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THE DETERMINANTS OF INFLATION IN NIGERIA

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ABSTRACT: *This paper examined the determinants of inflation in Nigeria using annual time series data covering the period of 1981 to 2017. This period has been carefully selected as it captures the different eras of policy implementation in Nigeria such as the pre–SAP era, SAP era, and the post–SAP era; and is long enough to make an objective assessment of the determinants of inflation in Nigeria. The study applied Auto–Regressive Distributed Lag (ARDL) methodology based on the outcome of the ADF unit root test which revealed that the variables are integrated of I (1) and I (0). The ARDL bounds test result provided evidence of a stronghold long-run relationship among the variables. This necessitated the estimation of ARDL short-run and long-run results. The short-run results of both models revealed that YGAP, M2, TGE, TIMP and UEMPR were significant determinants of inflation in Nigeria whereas the long-run results indicated that TGE, TIMP and UEMPR were significant determinants of inflation in Nigeria. The impact of YGAP, M2, TGE and TIMP was positive in both long and short runs whereas YGAP, TIMP, TGE and UEMPR impacted negatively on inflation in both periods. The outcome of all the diagnostic tests supported the acceptability of the models' results. The study concludes that both demand–pull and cost–push factors are responsible for inflation in Nigeria and also provide the social infrastructure that would encourage private investment.*

KEYWORDS: Inflation, Auto–Regressive Distributed Lag (ARDL), Unit root test.

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INTRODUCTION

Inflation has become a leading topic of discussion in Nigerian families and the press as its effects penetrate more deeply into the nation's life due to the prevailing increase in prices. The price increase, in turn, leads to a decline in the supply of the basic needs of citizens, including food, shelter and the infrastructural development of the country at large. Continuous increases in prices are among the most serious economic problems in Nigeria as well as Africa in general (Olatunji, Omotesho, Ayinde and Ayinde, 2010); as it erodes the purchasing power of money thereby lowering the value of investment and standard of living (Greenidge and Dacosta, 2009).

The first experience of inflation in Nigeria was in the 1970s when oil revenue rose astronomically. This was accompanied by an unprecedented increase in public expenditure which brought about a vast expansion of aggregate demand (Aiyede, 2002). The increasing inflationary pressure then was worsened by increased money supply which resulted in the monetization of the earnings from oil and the Udoji Salary Awards of 1974 when wages extensively increased (Anyanwu, 1992).

Okah (1986) added that certain allowances enjoyed by public servants were either removed or reduced accordingly. The regulation of bank liquidity, interest rate structure and credit expansion were measures adopted to reduce the supply of money. It is, however, ironical that despite the tight fiscal and monetary measures adopted, the rate of inflation continued to rise at unprecedented rates. From the foregoing, inflation has remained one of the most crucial macroeconomic problems in Nigeria given the major distortions it has caused to the economic growth of the country and the standard of living of the citizenry.

The cost-push proponents and their supporters argue that inflation results from an increase in the cost of production emanating from a rise in wages, an increase in the cost of funds (or interest rate), an increase in costs of imported raw materials, power supply, transport and other inputs of production and a fall in productivity of labour and shortages of commodities (Onwiodukit, 2002; Alexander, Andow and Danpome, 2015; Undji and Kaulihowa, 2015). In addition to their subscription to the demand-pull paradigm, the Keynesians believe that inflation is caused by movements in the rate of interest whereas the structuralists view inflation as the outcome of a low inelastic supply of food items and agricultural products owing to bottlenecks in the agricultural sector and foreign exchange shortages in developing countries (Goamab 1998; Gyebi and Boafo, 2013).

