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Estimating and Forecasting the Impact of Inflation on Economic Growth in Nigeria Using Threshold Analysis

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This study examined the causal relationship between inflation and economic growth as well as estimating threshold and forecasting of inflation in Nigeria for the period of 1961 – 2016. The study employed Granger causality test, Autoregressive Distributed Lag (ARDL), Autoregressive Integrated Moving Average (ARIMA) and a multivariate time series Vector Autoregressive (VAR) models. Granger causality test result showed that inflation does not granger cause economic growth and neither does economic growth granger cause inflation during the period of study. Using broad money supply to GDP as control variable, an inflation threshold of 14% -15% both in the short run and long run was established for Nigeria. As for the forecasting of inflation, the findings showed that VAR (1) could forecast inflation rate in Nigeria with high degree of accuracy. Hence, this result is vital for monetary policy formulation and need to be taken into consideration as a complement to the approach currently employed by the Central Bank of Nigeria in the targeting of a single digit inflation rate.

Keywords: ARDL; ARIMA; Economic Growth; Forecasting; Inflation Threshold VAR.
JEL Classification: E31; C53; E52; 040.

1.0 Introduction

Inflation is seen as a continuous and rapid rise in the price level. It is referred to as the tenacious and the significant rise in the overall level of prices (Jhingan, 2002). Ekpenyong, et. al., (2014) was of the opinion that, not all increase in price of goods and services in an economy can be referred to as inflation but only increase in price level that is enduring, continuous and affect all commodities in the economy. The Central Bank of Nigeria has used diverse approaches in operationalizing the monetary policy. The Central Bank of Nigeria (CBN) from the beginning employs two

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monetary policy framework viz: exchange rate targeting and monetary targeting. The first was adopted during the period of 1959 and 1974, while the later has been in use from 1974 to date. The attraction on the usage of monetary targeting as monetary policy framework was based on its capacity in enabling the CBN handle domestic issues, and ability to immediately signal monetary policy stance. But in recent time, this strategic approach has been criticized on the basis of poor performance and it not favouring the adoption of monetary and economic integration policy. Therefore, this gives credence to inflation targeting as an alternative option to be used by the monetary authority for macroeconomic management (Awogbemi and Taiwo, 2012). In addition, recent study by IMF staff on 88 non-industrialized countries shows that, inflation targeting was widely accepted by more than half of the participating countries IMF (2008). Hence, we cannot without any caution exclude Nigeria from this group as one of the priorities of the CBN is using monetary policy tools in maintaining single digit inflation and inflation targeting is a monetary policy framework directed at achieving the primary goal of price stability (CBN, 2011). Hence, studying the direction of inflation is crucial for the reason that it permits us to better understand the role of monetary authority in its control.

Every developing economy engages in ensuring sustainable economic growth which is driven by stable macroeconomic variables most especially low levels of inflation. Several studies in the past have established the relationship between inflation and economic growth. Studies like Fischer (1993), Bruno and Easterly (1998), Kremer, et. al(2009) are of the opinion that increased continuing levels of inflation affects economic growth negatively. Others, such as De Gregorio (1993), Hedgimichael, et. al., (1995), Khan and Senhadju (2000) maintained that low rates of inflation moves in the same direction with high level of economic growth. Hence, it can be concluded with the above assertion that, every developing economy must ensure keeping her inflation at a low rate to sustain economic growth.

On the same note, before being affirmative on the above deduction, some of the previous works still revealed that even though inflation is ill-disposed to economic growth (Barro, 1991 and Fischer 1993), others hold to the fact that significant level of continuous and persistent rise in price is necessary to attain economic growth

(Tobin 1969 and De Gregorio 1993). It then means that, as the economic managers try to maintain low rate of inflation, and also need to be conscious of that rate of inflation that is necessary to attain certain level of economic growth. Hence, this paper seeks to identify the causal relation between inflation and economic growth in Nigeria, estimate the level of inflation that is inimical to economic growth (inflation threshold) and fit a suitable model and use this model to forecast future values of inflation.

It is important to note that, to the best of our knowledge, although there are existing literature that estimated the inflation threshold in Nigeria using ARIMA and VAR models, a major departure from the previous works is the addition of ARDL model in achieving the objectives of this study.

Therefore, this study is imperative because apart from giving the monetary authority the clue to managing inflation, its in-depth knowledge can be used to take care of the lagged impact of macroeconomic variables in the economy which often trail the efficiency of monetary policy. Nevertheless, when the path of causality between inflation and economic growth is established, inflation verge estimated and future inflation values rightly forecasted with appropriate model, the performance of macroeconomic indicators can be tracked as well as ensuring their stability using threshold forecasted values. Hence, appropriate and timely measure can be taken to curb inflation rate forecasted that is above the inflation threshold and economic growth can then be sustained.

