

This theory provides the foundation for determining the effects of inflation on economic growth. This is because the theory explains the influence of fundamental factors that determine growth, such as increases in wages or prices. Getachew et al. (2018) posits that there is no specific level of inflation that is generally desirable or harmful to growth. That is, relatively low and stable inflation is positively related to growth, while relatively high and unstable inflation is harmful to growth. Therefore, this theory serves as the theoretical framework in determining the effects of the inflation threshold on economic growth in this study.

2.2 Empirical Literature

Empirical investigations into the inflation threshold effects on economic growth have received quite remarkable attention from researchers. Various empirical studies have been carried out on different aspects of the subject matter. While some of these studies find statistically significant inflation threshold effects on economic growth (Bawa et al., 2021; Doguwa, 2012; Fabayo & Ajilore, 2006), some other studies reveal statistically insignificant inflation thresholds (Bassey & Onwioduokit, 2011; Salami & Kelikume, 2010). These studies also established different inflation threshold levels for economic growth in different countries or groups of countries.

Maher (2023) investigates the inflation threshold in Egypt over the period 1976-2019. The study utilised the logistic smooth transition regression (LSTR) model. Findings highlight a statistically significant positive relationship between inflation and GDP growth in the lower regime at 9.32%. Beyond this

threshold, inflation harms GDP growth, indicating an asymmetric relationship between the two variables. Such a specified estimated inflation threshold could assist monetary authorities in setting their inflation target to be below that threshold. The study recommends that policymakers restrict inflation and keep it below the estimated threshold, considering that inflation in the Egyptian economy is derived from the aggregate supply, demand factors and the production apparatus's inelasticity. This study fdo not to carry out a sensitivity analysis of the results to check its robustness and reliability.

D'amour (2023) estimates the threshold effects of inflation on economic growth in Rwanda. Using both LS and 2SLS Threshold Models, the study utilised annual time series data from 1972-2021. The study established a threshold level for inflation of 6%, which means that below 6%, inflation stimulates economic growth, while beyond it, inflation can hamper economic growth. The findings proved that Rwanda has a moderate inflation threshold level compared to other developing countries, whereby the inflation threshold fluctuates above 6% and 15%. The study recommends that Macroeconomic factors such as interest rate, exchange rate, imports or trade in general and political stability were highlighted, among others, that lead to volatility in prices. Therefore, policymakers' attention should be on macroeconomic stabilisation. The technique of the analysis employed in this study may be suitable; however, other threshold models such as TAR, Hansen (1999, 2000), and Khan et al. (2001) are more desirable than LS and 2SLS.

Shugofta (2022) examines the relationship between inflation and economic growth. The study uses a secondary data set for 86 countries on the basis of their income level for the period 1996-2020. The dynamic threshold regression model, GMM and GLS were used for the estimation. Findings depict a negative and significant relationship between inflation and growth above the threshold level. The estimated threshold for high-income countries is 1-2%, for middle-income 3-28% and 9-13% for low-income countries. The study recommends that Governments and central banks should take into account that each country is unique and that the optimum strategy for catching up with or for sustained growth is different for every nation. Pakistan to experience the best economic growth, the inflation rate should be kept at or around 9%, and expectations for inflation should be maintained close to the target level. A major limitation of this study is that it drew conclusions based on aggregate effects obtained by combining countries and should have accounted for country-specific threshold effects.

Bawa and Ismaila (2021) examined the threshold effect of inflation on economic growth in Nigeria. The study adopts a threshold regression model developed by Khan and Senhadji (2001) to estimate a threshold level of inflation for the Nigerian economy using quarterly time series data for 1981-2009. The finding revealed an inflation threshold of 13 per cent for Nigeria. Inflation has a little negative effect on economic growth when it is below the threshold level. In contrast, above the threshold level, there is a high magnitude of negative effect of inflation on economic growth. The negative and significant relationship between inflation and economic growth for inflation rates both below and above the threshold level is robust with respect to changes in econometric methodology. These findings are essential for monetary policy formulation as they provide a guide for the policymakers to choose an optimal target for inflation, which is consistent with the long-term sustainable economic growth goals of the country. The persistence of the negative effect of inflation on economic growth when it is below the threshold level, even after testing for the sensitivity of the results, confirmed the robustness of the methodology and the reliability of the finding. However, an extension of the study periods to cover up to 2022 could have value addition into the study under investigation.

Azam and Khan (2020) explored Threshold Effects in the Relationship between Inflation and Economic Growth for 27 countries, which comprised 11 developed countries and 16 developing countries for the years 1975-2018, via the fixed effects and feasible generalised least square methods. They detected two different inflation threshold levels at 12.23 per cent and 5.4 per cent for the panel of developing and the panel of developed economies, respectively. The existence of the inflation thresholds indicates that inflation impedes growth when it exceeds the turning point of 12.23 per cent and 5.4 per cent for the developing and developed countries, respectively, whereas the negative effect is more pronounced in the panel of developing economies. They suggested that governments and management authorities of the respective countries should target inflation rates at or below 12.23 per cent and 5.4 per cent for the developing and the developed countries, respectively, to avoid the detrimental effects of high inflation on economic growth for sustaining macroeconomic stability. However, the authors do not carry out necessary post-estimation tests such as autocorrelation, heteroscedasticity and stability diagnostic checks to determine the robustness of the model.