The specific objectives of the study are: to determine how the real output gap is related to inflation in Nigeria, to ascertain the impact of money supply on inflation in Nigeria, to determine how total government expenditure relates to inflation in Nigeria, to ascertain the relationship between total import and inflation in Nigeria, to determine how the nominal exchange rate is related to inflation in Nigeria, to ascertain how agricultural and manufacturing industries GDP relates to inflation in Nigeria, to determine the relationship between interest rate and inflation in Nigeria, to ascertain how domestic pump price of premium motor spirit relates to inflation in Nigeria, to determine the relationship between unemployment and inflation in Nigeria. The following hypotheses which are stated in the null form are tested in this study: H_{01}: Real output gap is not related to inflation in Nigeria, H_{02}: Money supply has no impact on inflation in Nigeria H_{03}: Government total expenditure does not have a relationship with inflation in

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Nigeria, H_{04}: Total import does not have a relationship with inflation in Nigeria, H_{05}: Nominal exchange rate is not related to inflation in Nigeria, H_{06}: Agricultural and manufacturing industries GDP is not related to inflation in Nigeria, H_{07}: Interest rate has no relationship with inflation in Nigeria, H_{08}: Domestic pump price of premium motor spirit is not related to inflation in Nigeria, H_{09}: Unemployment has no relationship with inflation in Nigeria.

LITERATURE REVIEW

Theoretical Literature

Theoretical literature on the determinants of inflation is filled with contradictory views with regard to the causes of inflation. In fact, there are several theories that explain what causes inflation; however, most of them are formulated on the basis of the aggregate demand (demand – pull) and cost-push theories. Even though there are some controversies surrounding these two theories (Ball and Doyle, 1969, as cited in Greenidge & DaCosta, 2009), amongst all the arguments, they are the least controversial and lay the foundation for debates on inflation. Below are the theoretical explanations as postulated by various economists and schools of thought.

(A) Demand-Pull or Monetary Theories of Inflation

Demand-pull or monetary theories of inflation define inflation situations where aggregate demand for goods and services exceeds aggregate supply, thereby leading to a general rise in price levels (Otto and Ukpere, 2016). This approach states that high government spending policies of central banks to raise money supply, rise in household and firms' consumption and prices in the international market compared to that of the domestic market are responsible for raising the price level (Ogbokor and Sunde 2011; Nazima, 2017). The demand-pull paradigm is of the view that inflation exists when aggregate demand for goods and services exceeds aggregate supply for goods and services, such that the excess aggregate demand cannot be satisfied by running down the existing stocks, diverting suppliers from the export market to the domestic market, increasing imports or postponed demand (Anyanwu, 1993).

The demand-pull inflation may also be called surplus demand inflation because it arises from too much money chasing too few goods. Anyanwu (1993) opined that this was the situation during the Biafra-Nigeria war and after the Udoji Salary Awards of 1974 when wages increased astronomically. Higher wages increased the purchasing power of consumers thus leading to increased demand. The pressure on commodities, therefore, led to increases in their prices. More often it occurs where there is full employment so that the excess pressure on the factors of production leads to higher prices for the factors, ultimately leading to a rise in the cost of production. It could also be a short-run phenomenon where demand dynamics were not well anticipated. When there are production constraints, demand beyond the possible output level could also create inflation.

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(B) Cost-Push Theories of Inflation

Cost-push inflation exists when wages or production costs start rising. The producers in turn pass these rising costs upon the consumers, leading to higher prices (Undji and Kaulihowa, 2015). Depreciation of the exchange rate can initiate an increase in the prices of goods as most firms import the bulk of raw materials required for their production at higher prices. Ogbokor and Sunde (2011) noted that this kind of inflation occurs mainly because of a rise in the cost of imported raw materials and an increase in the cost of labour. Otto and Ukpere (2016) noted that cost-push inflation can also be called "market power inflation" because the increase in the prices of goods and services originates from the supply side of the economy. These increases may arise from increased wage rates or a fall in productivity which also increases the cost of labour output. It may also arise out of other factors of production or cost of inputs such as power supply, transport or raw materials. In Nigeria, multiple taxation and corruption are major suspects. Alexander, Andow and Danpome (2015) opined that the cost-push theory maintains that prices of goods and services rise because wages are pushed up by trade unions' bargaining power, or by the pricing policies of oligopolistic and monopolistic firms with market power. The cost-push view attributed inflation to a host of non-monetary supply-oriented influences of shocks that raise costs and consequently prices. Onwiodukit (2002) noted that this school of thought attributes inflation to random non-monetary shocks such as crop failures, commodity shortages, vagaries of weather and an increase in the price of oil.