The rest of the paper is structured as follows: section two gives the theoretical framework and reviews literature related to the study, section three presents the methodology of the study, while section four presents analysis and interpretation of results and section five concludes the paper and makes some policy recommendations.

1.1 Stylized Facts on Inflation, Money Supply and Economic Growth in Nigeria

One major focus of monetary authorities the world over is the effective and efficient management of inflation and money supply, to achieve steady growth of the economy. Price stability is a cardinal objective of the government macroeconomic goals, given that it bears direct impact on the standard of living as well as cost of living of the citizenry. Hence, the CBN as a government institution is charged with the primary responsibility of managing or controlling money supply to achieve stable prices of goods and services in the economy. According to Sarah (2014), the CBN takes whatever growth and inflation levels that the Federal Government desire to achieve, to determine how much money would be adequate to grow the economy. In other words, in observing the growth rates of GDP and Inflation, the CBN determines the extent of money supply that matches the Government budgetary objectives. The CBN adopts fiscal and monetary policy coordination to ensure: financial stability, moderate interest rate, and stable exchange and inflation rates with no adverse effect on the economy.

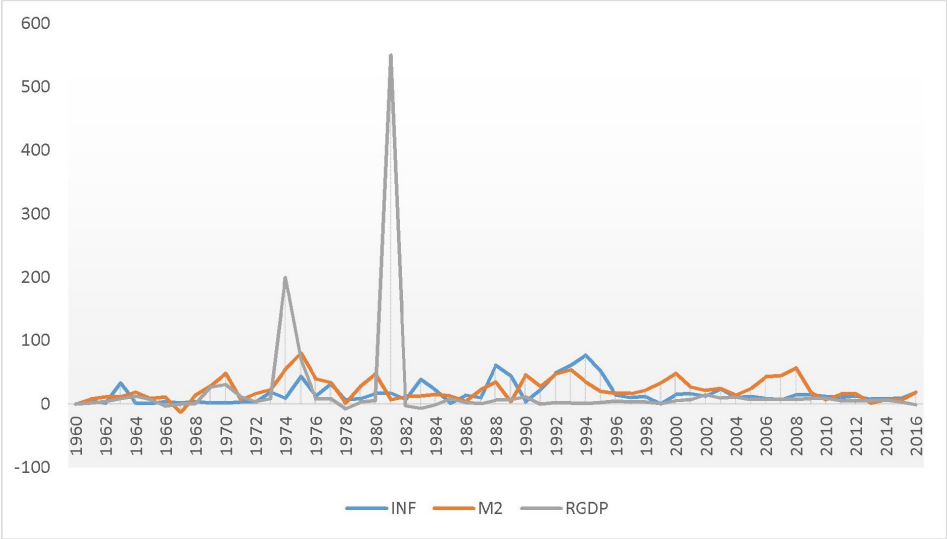

Figure 1: Trend Analysis of Annual % Growth Rate of INF, MS & RGDP in Nigeria: 1960-2016

For Nigeria, inflation rate was 5.2 percent in the first decade after independence. The money supply growth at the same period averaged 14.65 percent. The Real

Gross Domestic Product (RGDP) in the same decade after independence grew at an average of 8.78 percent. The performance of the economy and its associated variables over the period of 1960-1969 was characterized and influenced by drastic fall in output as a result of civil war. The actions of the CBN was more of contractionary monetary stance. The Government expenditure was more in favor of purchase of military hardware for the execution of Biafra-Nigerian war. So, the economy shrank, especially between 1966 and 1967. It recorded a negative growth rate of -3.24 and -0.17, respectively in those two years.

A two digit inflation rate became a phenomena in the 1970s. It averaged 15.12 percent between 1970 and 1979. Money supply over the same period grew at a double digit rate of 33.08 percent. The RGDP made improvement compared to the previous decade. It grew at an average of 31.01 percent. However the economy experienced negative growth rate in the period. For instance, the growth rate of RGDP for 1978 was -7.32 percent. Some of the events that explained the behavior of the economy included: massive expenditure to reconstruct the war torn economy.

The spike in the graph from 1980-1982 is an indication that the government policy of Structural Adjustment Programme (SAP) which commenced in 1980 and entailed a number of austerity measures was actually yielding some positive result as shown by the high growth of RGDP, before the Military intervention in the polity in December 1983. It shows that the economy was already on the path of recovery before the military coup of 1983; output of goods and services were improving as the economy was recovering from recession.