Ekinci, Tuzun and Ceylan (2020) selected a sample of 24 countries that implemented an inflation-targeting strategy and examined the relationship between inflation and economic growth using a dynamic panel data model for the analysis. An average of 4.182 per cent of the inflation threshold for the countries was detected. Below the threshold level, the inflation-growth relationship is not significant, while above the threshold level, inflation affects economic growth negatively. It is important to ascertain the threshold level to identify inflation expectations, expected yields of the investments, and the level at which the monetary policy will change direction. Hence, central banks will need to know the threshold level in order to determine monetary policy position. The major problem with this study is the need for a sensitivity analysis to check for the robustness of the model and the reliability of the results.

Raymond (2020) explored the existence of the inflation threshold level and the relationship between inflation and economic growth in Zimbabwe for the period 1981 to 2018. Using Dynamic Ordinary Least Square (DOLS) based on Stock and Watson (1993), he found a 4 per cent inflation threshold above which an additional increase in inflation slows economic growth and has a significant positive impact on economic growth below the threshold level. The findings suggest that policymakers should set inflation targets that keep inflation below the threshold level in order to achieve higher economic growth. However, threshold regression models such as TAR or smooth transition regression (STR) would have been a better methodology than Dynamic Ordinary Least Square.

Azam and Khan (2020) threshold effect of inflation on economic growth for 16 developing and 11 developed economies from 1975–2018. The methods of fixed effects and feasible generalised least squares (FGLS) are used to estimate the inflation threshold and its effects on growth. Findings show a significant negative association between inflation and growth above the threshold level of inflation. The empirical estimate indicates that inflation impedes growth when inflation exceeds the threshold of 12.23% and 5.36% for developing and developed countries, respectively, and with the greatest negative effects for developed countries. Overall, the empirical result of this study could be of use in providing policy direction to governments and management authorities. In developing and developed economies, the management authorities need to cogitate a maximum rate of 12.3% and 5.4%, respectively, as an inflation target to avoid the detrimental effects of high inflation on economic growth for sustaining macroeconomic stability.

However, the application of either a dynamic or nondynamic panel threshold model, such as Hansen (1999, 2000), would have been a better methodology than the FGLS model.

Sanga and Gui-Diby (2020) assessed the growth-inflation nexus in Franc zone currency unions. The study employed Khan and Senhadji (2001) using annual data for the period 1970-2018. Based on country-level data, the results indicate that the current levels of the inflation-based convergence criteria used by central banks in the Franc zone are below the threshold that could be used to spur additional growth in these developing countries. For instance, in comparison with 3 per cent used by the regional central bank of the Central African Monetary Union (CAMU) and 2 per cent by the West African Monetary Union (WAMU), the study finds inflation thresholds at about 5.4-5.6 per cent in the CAMU and 4.3-4.5 per cent in the WAMU. Homogeneous cointegration panel data analyses confirm the need to increase the threshold in Central African Monetary Union countries but not in the West African Monetary Union countries. They suggest that there are opportunities to exploit the range of margins that is derived from the inflation difference between the current 3 per cent level (or 2 per cent) that is used by regional institutions and levels derived in this study. Concerning recovery policies in the post-COVID-19 era, the findings stressed the role of the central bank in supporting economic recovery while achieving its objectives on domestic and external price stability. The study appears to be robust, and the results are therefore reliable.

Tenaw and Demeke (2020) examined inflation threshold effects on growth in Ethiopia: Evidence from Food and Non-Food Sectors. Using a Two-regime Threshold Autoregressive (TAR), the study covers the period 1975-2018. Preliminary investigation of the study reveals that food inflation is a major driver of general inflation and is less persistent. Findings indicate the existence of an inflation threshold in a range of 9-10%. In all cases, the results strongly suggest the growth-detrimental effect of inflation above the threshold level. The study recommends the need to consider the specific behaviour of food and non-food prices and implement appropriate fiscal and monetary policies to bring inflation down to a single-digit level. The methodology they adopted is well suited for the data, and the authors have accounted for the effects of structural breaks on the stationarity of the variable in order to ensure the robustness of the stationarity tests. The results are, therefore, robust and reliable.

Mosikari and Eita (2018) studied estimating threshold level of inflation in Swaziland using annual data spanning from 1980 to 2015. They adopt the threshold model used by Khan and Senhadji (2000), Mubarik (2005), Nasir and Nawaz (2010) and applied liner OLS and Two-Stage least squares (2SLS) methods to determine the optimal effect of inflation on growth. The results of the liner OLS method show that the estimated optimal threshold level is at 12 per cent and that the inflation rate beyond the optimal level of 12 per cent decreases growth by 1.02 per cent. Similar results were also found in applying the 2SLS method, where inflation exerted a negative impact beyond the threshold point by 18.5 per cent. These findings have crucial implications for monetary policymakers in terms of keeping inflation below the threshold point to sustain positive economic growth in the long run. The study is robust as it considers different measures of inflation thresholds, and the methodology adopted is well-suited for the analysis.