(C) The Classical Theory of Inflation

the The classical theory of inflation is derived directly from the classical quantity theory of money which is one of the oldest surviving economic doctrines. The theory is found in the famous equation of exchange developed in the 19th century by Irving Fisher (1876 – 1947). Fisher's equation of exchange states that MV = PY. If velocity (V) and output (Y) are constant, the increase in money (M) will cause a direct and proportionate increase in prices (P) (Almahdi and Faroug, 2018). The theory assumes full employment in the economy while M is exogenously determined by the monetary authority. The greatest shortcoming of this theory is that it does not explain the channel (whether interest rate, wages, unemployment, demand, etc.) by which an increase in money supply causes the rise in the price level.

(D) The Keynesian theory of inflation

John Maynard Keynes (1883 – 1946) and the Keynesian economists in their support for the demand-pull inflation theory, opined that inflation is majorly caused by an increase in aggregate demand, which is composed of investment, government expenditure and consumption. They explain this using the concept of the inflationary gap - the excess of aggregate demand over aggregate supply. Keynes submitted that the larger the gap between aggregate demand and aggregate supply, the more the rapidity of inflation. Reducing inflationary tendencies in any economy entails initiating policies that reduce those components of total demand (Ndidi, 2013).

The Keynesians tend to attribute inflation more to demand pressures within the economy. It is not necessarily a monetary phenomenon as proposed by the Monetarists (Goamab 1998; Ogbokor & Sunde 2011). Furthermore, they believe that inflation is caused by movements in the rate of interest, which is in contrast to the Monetarists' view, which claims that inflation is caused by money supply.

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(E) The Monetarists' theory of inflation

The monetarists argue that there is a direct relationship between price and money supply. They believe that inflation is always and everywhere a monetary phenomenon; hence, prices are likely to increase when the rate of increase in money supply is greater than the rate of increase in real output of goods and services (Johnson, 1973, as cited in Olatunji, Omotesho, Ayinde, & Ayinde, 2010). In addition, Goamab (1998) noted that such a situation whereby any extra cash balance is spent on the acquisition of assets will give rise to excess demand for assets, which will ultimately lead to increases in the general price level, thereby leading to a rise in inflation.

In Milton Friedman's submission, only money matters, and monetary policy is the potential in ensuring economic stabilisation as against the fiscal policy, which is vehemently supported by the demand-pull theory. According to the monetarists, money is the dominant but not exclusive determinant of inflation in an economy.

(F) The Structuralist Theory of Inflation

This theory was developed by Myrdal and Straiten in 1987. The structuralist theory explains the long–run inflationary trends in developing countries in terms of structural rigidities, market imperfection and social tension, relative inelasticity of food supply, foreign exchange constraints, protective measures, and rise in demand for food, fall in export earnings and political instabilities. The structuralists argue that by the very nature of their economies, the less developed countries are prone to inflation. The reason assigned for this argument is that there exist structural rigidities or bottlenecks namely; economic, institutional and socio-political factors in these countries, which in one way or the other impede the expansion of output (Gyebi and Boafo, 2013). This theory views inflation from the supply side of the economy and identifies some mechanisms that trigger inflation as a low inelastic supply of food items and agricultural products owing to bottlenecks in the agricultural sector and foreign exchange shortages.