2.0 Literature Review

2.1 Theoretical Framework

This study employed the Keynesian theory using the Aggregate Demand (AD) and Aggregate Supply (AS) curve as the theoretical framework of this study. This theory explains the relationship between economic growth and inflation. It postulated that, the aggregate supply (AS) has its acute feature when it is upward sloping rather than when vertically sloppy. This is because, if the AS curve is

vertically sloppy, any changes with the aggregate demand (AD) will only affect price level, while in a situation of AS sloping upward, variations in AD impact both prices and output (Dornbusch, et al, 1977). This is informed by some factors that influence inflation and level of output in the short-run such as consumers and producers prospects; labour force; prices of other factors of production, fiscal and/or monetary policy.

On the other hand, the long-run analysis depicts a steady movement of the aforementioned factors as well as their shocks. The steady state of the economy is a state in which everything remain the same. Hence, the interaction of the short-run AD and AS curves will produce modification path which displays the first direct association between inflation and growth, this on the other hand goes opposite direction towards the later part of the alteration path. This first relationship between inflation and output is explained by Figure 2 depicting the movement from E^0 and E^1.

Based on this concept, the producers are divided into two parts, the first part believes that there is an increase in the price of their products while that of other producers remain the same. Contrary to this, what all the producers are experiencing is an overall increase in prices but the producers continue to produce more goods so as to enjoy the benefit of increased price showing positive relationship between inflation and output. Also, Blanchard and Kiyotaki (1987) explain that the positive relationship between inflation and output can be as a result of an agreement reached by firms in supplying goods and services at a determined price in the future time. Consequently, an increase in price will not reduce the level of output for the fulfilment of the agreement made between the producer and the consumer.

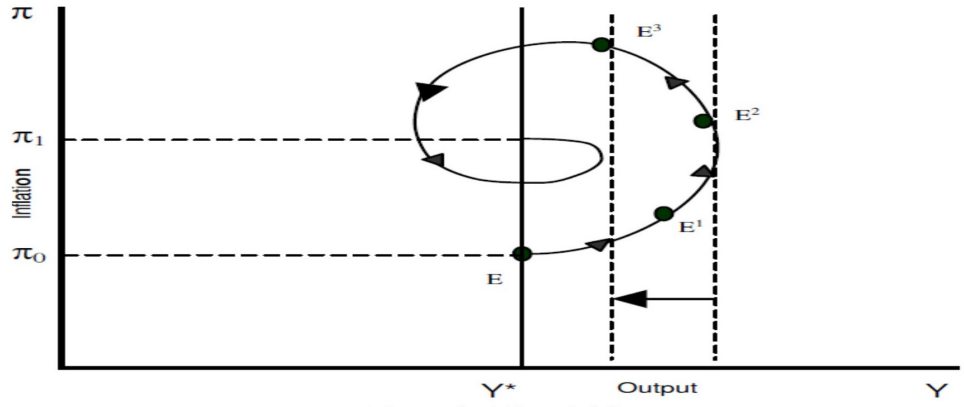

Figure 2: AD and AS curves

From Figure 2, the adjustment process shows that, points E^2 and E^3 describe a situation where output decreases and inflation rate increases which represents a negative relationship between output and inflation as obtainable in practice.

In the same vein, the economy respond to rise and fall in inflation rate and this leads only to trade-off between output and the change in inflation in the short run but not in the long run. Hence, to maintain a stable level of inflation, the production in the country (output) must be at the same level with the natural rate (Y^*).

2.2 Empirical Review

Estimation of inflation threshold, Inflation modelling and forecasting has been widely covered in the Literature as this has received the attention of scholars, academia and policy makers given the importance of its understanding in the formulation of effective and efficient policy. Those that are of a great insight to our study are deduced as follows:

Mubarik (2005) examined the relationship between inflation and output growth by estimating a threshold model of inflation and output growth for Pakistan economy. He employed Granger Causality and sensitivity analysis and his result revealed that, there is a unidirectional relationship between the existing rates of inflation and the levels of economic growth, while a 9 per cent inflation threshold was es-

tablished for economic growth in Pakistan within the period of the study and this was proposed as a threshold inflation for a well domestic output level.

Fabayo and Ajilore (2006) investigated inflation level that will affect negatively the level of economic growth in Nigeria using time series data for the period of 1970 to 2003. Their result showed 6 per cent inflation threshold in Nigeria and they put forward that, any inflation rate above this will have negative impact on economic growth and vice versa. Kremer, et. al., (2009) in another expository study that captured the inflation threshold levels in both developed and developing countries using a dynamic panel threshold model to examine the impact of inflation on long-run economic growth revealed a threshold of 2 per cent for developed economies while 17 per cent was established as the level at which inflation is not inimical to economic growth in developing countries. Even though below this threshold, there is no significant relationship between inflation and economic growth, their result does not suggest growth spur by inflation in emerging economies.