Oyelade and Tella (2018) estimated the appropriate threshold level of inflation for economic growth in Nigeria for the period from 1980-2016 using Error Correction Model (ECM) and threshold regression model proposed by Sarel (1996), Khan and Senhadji (2001), Li (2005), Drukker et al. (2005) and Mohanty et al. (2011). They projected the highest tolerable level of inflation threshold in Nigeria at 13.13 per cent, over which inflation above the threshold level becomes detrimental to economic growth, whereas inflation

is likely to have a mild impact on economic growth below the threshold level. They recommended that Nigeria should maintain a relatively low and stable inflation rate if the goal of attaining steady and rapid economic growth is to be achieved. However, most of the explanatory variables used in the analysis (which are based on the monetary theory of inflation) may need to be better suited as the model do not capture population growth and rate of investment, which are essential in determining growth. In many theoretical growth models like Harrod-Domar, Solow (1956) and Swan (2009), population growth and investment are considered important determinants of economic growth (see Risso and Carrera (2009). Furthermore, the study do not to carry out diagnostic tests to assess the reliability of the model for valid inference

Celil (2017) carried out a study on D-8 countries for the period between 1971 and 2014 and investigated the inflation-growth nexus: A dynamic Panel threshold analysis based on the neoclassical production function modified by Khan and Senhadji (2001) and Kremer et al. (2013). He found the inflation threshold level at 12.88 per cent, and an inflation rate exceeding the threshold level negatively influences economic growth. In contrast, an inflation rate under the threshold level positively influenced it. He suggests that it is important to ensure sustainable growth, which plays a significant role in increasing the efficiency of the monetary policies implemented and assuring stability. However, this study may suffer from poor proxy by using real GDP per capita (which is capable of measuring living standards) for economic growth. Furthermore, the inclusion of the lagged value of GDP into the model as an explanatory variable is worrisome.

Getachew and Meaza (2018) examine Do prices influence economic growth? estimating the inflation threshold of the Ethiopian economy. Appropriate macroeconomic variables obtained from various sources were used in a quarterly dataset from 1992Q1 to 2015Q4. The study followed the Conditional Least Square (CLS) technique used by Khan and Senhadji (2001). The estimated result suggests that 10 per cent of the optimal level of inflation facilitates economic growth. An inflation level higher than the estimated threshold level will affect the growth of the real GDP negatively. Likewise, suppose the inflation rate is below the threshold level. In that case, it triggers the economy as real GDP could have grown more since inflation is positively related below the threshold point.

In contrast, the level of inflation rate at 10 per cent keeps the growth of the economy at the optimal level. Therefore, fiscal and monetary policy coordination is vital to keep inflation at its threshold level. The methodology appears appropriate, and the authors have conducted diagnostic tests for the optimal level of inflation and the suitability of the models used and are found to be fit. This confirms the reliability of the results.

Another study was conducted in Pakistan using an annual dataset for the period 1972-2016 by Hameed, Nazir, Muhammad and Saeed (2017). They applied different techniques like OLS, FMOLS, TAR and dummy method threshold model to estimate the relationship between the inflation rate and economic growth. The results of the nonlinear model are quite consistent with the theory estimated by FMOLS, and the inflation threshold level was found to be 9 per cent. The dummy method found an inflation threshold level of 5.5 per cent, and by estimating the TAR model, they found that an inflation rate below 5.5 per cent suggested there is a negative and significant impact of inflation on economic growth; medium inflation rate between 5.5 per cent and 9 per cent has a positive and significant impact on the economic growth as inflation can boost the economic growth and increase the capital formation. Based on the above findings, they recommend that the threshold level for inflation should be between 5.5 per cent and 9 per cent. The

study applied different approaches to measuring inflation thresholds for the analysis, and the methodology adopted is well-suited for the data. However, the major limitation of this study is the failure to conduct sensitivity tests for the optimal effect of inflation on growth.

Sumon and Miyan (2017) studied inflation and economic growth: an empirical evidence of Bangladesh (1986-2016) and detected a statistically significant positive relationship between inflation and economic growth by employing Engle-Granger, Johansen cointegration and Conditional Least Square methods. They estimated an inflation threshold level of 8 per cent, above which any rate beyond this does not significantly influence the growth rate. However, the use of better mythology, especially threshold regression models, may produce more robust results than Conditional Least Square methods.

Chu, Sek and Ismail (2017) examine the threshold effect of inflation on economic growth by applying the static panel threshold regression (SPTR) on 18 developed countries' datasets over the period 1980–2016. Results capture the existence of a threshold effect in the relationship between inflation and growth. In the first regime, where the inflation rate is below or equal to the threshold value of 4.14%, higher inflation is associated with higher output growth, implying a tradeoff relationship exists. The higher threshold level of inflation is compensated with higher growth. Other determinants of growth include producer price, trade openness, exchange rate, interest rate and population growth. Among these determinants, exchange rate and trade openness have a significant direct effect on growth. The study recommends that policymakers should control the level of inflation in order to balance the objective of high growth and stable/ lower inflation rates. However, the technique adopted for this study does not account for the threshold effects of unique country experiences.