Empirical Literature Review

Several studies have examined determinants of inflation in both developed and developing nations although only a few of them are done in Nigeria. However, Kabundi (2011) tried to identify the main features underlying inflation in Uganda, both in the long -run and short run, using monthly data from January 1999 to October 2010. The author ran a single equation Error Correction Model (ECM) based on the quantity theory of money including both external and domestic variables. Finally, they concluded that evidence of inflation inertia which can be attributed to expectations of agents and/or inflation persistence.

Ratnasiri (2006) attempted to examine the determinants of inflation for Sri Lanka over the period 1980-2005 using VAR based co-integration approach. The findings indicate money supply growth and the increases in rice price are the most important determinants of inflation in Sri Lanka in the short run and long run. The effect of GDP growth and exchange rate depreciation on inflation has been found to be negligible and statistically not significant. The short-run effect of money growth, rice price and exchange rate effect on inflation is statistically significant. However, GDP growth is not significant in the short run too. It is obvious that the supply side effect on inflation in Sri Lanka is reflected in rice prices.

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Mallik and Chowdhury (2001) examined the short-run and long-run dynamics of the relationship between inflation and economic growth for four South Asian economies: Bangladesh, India, Pakistan, and Sri Lanka. Applying Co-integration and Error Correction Models to the annual data retrieved from the International Monetary Fund (IMF) and International Financial Statistics (IFS), they found two motivating results. First, the relationship between inflation and economic growth is positive and statistically significant for all four countries. Second, the sensitivity of growth to changes in inflation rates is smaller than that of inflation to changes in growth rates.

Fatukasi and Bayo (2006) investigated the determinants of inflation in Nigeria between 1981 and 2003. They concluded that all explanatory variables (fiscal deficits, money supply, interest and exchange rates) significantly and positively impacted the rate of inflation in Nigeria during the period under review.

Abidemi and Maliq (2010) analysed the dynamic and simultaneous inter-relationship between inflation and its determinants in Nigeria between 1970 and 2007. They observed that within the periods of high monetary growth (1988, 1990, 1992-1994), inflation surged accordingly, though with some lags. As the increase in narrow money rose from 4.1% in 1988, the inflation rate increased from 5.4 to 38.3% during the same period. Following the lag response of inflation to monetary growth, inflation peaked at 50.0% in 1989. Similarly, when the money supply growth increased substantially, inflation also accelerated. On the other hand, the decline in the monetary growth rate in 1994 led to a consequent decline in the inflation rate. This confirmed that there is a strong link between increases in money supply and inflation.

Uddin, Chowdhury and Hossain (2014) explored the link between inflation and its determinants in Bangladesh using Autoregressive Distributed Lag (ARDL) model and annual time series data spanning 1972 to 2012. The model which expressed Inflation (INF_t) as a function of Gross Domestic Product (GDP_t), broad Money Supply (MS_t), Real Exchange Rate (RER_t), and Interest Rate (IR_t) indicated that the Gross Domestic Product (GDP_t), Money Supply (MS_t), and Interest Rate (IR_t) of the current year, as well as previous year's real Exchange (RERt-1) and Inflation Rate (INFt-1), impacted positively and significantly on inflation in Bangladesh whereas real exchange rate of the current year (RER_t) and previous year's broad money supply ($M2_{t-1}$) made a significant and negative impact. The study recommends that the government should pursue with vigour, policies that will enhance the reduction of the general price level but enhance increased productivity of goods and services.

Lim and Sek (2015) investigated the determinants of inflation in two groups (high inflation and low inflation countries) using Auto Regressive Distributed Lag (ARDL) methodology and annual time series data on Inflation (Inf), Money Supply (MS), Gross National Expenditure (GNE), Imports of goods and services (IMP), and Gross Domestic Product Growth (GDP Growth) from 1970 to 2011. The high inflation countries model included Iran Islamic Rep., Argentina, Uruguay, Sudan, Burundi, Colombia, Ecuador, Ghana, Iceland, Indonesia, Israel, Mexico, and Turkey while the low inflation countries were Australia, Canada, Cyprus, Denmark, Finland, Italy, Malaysia, Malta, Morocco, Netherlands, Norway, United States, Bahamas, and Singapore.