Chimobi (2010) using time series data for the period of 1970 to 2005 investigated the presence or absence association amid inflation and economic growth in Nigeria. He employed the Johansen-Juselius co-integration technique and Engle-Granger causality test. While the causality test result revealed a unidirectional causality running from inflation to economic growth, the co-integration result showed that there is long-run connection between inflation and economic growth in Nigeria. However, the study did not estimate or predict inflation threshold for Nigeria.

Frimpong and Oteng-Abayie (2010) on a study conducted for Ghana economy investigated if inflation is harmful to economic growth or not using a threshold regression model for the period of 1960-2008. The result revealed an established 11 per cent threshold point for inflation and any rate below this shows a positive relationship with economic growth and vice versa.

Mohanty, et al. (2011) examined likely nonlinear relationship between inflation and growth in India employing quarterly series and deduced inflation threshold of 4 to 5.5 per cent. However, their study do not find decisive proof of the reality of

an inflation threshold, they therefore inferred that inflation rate less than 5.5 per cent tend to have positive impact on Indian economic growth, while the reverse is the case in a situation of inflation rate above 5.5 per cent.

Following the framework of Li (2005), Bassey and Onwioduokit (2011) investigated the relationship between inflation and economic growth and at the same time examined a fitting inflation threshold. Their result revealed a negative relationship between inflation and economic growth and a statistically insignificant threshold level of 18 per cent was identified which served as the rate of inflation that still boost economic growth.

In the case of inflation modelling and forecasting, Landsman and Damodaran (1989) used the univariate autoregressive integrated moving average method in modelling and forecasting inflation. Their conclusion gave credence to Autoregressive Integrated Moving Average (ARIMA) parameter estimator for its ability to make accurate forecasting giving its low mean squared percentage error. Meyler, et. al., (1998) maintained that, even though ARIMA model perform greatly in forecasting compared to other models such as the vector autoregressive method (VAR), and the Bayesian VAR, it has been noticed that, ARIMA model cannot be relied on when applied to unstable and high frequency data.

In the study carried out by Ho and Xie (1998), using the ARIMA framework, they settled that ARIMA model is a realistic supernumerary giving suitable results in line with its prophetic presentation.

Kelilume and Salami (2013) also used a univariate time series in the form of ARIMA model advanced by Box and Jenkins and multivariate time series model in the form of VAR in Modeling and Forecasting Inflation in Nigeria using time series data for the period of 2003 to 2012. The result obtained shows that, VAR forecast well and gives rate close to the current inflation rate and also comes with minimum square error as an important criteria. Akdogan et.al (2012) employed numbers of models such as ARIMA model, Philips curve time varying model, decomposition based models, VAR and Bayesian VAR model and dynamic factor

model to investigate the short-term forecasts for inflation in Turkey. Their result revealed that the models which integrate additional economic statistics outperformed the random walk model at least up to two quarters ahead. Pufnik and Kunovac (2006) examined the possibility of improvement in final forecast of all item index of Croatia's CPI by employing univariate seasonal ARIMA models and forecasting future values of the variables from past behavior of the series. Their findings revealed that, with a fairly longer time horizon of three to twelve months, the most accurate forecasts of all items (CPI) are found by first forecasting the index's components and then aggregating them to obtain the all items index.

Also, Alnaa and Ferdinand (2011) employed ARIMA model in estimating inflation threshold in Ghana using monthly data from June 2000 to December 2010. They found that ARIMA (6,1,6) is best for forecasting inflation in Ghana. While, Suleman and Sarpong (2012) using an empirical approach to model monthly CPI data in Ghana applied the seasonal ARIMA model. Their result revealed that ARIMA (3,1,3) and (2,1,1) model was appropriate for modeling Ghana's inflation rate.

Akhter (2013) predicted the short-term inflation rate of Bangladesh using the monthly CPI from January 2000 to December 2012. Using seasonal ARIMA models recommended by Box, et al. (1994). Because of the incidence of structural break in the CPI, the study shortens the series and using data from September 2009 to December 2012 fitted the seasonal ARIMA (1,1,1) and (1,0,1) model. Omane-Adjepong et al (2013) investigated the greatest suitable short-term forecasting method for Ghana's inflation. The monthly dataset used was broken down into two sets, with the first set used for modeling and forecasting, while the second set was used as test. Seasonal ARIMA and Holt-Winters approaches are used to obtain short-term out of sample forecast. From the results, they concluded that an out of sample forecast from an estimated seasonal ARIMA (2,1,2) and (0,0,1) model far supercedes any of the Holt-Winters' approach with respect to forecast accuracy.