Following Khan and Senhadji (2001), Obi and Uzodigwe (2016) investigated the inflation-output growth nexus in Nigeria: A threshold Analysis using an annual dataset for the 1970-2015 periods. They projected the inflation threshold for Nigeria for the whole period of investigation. Then, they projected the threshold for three different periods based on major structural changes, which include the pre-SAP era (1970 - 1986), the post-SAP era (1986 – 1998) and the era of civil rule (1999 - 2015). They identified different inflation threshold levels for Nigeria across the periods of 12 per cent, 11 per cent, 7 per cent and 8 per cent for 1970 – 2015, 1970 – 1985, 1986 – 1998 and 1999 – 2015, respectively. They concluded that relying on a large number of periods in estimating the threshold level of inflation, especially in the presence of obvious structural breaks, may yield misleading results. The results also revealed that the inflation rate below the threshold levels stimulates economic growth, while inflation turns inimical to economic growth above the threshold levels. They recommended that policymakers should monitor inflation closely and choose an optimal target for inflation which is consistent with long-run sustainable economic growth and development of the economy. The major drawback of this study is the absence of diagnostic tests such as normality, stability and autocorrelation to check for the suitability of the parameters of the model. Moreover, extending the study period to cover the most recent data up to 2022 may produce important insight into the subject matter.

Ashagrie (2015) studied the inflation-growth nexus in Ethiopia: Evidence from the threshold autoregressive model. The study employed the Threshold Autoregressive (TAR) model to assess whether there exists an inflation threshold effect on growth, using annual data for the period 1971 to 2013. The finding does not support the existence of a nonlinear relationship between inflation and growth. This might be attributed to the lack of a market-led economic system and the low financial sector development in the study area over

the period, especially in the first 25 years. The lack of adequate number of observations also impedes the reliability of the result. However, empirical result from the linear model suggests that current inflation is negatively related to economic growth, and inflation has a long-run positive impact on the economy because current inflation affects economic growth positively after two years. This is likely due to the existence of financial repression, which keeps borrowing costs low irrespective of the change in inflation. Therefore, policymakers should balance this positive effect with its negative impact on the standard of living and poverty in the country. To this end, both monetary and fiscal authorities should strengthen their coordination effort and continue to work together to avoid the setting of conflicting macroeconomic objectives. The methodology they used is appropriate for the time series data, but the control variables (especially rainfall and second lag of inflation) may not be well suited.

Madhu and Giri (2015) re-examined the threshold effect of inflation and economic growth relationship in India for the period 2004:Q1-2014:Q2. The logistic smooth transition regression (LSTR) method was employed to find the threshold level of inflation for the period under investigation. The result reveals that the estimated threshold level of inflation in India is found at 6.75 per cent. Above this threshold level, inflation strongly impedes economic growth, while there exists a significant positive relationship between inflation and growth when inflation is below the threshold level. The study suggests that there should be macroeconomic policy outcomes aimed at bringing inflation below the threshold level of 6.75 per cent. The methodology appears to be appropriate, and the results are therefore reliable.

Tung and Thanh (2015) used Two-Stage Least Square (2-SLS) and Generalized Method of Moment (GMM) on annual data for the period 1986-2013 to determine a threshold level in the relationship between inflation and economic growth in Vietnam. They found an inflation level of 7 per cent, the level at which inflation above it will be detrimental to economic growth. The result suggests that policymakers need to define a target inflation rate lower than this level to enhance economic growth. The methodology is suitable, and the study period appears to be adequate. Nevertheless, they do not conduct the needed post-estimation tests to determine the robustness of the model.

3. Methodology

This section outlines the technique employed to analyse the data. The framework delineates the steps involved, which encompasses the kinds and sources of data, descriptive analysis, technique of data analysis, and model specification.

3.1 Sources of Data

Quarterly time series data were sourced for the period 1980Q1-2022Q4. The data were sourced from the Central Bank of Nigeria (for inflation rates, Financial Deepening), National Bureau of Statistics (NBS) (for economic growth), World Development Indicator (for gross capital formation as a percentage of GDP and Population growth).

3.2 Model Specification and Estimation

Based on the New Classical Growth Theory, this study follows the threshold model developed by Khan and Senhadji (2001) to assess the effect of the inflation threshold on economic growth. Several other researchers have applied the model in computing the inflation threshold level for different countries. For instance, Mubarik (2005), Hussein (2005) for Pakistan; Frimpong et al. (2010) for Ghana; Doguwa (2012),

Obi et al. (2016), Bawa et al. (2021) for Nigeria and Aydin (2017) for D-8 countries among others. The model postulates that economic growth is explained by inflation and some other control variables. Following Bawa et al. (2021), the general form of the model, which also incorporates dummy variables to account for time specific effects of the structural break periods is specified as follows:

$$Y_t = \alpha_0 + \alpha_1 p_t + \alpha_2 D_t\ (p_t - \pi) + \alpha_{2+i} X_{it} + \alpha_3 \vartheta_{k,t} + \mu_t \quad (3.1)$$

Where economic growth and inflation are computed as:

$Y_t = \Delta \ln GDP$; $P = \Delta \ln CPI$; GDP and CPI denote gross domestic product and consumer price index, respectively; p_t is inflation, π is the threshold level of inflation, μ_t is a random error term. ϑ is the vector of the intervention variables which account for the influence of structural breaks in the model which is defined as:

$$\vartheta_{k,t} = \begin{cases} 1, if\ t > k \\ 0\ otherwise \end{cases} \qquad I_t = \begin{cases} 1, if\ t = k \\ 0\ otherwise \end{cases}$$

Where ϑ is the break dummy and I is an indicator variable. The indicator variable provides the structural stability for the model when the breakpoint is known a priori (Baum, 2006 and Joyeux, 2007).