The empirical findings revealed that in the long run, money supply and national expenditure have significant positive and negative impacts respectively on inflation in high inflation countries, while GDP growth and import of goods and services have significant positive and

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negative impacts respectively in low inflation countries. In the short run, none of the variables included in the analysis has a significant impact on inflation in high inflation countries whereas the importation of goods and services made a significantly positive impact on inflation. GDP growth and Money Supply made a significantly negative impact in low inflation countries. The study recommends that the determinants of inflation with significant impact should be controlled to enhance stability in the economy.

Alexander, Andow and Danpome (2015) investigated the main determinants of inflation in Nigeria for the period 1986-2011 using the Vector Autoregressive (VAR) model and annual time series data on Inflation Rate (IR), Real Gross Domestic Product (RGDP), Exchange Rate (EX), Lending Rate (LR), and Fiscal Deficit (FD), GDP of Agriculture (ARGDP), Money Supply (MS) and Import (MP). The estimated VAR result showed that exchange rate, fiscal deficits, GDP of agriculture, money supply and import of goods and services have a long-run influence on the inflation rate in Nigeria. Only lending rates influenced inflation in the short and long-run horizons. The variance decomposition and impulse response results showed that "own-shocks'' were significantly responsible for the variation and innovations in all the variables in the equation. While the study discourages excessive waste of public funds through fiscal deficit, it recommends that the monetary authority should encourage a lending rate policy that promotes investment as well as retention of the desired level of money supply and interest rates that reduce the inflation rate in Nigeria.

Musa and Yousif (2018) investigated the determinants of inflation in Sudan using the Generalised Method of Moments (GMM) technique and annual time series data on Inflation rate (INF), Gross Domestic Product (GDP), Government Expenditure (GE), Money Supply (MS), Exchange Rate (ER), and Unemployment Rate (UEMPR), and Consumer Price Index (CPI) for the period 2000 – 2017. The results revealed that GDP, CPI, ER, and GE had a significant and positive impact on inflation whereas that of UEMPR and MS was significant and negative.

METHODOLOGY

Annual Time Series Data covering the period of 1981 to 2017 which were obtained from the CBN Statistical Bulletin (2018), World Development Indicator (2018), and Petroleum Product Pricing Regulatory Agency (PPPRA) Bulletin (various issues) were used in this study. Using Augmented Dickey-Fuller (ADF), the variables are subjected to stationary testing. Time series characteristics of the research variables need to be studied in order to determine the order of their integration. Time series data are mostly not stationary, meaning that the mean, variance, and covariance of such data sets are not invariant in time (Gujarati, 2009). Non-stationary series can result in spurious and misleading regression. This study employs the Auto-Regressive Distributed Lag (ARDL) methodology suggested by Pesaran, Shin and Smith (2001) for the analysis of data.

Theoretical Framework

The study adopts the models in Greenidge and DaCoasta (2009) and Alexander, Andow and Danpome (2015) but with modifications due to the non-inclusion of some relevant explanatory variables. The explanatory variables in this study are Real Output Gap (YGAP) measured as the deviation of actual RGDP from desired RGDP, broad Money Supply (MS), Total

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Government Expenditure (TGE), Total Import (TIMP), Nominal Exchange Rate (NEXR) taking as U.S dollar to Naira, Agricultural and Manufacturing Industries GDP (AMIGDP), Interest (lending) Rate (INTR), Domestic Pump Price of Premium Motor Spirit (PPMS), and Unemployment Rate (UEMPR), whereas the dependent variable is Inflation Rate (INFR) as measured by Consumer Price Index. The data used in the analysis is secondary annual time-series data of ten variables which were obtained from the CBN Statistical Bulletin (2018), the time period covered in this study is 36 years (1981 to 2017). Using Augmented Dickey-Fuller (ADF) unit root test was conducted and the result necessitated the test for the short-run and long-run relationship among the variables (co-integration). Also, the study employs the Auto-Regressive Distributed Lag (ARDL) methodology suggested by Pesaran, Shin and Smith (2001) for the analysis of data.