Adeleke (2012) employed Khan and Sendhadji's (2001) threshold regression technique to observe the existence of ideal inflation. Using Granger causality test to

examine the causal relationship between inflation and growth, the result showed that, there is a unidirectional causality from inflation to real GDP, with no response from output growth to inflation, while the threshold result showed an optimal rate of eight per cent level of inflation as that which will facilitate sustainable economic growth. The findings from the threshold model showed a negative relationship between inflation and growth. Hence, the idea of single digit inflation by the monetary authorities in Nigeria was upheld in this study. Also, Bawa and Abdullahi (2012) estimated a threshold level of inflation for Nigeria using a quarterly time series data for the period 1981 to 2009 by adapting a model developed by Khan and Senhadji (2001). The result of their empirical analysis revealed a threshold inflation level of 13 per cent for Nigeria and it was put forward that 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, additional explanatory variables and changes in data frequency.

In furtherance to the above, Doguwa (2013) re-examined inflation threshold using three different approaches of Sarel's (1996), Khan and Senadji (2001) and Drukker et al (2005). The results revealed that Sarel's approach provides a threshold point estimate of 9.9 per cent that was not well identified by the data, the technique of Khan and Senhadji (2001) identifies a 10.5 per cent inflation threshold as statistically significant to explain the inflation-growth nexus in Nigeria and Drukker et al (2005) approach suggests a two threshold point model with 11.2 and 12.0 per cent as the appropriate inflation threshold points. He concluded that, the threshold level of inflation above of which inflation is inimical to growth is estimated at 10.5 to 12 per cent for Nigeria.

3.0 Methodology

For the purpose of this work, we first of all investigate the causal relationship between inflation and economic growth as well as the bearing of causality. We employed parametric linear causality proposed by Granger (1969) to examine the causal relationship between inflation and economic growth. The Granger causality

specification is presented below.

$$g_t = \alpha_{11} + \sum_{i=1}^{i=T} \alpha_i g_{t-i} + \sum_{j=1}^{j=T} \alpha_j i_{t-j} + \varepsilon_t^Y \tag{1}$$

$$i_t = \alpha_{21} + \sum_{i=1}^{i=T} \beta_i g_{t-i} + \sum_{j=1}^{j=T} \beta_j i_{t-j} + \varepsilon_t^{OP} \tag{2}$$

Then, testing $H_0 : \sum_{i=1}^{i=T} \alpha_i = 0$ against $H_A : \sum_{i=1}^{i=T} \alpha_i \neq 0$, is a test that i does not Granger-cause g.

Similarly, testing $H_0 : \sum_{i=1}^{i=T} \beta_i = 0$ against $H_A : \sum_{i=1}^{i=T} \beta_i \neq 0$, is a test that g does not Granger-cause i.

In order to investigate the inflation rate threshold that is optimal for economic growth in Nigeria, the traditional ARDL methodology was employed after the stationarity of the variables was established by both the graphical and the formal test. The ARDL optimal lags specification was selected using the information criteria. The threshold inflation rate was captured using dummy variable labeled as k and we used it to form inequality dummy variable constructed as $(i - k^* > 0)$ and $(i - (k^* + 1)) \leq 0)$. These dummies are included as fixed regressor in the specification window. Assuming that k^* is positive, we sequentially choose k^* arbitrarily within the range of variable i. $(i - k^* > 0)$ is represented as 1 while it is 0 otherwise. Also, $(i - (k^* + 1)) \leq 0)$ is represented as 1while it is 0 otherwise .There are four possible inequalities with only three being valid. $i > k^*$ and $i \leq k^* + 1$, $i < k^*$ and $i < k^* + 1$ and lastly $i > k^* + 1$.

The following $ARDL(1, 0, 0)$ equation is estimated using OLS technique due to its consistency property.

$$g_t = \alpha_0 + \alpha_1 g_{t-1} + \alpha_2 m g_t + \alpha_3 i_t + \alpha_4 * i_t * (i - k^* > 0) + \alpha_5 * i_t * (i - k^* \leq 0) + \varepsilon_t \tag{3}$$

Lastly, we try to model and forecast inflation in Nigeria with the aid of a traditional model i.e. ARIMA model and VAR model. The selection of these models was based on their recent forecasting ability. However, forecast performance evaluations statistics was reported to ascertain which model could predict inflation rate

in Nigeria better. The data was sourced from the World Bank statistical data. The frequency of the data is yearly and the period covered is 1961 to 2015.