The quarterly growth rates of GDP and inflation used in the analysis was determined by taking the first difference between the current and the corresponding quarter values of GDP and CPI, i.e., the current quarter value of the current year less the corresponding quarter value of the previous year. This can be expressed as$Y_t - Y_{t-4}$ where Y_t is the current quarter, and Y_{t-4} is the corresponding quarter value. The variable X_{it} is a vector of control variables which include the growth rate of gross domestic investment as a proportion of GDP (inv), Financial Deepening (findeep) and Population growth (pop). The growth rates of these explanatory variables were computed using a similar method as Y_t and P (Frimpong et al, 2010 and Bawa, 2021).

Therefore, the econometric model for this study can be expressed as follows:

$$\ln GDP = \alpha_0 + \alpha_1 \ln CPI + \alpha_2 D_t\ (\ln CPI - \pi) + \alpha_2 INV + \alpha_3 FINDEEP + \alpha_4 POP + \alpha_5 DUM_t + \mu_t \quad (3.2)$$

The dummy variable D_t is defined as follows:

$$D_t = \begin{cases} 1, lncpi\ > \pi \\ 0, lncpi \leq \pi \end{cases} \quad (3.3)$$

The threshold inflation level represented by the parameter π has the property given by: (i) β_1 represents low inflation; (ii) $\beta_1 + \beta_2$ represents high inflation. The high inflation means that when β_2 is significant, both (β1 + β2) would be added to see their impact on economic growth, which would be the threshold level of inflation. By estimating regressions for different values of π, which is chosen in ascending order (that is, 1, 2, 3 and so on), the optimal value of π is obtained by finding the value that minimizes the sum of squared residuals (maximizes the adjusted R^2) from the respective regressions. Inflation at this level has a significant impact on growth. (See Mubarik, 2005; Frimpong and Oteng-Abayie, 2010 and Bawa, 2021).

4. Results and Discussions

This section presents the analyses of the data, which is organized into three categories: the pre-estimation tests, model estimations and interpretations of results, and post-estimation tests.

4.1 Pre-estimation Tests

The preliminary tests carried out for this study focused on unit root tests with structural breaks, tests for nonlinearity, and nonlinear unit root tests, since the threshold regression model accounts for nonlinearity in the series by permitting different error variances across regimes.

4.2 Unit Root Test With structural breaks

This study considered the Clemente et el. (1998) unit root test, which provides the evidence of structural breaks within the series. The Clemente et al. (1998) offered tests that allow for two events within the observed history of the series: either the additive outliers (AO) model, which captures a sudden change in a series or the innovational outliers (IO) model, which allows for a gradual shift in the mean of the series. However, this study focused only on AO because the model is considered more appropriate for the variables since it reflects sudden structural changes rather than gradual shifts.

Table 4.1: Summary Results of Clemente et al. Unit Root Test

Level Values				First Difference			
Variable	t-stat	BD1	BD2	t-stat	BD1	BD1	Decision
cpi	-7.01 (-5.490)	1992q2*	1996q1*	-	-	-	I(0)
gdp	-7.95 (-5.490)	1992q2*	1997q2*	-	-	-	I(0)
pop	-3.69 (-5.490)	1992q2	2007q2	-8.13 (-5.490)	1988q4*	2012q3*	I(1)
findeep	-6.21 (-5.490)	2001q2*	2008q2*	-	-	-	I(0)
inv	-4.12 (-5.490)	1985q2	2002q2	-7.51 (-5.490)	1984q3*	2016q3*	I(1)

Source: Author's Computation (2023)

Note: BD1 and BD2 are the structural break dates. *Indicates that the breaks are significant at 5% level

Table 4.1 presents the summary results of the Clemente et al. unit root test with two structural breaks for the variables used in the study. The test is conducted at both level values and first differences while accounting for possible structural breaks in the series. The results indicate that some variables are stationary at level. Specifically, inflation (cpi), gross domestic product (gdp), and financial deepening (findeep) are stationary at level, This implies that these variables are integrated of order zero, I(0). The structural break dates associated with these variables are statistically significant at the 5% level. On the other hand, population growth (pop) and growth rate of gross domestic investment (inv), become stationary at first difference at 5% level. This indicates that these variables are integrated of order one, I(1). In essence, the results reveal that the variables exhibit a mixed order of integration, with some variables being stationary at level and others at first difference. The presence of significant structural break dates suggests that the

series experienced important economic shifts during the sample period. The mixed integration order justifies the adoption of nonlinear or regime-switching estimation technique. Moreover, an assessment of the structural break points reveals some cluster of break dates for cpi, gdp, and pop. Apparently, these multitudes of breakpoints occur mostly around the periods of the global oil price shocks which seems to reflect a significant shift in the economic activities of the Nigerian economy.