4.0 Empirical Result

4.1 Data Analysis

Table 1: Descriptive Statistics

	i	g	mg
Mean	16.12854	4.050245	19.21593
Median	11.55783	4.345171	14.19678
Maximum	72.83550	33.73578	70.20216
Minimum	-3.726337	-15.74363	-9.764590
Std. Dev.	15.86867	8.293866	17.94250
Coefficient of variation	0.983888	2.047744	0.933031
Skewness	1.879473	0.776826	1.071354
Kurtosis	6.104617	5.893126	3.695067
Jarque-Bera	55.45943	25.16269	11.84008
Probability	0.000000	0.000003	0.002685
Sum	903.1982	226.8137	1076.092
Sum Sq. Dev.	13849.80	3783.352	17706.34
Observations	56	56	56

Table 1 shows the descriptive statistics of Inflation rate (i), real GDP growth rate (g) and the real GDP weighted broad money supply (mg) which proxy the level of financial deepening. It can be shown that the variables contained 56 observations. It can be shown that all the variables were positively skewed. Also all the variables were leptokurtic as their respective kurtosis are greater than three. The coefficient of variation statistics was computed to show the unitless dispersion comparison of the three variables and it shows that there is lesser variation in the real GDP weighted broad money supply (mg) followed by Inflation rate (i) . The probability value of the Jarque-Bera normality test based statistics shows that none of the variables were normally distributed.

4.2 Unit Root Test

Before one pursue formal tests, it is always advisable to plot the time series under study as it may reveal the integrating nature of the series. The variables (Inflation rate (i), real GDP growth rate (g) and the real GDP weighted broad money supply (mg)) used in this study are examined graphically below.

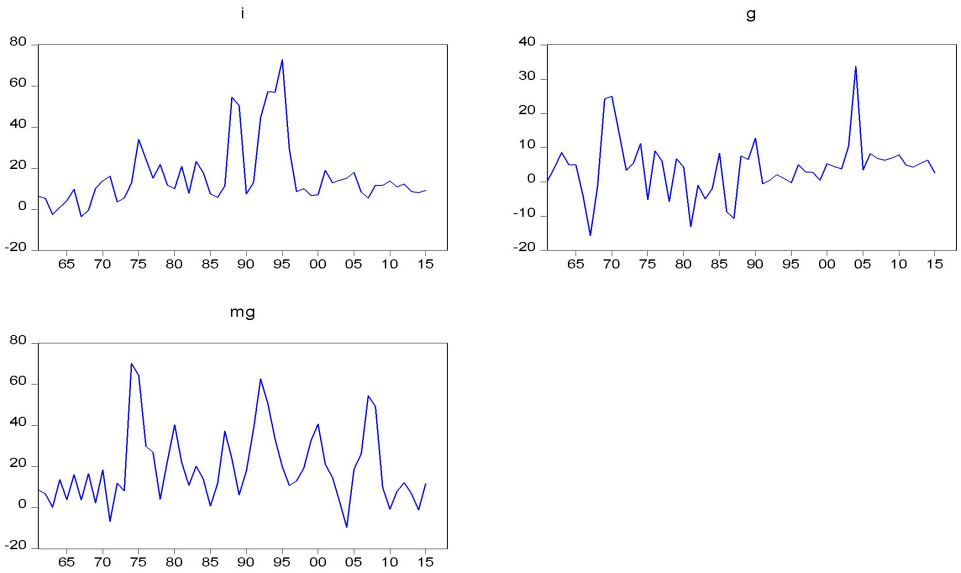

Figure 3: Trend Analysis

It can be shown from the table above that none of the three variables (Inflation rate (i), real GDP growth rate (g) and the real GDP weighted broad money supply (mg)) are upward trending. There is tendency for mean reverting and variance constancy overtime. The three variables show similar hovering around their respective means throughout the years. This also suggests their mean reverting and variance constancy over time. However, no statistical fact can be derived numerically from the graphical inspection of the variables. Based on this caveat, ADF unit root test and Phillip-Perron unit root test are employed to investigate statistically their integration properties.

Table 2: PP and ADF unit root test

		PP @ level			ADF @ level		
		i	g	Mg	i	G	mg
C	t-stat	-3.2969	-5.2858	-3.6556	-15.3699	-27.7413	-15.6823
	Prob.	0.0198**	0.0000***	0.0076***	0.0000***	0.0001***	0.0000***
C&T	t-stat	-3.2890	-5.2410	-3.5849	-17.0571	-27.8669	-17.3589
	Prob.	0.0788**	0.0004***	0.0404**	0.0000***	0.0001***	0.0000***
No C&T	t-stat	-2.1069	-4.5904	-2.6434	-14.9614	-28.1253	-15.9239
	Prob.	0.0348**	0.0000***	0.0091**	0.0000***	0.0000***	0.0000***

C represents Constant while T represents Trend. ** and *** shows stationarity at 5% and 1% level of significance

The result of the PP unit-root test and the ADF unit-root test is presented in Table 2. From the result, it can be shown that all the variables were stationary at level at 5% and 1% level of significance and there is no further need to proceed to the first difference. The stationarity nature of the variables had been suggested earlier by their graphical inspection above. There is no need to proceed to cointegration testing. The stationarity properties of the three variables comply with the use of traditional VAR, ARDL and ARMA methodologies.