4.3 Nonlinear Unit Root Tests Results

This subsection presents the results of the nonlinear unit root tests based on KSS (2003) and Kruse (2011) methodologies. The tests were conducted using the raw data, the demeaned data, and the detrended data.

4.3.1 The Kapetanios–Shin–Snell (KSS)

The KSS nonlinear unit root test is employed to determine the stationarity properties of the variables while accounting for possible nonlinear adjustments in the series. Table 4.2 presents the summary results of the KSS unit root test. The test is conducted under three specifications: raw series without constant, demeaned series with constant, and detrended series with constant and trend. The null hypothesis of the KSS test is that the series contains a unit root. Rejection of the null hypothesis therefore indicates that the variable follows a nonlinear stationary process.

Table 4.2: Summary Results of KSS Nonlinear Unit Root Test

Variable	Raw: No Constant	Demeaned: With Constant	Detrended: With Constant and Trend
cpi	-2.26	-2.42	-2.64
	(-2.22)***	(-2.93)	(-3.40)
gdp	-9.27	-10.11	-10.88
	(-2.22)***	(-2.93)***	(-3.40)***
pop	0.66	-2.38	-2.42
	(-2.22)	(-2.93)	(-3.40)
findeep	-0.29	-1.21	-4.93
	(-2.22)	(-2.93)	(-3.40)***
inv	-3.27	-2.95	-1.33
	(-2.22)***	(-2.93)***	(-3.40)

Source: Author's Computation (2023)
Note: *** denote significance at 5% level

The results show that inflation (cpi) is stationary in the raw specification, however, the null hypothesis cannot be rejected in the demeaned and detrended specifications, suggesting weaker evidence of nonlinear stationarity when deterministic components are included.
For gross domestic product (gdp), the test statistics are highly significant across all three specifications, indicating strong rejection of the null hypothesis. This implies that gdp follows a nonlinearly stationary process, suggesting that deviations from equilibrium adjust through nonlinear dynamics. Similarly, population (pop) does not show significant nonlinear stationarity across the three specifications. This indicates the persistence of a unit root in the population series. For financial deepening (findeep), the null hypothesis cannot be rejected in the raw and demeaned forms, but it is rejected in the detrended specification. This suggests that the series becomes nonlinearly stationary after controlling for trend effects. Investment (inv) shows significant nonlinear stationarity in the raw and demeaned specifications but the

detrended specification does not reject the null hypothesis, indicating that the presence of trend weakens the evidence of stationarity. Therefore, the KSS nonlinear unit root test results suggest mixed evidence of nonlinear stationarity across the variables, with some variables becoming stationary only under specific deterministic assumptions. These findings further support the presence of nonlinear dynamics in the data, thereby justifying the use of nonlinear econometric techniques, such as the threshold regression model, in the empirical analysis of the study.

However, KSS (2003) assumed that the location parameter in the exponential transition function, denoted by *c*, is equal to zero. In contrast, Kruse (2011) showed that the location parameter may not necessarily be zero and could take a non-zero value. Consequently, he modified the Wald-type test to allow for the possibility of a non-zero location parameter.

Table 4.3: Summary Results of Kruse Nonlinear Unit Root Test

Variable	Raw: No Constant	Demeaned: With Constant	Detrended With Constant and Trend
cpi	5.08	10.26	13.94
	(9.53)	(10.17)***	(12.82)***
gdp	101.52	150.22	144.46
	(9.53)***	(10.17)***	(12.82)***
pop	9.94	5.72	5.91
	(9.53)***	(10.17)	(12.82)
findeep	1.22	6.35	25.18
	(9.53)	(10.17)	(12.82)***
inv	10.67	9.11	2.18
	(9.53)***	(10.17)	(12.82)

Source: Author's Computation (2023)

Note: *** denote significance at 5% level

Table 4.3 presents the results of the Kruse nonlinear unit root test, which is used to examine the stationarity properties of the variables while allowing for nonlinear adjustments with a non-zero location parameter. The null hypothesis of the Kruse test is that the series contains a unit root, while rejection of the null implies that the series follows a nonlinear stationary trend process. The results show varying degrees of nonlinear stationarity across the variables. For inflation (cpi), the test statistics are insignificant in the raw specification but become significant in the demeaned and detrended specifications. This indicates that inflation becomes nonlinearly stationary when deterministic components are considered. For gross domestic product (gdp), the test statistics strongly rejects the null hypothesis across all the specifications. This shows that gdp is nonlinearly stationary irrespective of the specification used. For population growth (pop), the null hypothesis is rejected only in the raw specification, suggesting persistence of a unit root when deterministic terms are included. Similarly, financial deepening (findeep) does not show significant stationarity in the raw and demeaned forms but becomes stationary in the detrended specification where the variable exhibits nonlinear stationarity after accounting for trend effects. For investment (inv), the null hypothesis is rejected only in the raw specification. However, the demeaned and detrended specifications do not provide sufficient evidence to reject the null hypothesis. In general, the results of the Kruse nonlinear unit root test reveal mixed evidence of nonlinear stationarity across the variables, with several variables becoming stationary once constant and trend components are included. These findings reinforce the

presence of nonlinear dynamics in the data, thereby supporting the suitability of nonlinear modelling techniques, such as the threshold regression approach employed in this study.

Although the nonlinear unit root tests provide sufficient evidence of a nonlinear trend stationary process, it is still necessary to examine the presence of serial dependence in the series in order to properly guide the choice of an appropriate modelling technique for the study. Conventional time series analysis typically assumes that data are generated from a linear process. However, the BDS test is useful for detecting departures from this assumption by identifying possible nonlinear dependencies in the series.

4.4 Brock–Dechert–Scheinkman (BDS) Test Results

Although the nonlinear unit root tests provide enough evidence of nonlinear trend stationary process, it is important to check for serial dependence in the series to appropriately guide the study on the modelling technique to use. Traditional time series analysis often assumes that data are generated through a linear process. The BDS test helps to identify deviations from this assumption, suggesting the presence of nonlinear dependencies. Table 4.4 presents the summary results of the BDS test conducted to examine the presence of nonlinearity in the series.

Table 4.4 Summary Results of the BDS Test

Variables	Dimension	BDS Stats	Std. error	Z-value	P-value
cpi	2	0.168808	0.009672	17.45311	0.0000*
	6	0.419279	0.019136	21.91090	0.0000*
gdp	2	0.162024	0.007881	20.55873	0.0000*
	6	0.399966	0.015339	26.07478	0.0000*
Pop	2	0.196082	0.004428	44.27904	0.0000*
	6	0.509614	0.008442	60.36949	0.0000*
findeep	2	0.187973	0.004192	44.83823	0.0000*
	6	0.488232	0.007835	62.31266	0.0000*
inv	2	0.200005	0.006628	30.17617	0.0000*
	6	0.550794	0.012699	43.37175	0.0000*
	6	0.447454	0.008150	54.90571	0.0000*

Source: Author's Computation (2024)

Note: * denote significance at 1% level

Table 4.5 reports the results of the BDS test for embedding dimensions 2 and 6, with epsilon ($\in$) values of 0.1 and 0.5. The findings indicate that the BDS test statistics for all variables are significantly larger than the corresponding critical values across the different dimensions. This outcome suggests that the series do not follow a standard normal distribution. Consequently, the null hypothesis of independent and identically distributed (i.i.d.) observations is rejected. In general, the results provide strong evidence that the series exhibit a nonlinear trend process. This implies that the variables reveal significant nonlinear dependence and complex dynamic structures. The consistency of the results across different embedding dimensions further strengthens the evidence of nonlinearity in the data.

4.2 Model Estimation Results

Table 4.5 presents the results of the inflation threshold effect on economic growth in Nigeria over the period 1980Q1-2022Q4. The estimated coefficients are presented in two regimes. Regime 1 reports the marginal effect of the threshold variable (inflation) and other control variable when the level of inflation is less or equal to the estimated threshold value (π), which is accounted for by the coefficient α_1. Regime 2 reflects the coefficients of the marginal effect of the threshold variable and some other control variables when inflation exceeds the estimated threshold value (π). This represents the long-run inflation coefficient estimate, and if found significant, then both coefficients would be added ($\alpha_1 + \alpha_2$) to see their impacts on economic growth. Furthermore, structural break periods were also incorporated in the threshold regression using break dummy and indicator variables.

The optimal inflation threshold level is that which minimizes the Residual sum of squares (RSS). Thus, Table 4.6 reveals the estimate of 9.41% as the optimal inflation threshold level, which is tolerable to economic growth in Nigeria for the period under study.

Table 4.5: Results of the Inflation Threshold Effect on Economic Growth in Nigeria

Variables	Model 1	
Dep. Variable: gdp	Parameters	
	Regime 1	Regime 2
cpi	0.605***	-0.0931***
	(0.0875)	(0.0129)
pop	0.694	-2.101***
	(0.704)	(0.501)
findeep	0.00306	-0.0347***
	(0.0127)	(0.00606)
inv	0.00245	-0.00392
	(0.00234)	(0.00256)
Structural break dummy1	0.340***	-0.493***
(1988q4)	(0.099)	(0.089)
Structural break dummy2	0.517***	-0.976***
(1992q2)	(0.091)	(0.099)
constant	0.417	3.647***
	(1.587)	(1.314)
Threshold		
	9.41%	

Source: Author's Computation (2023)
Note: Values in parenthesis are standard errors
*** denote significance at 5% level

The results suggest that the inflation rate below the threshold value of 9.41% has a positive and significant effect on economic growth at 5%, while a higher rate of inflation beyond the threshold level has a significant negative effect on economic growth at the chosen significance level. This implies that while an inflation rate below the threshold value is desirable to economic growth, a higher rate of inflation in excess

of the threshold level is detrimental to economic growth. In particular, the results show that for every additional percentage point of inflation-to-growth rates below the threshold level, inflation increases economic growth by 0.61%. On the other hand, the inflation rate reduces the economic growth by 0.512% for each additional percentage point of inflation-to-growth when inflation is above the established threshold value. Moreover, the structural break dummy variable has a significant positive effect on economic growth in the low inflation regime and a significant negative effect in high inflation regime at 5% level of significance. This suggests that the effects of inflation threshold on economic growth after the break increases when inflation rate is below or equal to the threshold value, while the post-break effect of inflation threshold on economic growth decreases when the inflation rate is above the threshold value.