4.3 Granger Causality Test

Table 3: Granger Causality

Hypotheses	F-stat	Prob.
g does not granger cause i	0.17544	0.6770
i does not granger cause g	0.12503	0.7251

From the Table 3, the result of the pair-wise Granger causality showed that, there is no direction of causality between g and i. In essence, none of the variable's past solely could be used to forecast each other.

4.4 Inflation Threshold Modelling

In order to investigate the inflation rate threshold that is optimal for economic growth in Nigeria, the traditional ARDL methodology was employed since the stationarity of the variables had been justified that both the graphical and the formal test. The ARDL optimal lags specification was selected using the information criteria. $ARDL(1,0,0)$ over the periods of 1962 to 2016 was selected and estimated. The threshold inflation rate was captured using inequality dummy variables and it is included as fixed regressor in the specification window. The dummy

is constructed as $(i - k^* > 0)$ and $(i - (k^* + 1)) \leq 0)$. $(i - k^* > 0)$ is represented as 1 while it is 0 otherwise. Also $(i - (k^* + 1)) <= 0)$ is represented as 1 while it is 0 otherwise. There are four possible inequalities with only three being valid. $i > k^*$ and $i \leq k^* + 1$, $i < k^*$ and $i < k^* + 1$ and lastly $i > k^* + 1$. Various ARDL models with different inflation rate threshold intervals were estimated and only the one with statistically significant threshold interval coefficient is reported in this study. Inflation threshold within the range 2%-3% is not defined as this falls outside the feasible region. Inflation threshold within the range 14%-15% is highly statistically significant.

Table 4: ARDL short run and ECM representation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
d(mg)	-0.075914	0.058322	-1.301621	0.1991
d(i)	-0.713812	0.408143	-1.748929	0.0866*
d(i * (-14+i > 0))	0.788965	0.388465	2.030983	0.0477**
d(i * (-15+i <= 0))	1.335813	0.365869	3.651069	0.0006***
ecm(-1)	-0.755185	0.115550	-6.535576	0.0000***

Note: *, ** and *** denotes significance at 10%, 5% and 1% respectively.

From Table 4, it can be shown that mg and i impacted negatively on g in the short run respectively though, mg is not statistically significant. If inflation rate lies between 14%-15%, g will increase by -0.713812%+0.788965%+1.335813%=1.41%, if inflation rate is less than 14%, g will increase by -0.713812%+1.335813%=0.62% and if inflation rate is more than 15%, g will increase by -0.713812%+0.788965% =0.075% in the short run. The result in the table indicate that the coefficient of the error correction term ECM(-1) had a correct sign and significant at 1% level. The value of the coefficient is -0.76; this means that, about 76% of the disequilibrium in the level of g of previous year's shock adjust back to the long run equilibrium in the current year. In another word, the level of real GDP growth rate (g) adjust to equilibrium with lags and only about 76% of the discrepancy between long and short run real GDP growth rate (g) in Nigeria is corrected within a year.

Table 5: ARDL long run representation

Variable	Coefficient	Std. Error	t-Statistic	Prob.
mg	-0.100523	0.078211	-1.285276	0.2047
I	-0.945215	0.554976	-1.703164	0.0949*
i*(i-14>0)	1.044731	0.534318	1.955261	0.0563*
i*(i-15<=0)	1.768855	0.537162	3.292962	0.0018***
constant	-0.137809	2.835398	-0.048603	0.9614

Note: *, ** and *** denotes significance at 10%, 5% and 1% respectively.

From Table 5, it can be shown that mg and i impacted negatively on g in the long run respectively though mg is not statistically significant. If inflation rate lies between 14%-15%, g will increase by -0.945215%+1.044731%+1.768855%=1.87%, if inflation rate is less than 14%, g will increase by -0.945215%+1.768855%=0.82% and if inflation rate is more than 15%, g will increase by -0.948185%+1.044731% =0.10% in the long run. In other words, the moderate inflation rate for Nigerian economy lies between 14%-15%. Out of the bound will reduce the growth rate of the economy.

4.5 Inflation Forecasting

In real life, it is glaring that many economic variables are related to each other in one, two or more ways. This, however, does not imply that a pure time series analysis is wrong or not ideal. However, building an interrelated system of model equations of course has advantages but do require a 'correct' representation of the underlying economy. In the time series approach, one is more concerned with predicting future values, including future uncertainty (variances or volatility). From the predictive point of view, a pure time series approach often outperforms a more structural approach and the fact that two variables are related does not imply that a pure times series approach like ARIMA/FARIMA/ARARA is invalid (see Verbeek, 2004).

In order to forecast inflation rate in Nigeria due to its importance in determining economic growth, VAR and ARMA methodology was employed since the stationarity of the variables had been justified by both the graphical and the formal test. The VAR optimal lag was selected using the information criteria while the ARMA specification was selected using automatic optimal model selection. The lag selection criteria selected lag period 1 for the VAR while the automatic ARIMA model

selector chose ARMA (1, 1) over the periods of 1962 to 2016. Both the VAR and the ARMA models were used to perform in sample-forecast for the period 2014 to the year 2016 and out of sample (2017-2020) is forecasted using the stochastic and dynamic method as uncertainty need to be taken into account while forecasting.

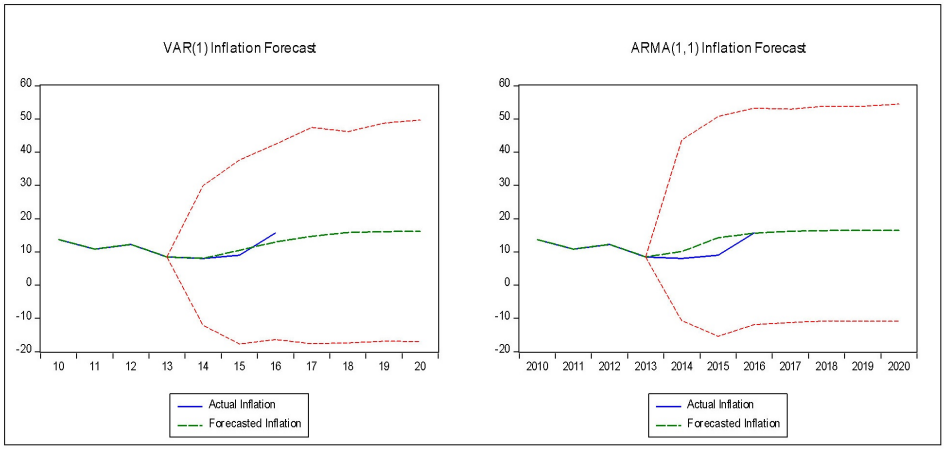

Figure 4: VAR and ARIMA Forecast

The Figure 4 shows the inflation forecast of both VAR (1) and ARMA (1,1). The red dotted line is the confidence bound that account for forecast uncertainty. As both forecasts fall within the bound, consistency is still retained.

Table 6: VAR and ARIMA Model

	2017	2018	2019	2020
VAR(1)	14.5%	15.5%	16.1%	16.1%
ARMA(1,1)	16.4%	16.7%	16.5%	16.4%

As reveled from Table 6, VAR(1) forecast inflation rate for the year 2017 to 2020 to be 14.5%, 15.5%, 16.1% and 16.1% on average respectively. Likewise, ARMA (1, 1) forecast inflation rate for the year 2017 to 2020 to be 16.4%, 16.7%, 16.5% and 16.4% on average respectively. It can be seen that there is a much agreement for both VAR (1) and ARMA (1, 1) inflation forecast for the year 2019 and 2020.

Table 7: VAR and ARIMA Model Forecast Performance

	RMSE	MAPE	THEIL	MAE
VAR(1)	0.38296	0.62661	0.00850	0.07460
ARMA(1,1)	0.67343	1.02085	0.01493	0.12772

From Figure 4, it can be shown that VAR (1) could forecast inflation better than the ARMA (1,1) . However, no statistical fact can be derived numerically from the graphical inspection of the variable in question. Based on this caveat, the forecast performance of the two methodologies is investigated and this is summarized in the Table 7. Four forecast performance evaluations are reported in the Table 6. The four forecast performance evaluations revealed that, the VAR (1) outperformed the ARMA (1,1) in inflation forecasting in Nigeria.

5.0 Conclusion and Policy Implications

This study examined the relationship between inflation and economic growth in Nigeria with the aim of determining the level of inflation that can sustain the economy. Therefore, the causality between inflation and economic growth was investigated as well as the inflation threshold forecasting for the period of 1961 to 2016. The result of the granger causality test shows that inflation does not granger cause economic growth and economic growth does not granger cause inflation. Using control variable of broad money supply to GDP (GLM2/GDP), we established an inflation threshold of 14%-15% both in the short run and long run for Nigeria. Also, we attempted to forecast inflation rate using VAR and ARMA methodologies. The findings shows that VAR (1) could forecast inflation rate in Nigeria with higher degree of accuracy. This result is relevant for monetary policy formulation as it shows that monetary authority in Nigeria needs to consider inflation threshold for the country in the process of targeting single digit inflation as one of its major objectives. One of government macroeconomic challenges is maintenance of price stability. Attainment of inflation threshold of 14% would boost the economy and bring it to a steady path of growth. The findings from this study would enable policy makers to forecast the level of inflation and maintain policy effectiveness.

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