On the effect of the control variables incorporated in the model estimation, the results suggest that the estimated coefficients in both inflation regimes demonstrate varying degree of signs and significance. In the low inflation regime, none of the variables has significant effect on economic growth; that is, all the variables are growth neutral. However, in the high inflation regime, population growth and financial deepening have significant effects on economic growth. Both financial deepening and population growth exert a negative effect on economic growth. This is in accordance with some growth and empirical literature; Aydin (2017) also finds that population growth has a significant negative effect on growth. Growth theory has recommended the role of population growth in the growth model, which suggests that an increase in investment, together with a decrease in population growth rate, promotes economic growth. As Eggoh and Khan (2014) suggest, the coefficient of population growth is negative, and it stands an essential determinant of economic growth at conventional levels. Such negativity signifies the burden overpopulation has on long-term growth, which is also supported by the growth model.

In conclusion, the empirical result finds some evidence that inflation has a threshold effect on economic growth in Nigeria during the period of study. Specifically, when the inflation rate is below the threshold value of 9.41%, economic growth would increase by 0.605% in response to a unit increase in the inflation rate. This reveals the desirability of inflation towards improving economic growth in this regime. This positive relationship could be premised on the views of Creamer and Bother (2017), who argued that increased inflation (below the threshold) reduces the real interest rate, which, in turn, increases capital accumulation at the expense of holding money. Beyond the threshold level, the result indicates that inflation exerts a negative effect on economic growth. That is, inflation reduces the rate of economic growth by 0512% for every additional percentage increase in the inflation rate. Inflation rate in this regime is viewed as a disincentive and detrimental to economic growth due to its negative effects. This negative relationship may occur possibly because inflation snatches the real value of money and thus increases the incentives to consume and discourages savings. As Creamer and Bother (2017) suggest, inflation volatility reduces a Firm's ability to plan for the long run and may cause hesitancy in the long-run investment or capital formation. In addition, the inflation-economic growth relationship is found to be nonlinear, while the magnitude of the effect of the inflation threshold on economic growth varies across the regimes. This finding is in line with Khan and Senhadhi's (2001) threshold range of 7%−11% for developing countries. The result is also consistent with those of Maher (2023), Shughofta (2022), Tenaw and Demeke (2020) who find the existence of inflation threshold effect on the economic growth of 9.32%, 9.06% and 9.00% for Egypt, Pakistan and Ethiopia respectively.

Post-Estimation Test Results

Table 4.7 presents the results of the Omnibus Wald and Shapiro-Wilk W Tests for the model. The Omnibus test results show that the group of coefficients for the specified variables is collectively significant in explaining the variation in the dependent variable in all the regimes. On the other hand, the overall effect of the coefficients of the specified predictor variables on the dependent variable(s) in the context of the model is statistically significant across different regimes. Therefore, the study rejects the null hypothesis of no significant effect of the

Table 4.7: Results of Omnibus Wald and Shapiro-Wilk W Tests

Test	Test Type	Models	Chi-squared	P-value
Wald	**Omnibus Wald Test**	1	173.94	0.0000
		2	253.76	0.0000
		3	13887.39	0.0000
		4	14174.54	0.0000
			Statistics	
Swilk Residuals	**Shapiro-Wilk W. Test**	1	0.89769	0.6915
		2	0.95576	0.7915
		3	0.95796	0.8559
		4	0.98537	0.8865

Source: Author's Computations (2023)

group of predictor variables on the dependent variable(s). We, therefore, conclude that the model is suitable for inference.

Concerning the Shapiro W. Tests, the result in Table 4.7 shows that we cannot reject the null hypothesis of normality of the residuals for the model. This suggests that the residuals of the model are reasonably consistent with a normal distribution. That is, the distribution of the residuals better fits the assumption of normality. Thus, the model is suitable for inference.

Conclusion and Recommendations

The empirical result finds some evidence that inflation has a threshold effect on economic growth in Nigeria during the period of study. Specifically, the result reveals that inflation threshold has a significant positive effect on economic growth when the inflation rate is below the threshold value of 9.41%. Low inflation regime encourages steady economic growth implied by an increase in inflation rate. In other words, inflation below the estimated threshold level is desirable for economic growth. Also, inflation has a deleterious effect on economic growth if it exceeds the optimal threshold level, which indicates the asymmetric relationship between inflation and economic growth. The degree of the effect of the inflation threshold on economic growth differs across the regimes. This finding is in line with Khan and Senhadhi's (2001) threshold range of 7%−11% for developing countries. The result is also consistent with those of Maher (2023), Shughofta (2022), Tenaw and Demeke (2020) who find the existence of inflation threshold effect on the economic growth of 9.32%, 9.06% and 9.00% for Egypt, Pakistan and Ethiopia respectively. Therefore, the study recommends that Monetary authorities, particularly the Central Bank of Nigeria,

should aim and maintain inflation rate at or below 9.41%. Since inflation within this range promotes economic growth. Government should also choose an optimal inflation target consistent with steady and sustainable economic growth.

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