Model Specification

Two models which hypothesised variations in inflation to be a function of the explanatory variables are algebraically specified. Model 1 is specified based on demand-pull theories while Model 2 is specified based on cost-push theories.

Model 1

$$INFR = f(YGAP, MS, TGE, TIMP, NEXR) \quad (1)$$

The parameterized version of the inflation model 1 is presented as

$$INFR_t = \beta_0 + \beta_1 YGAP_t + \beta_2 MS_t + \beta_3 TGE_t + \beta_4 TIMP_t + \beta_5 NEXR_t + \mu_{1t} \quad (2)$$

Where the variables are as itemised above; β_0 is the constant while $\beta_1 \ldots \beta_5$ are the coefficient of the parameters; t is a subscript denoting time. Based on a priori, $\beta_1 > 0$, $\beta_2 > 0$, $\beta_3 > 0$, $\beta_4 > 0$, $\beta_5 > 0$.

Model 2

$$INFR = f(AMIGDP, INTR, PPMS, UEMPR) \quad (3)$$

The parameterized version of the inflation model 2 is presented as

$$INFR_t = \lambda_0 + \lambda_1 AMIGDP_t + \lambda_2 INTR_t + \lambda_3 PPMS_t + \lambda_4 UEMPR_t + \mu_{2t} \quad (4)$$

Where the variables are as itemised above; λ_0 is the constant while $\lambda_1 \ldots \lambda_4$ are the coefficient of the parameters; t is a subscript denoting time. Based on a priori, $\lambda_1 < 0$, $\lambda_2 < 0$, $\lambda_3 > 0$, $\lambda_4 < 0$.

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Estimation Technique and Procedure

Test for Unit Root:

The presence of trends and unit roots are detected from the slowly decaying autocorrelation function in the univariate process which indicates non-stationarity. Consider $AR_{(p)}$ model so that

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + ... + \phi_p Y_{t-p} + \varepsilon_t \text{ which can be written as}$$

$$\psi(L) y_t = \varepsilon_t \qquad (5)$$

$$\text{where } \psi(L) = 1 - \phi_1 L - \phi_2 L^2 - ... - \phi_2 L^2 \text{ is a polynomial in lag L.}$$

If the root of the characteristic equation $\psi(L) = 0$ is all greater than unity in absolute terms, then y_t is stationary, otherwise y_t is non-stationary.

Dickey-Fuller test:

The Dickey-Fuller test affirms if $\phi = 0$. In this model of the data $y_t = \beta_t + \phi y_{t-1} + e_t$, which is written as $\Delta y_t = y_t - y_{t-1} = \beta_t + \gamma y_{t-1} + e_t$. It is written this way so we can perform a linear regression of Δy_t against t and y_{t-1} and test if γ is different from 0. If $\gamma = 0$, then we have a random walk process. If not and $-1 < 1 + \gamma < 1$, then we have a stationary process. Given the model

$$y_t = \beta y_{t-1} + \varepsilon_t \qquad (6)$$

Subtracting y_{t-1} *from both sides, we have*

$$y_t - y_{t-1} = \beta y_{t-1} - y_{t-1} + \varepsilon_t$$
$$\Rightarrow \Delta y_t = (\theta - 1) y_{t-1} + \varepsilon_t$$
$$= \delta y_{t-1} + \varepsilon_t \qquad (7)$$

Testing for $\theta = 1$ is equal to testing for $\delta = 0$

The following regression equations and the associated error terms are considered for the unit root test:

$$\Delta y_t = \delta y_{t-1} + \varepsilon_t \qquad (8)$$
$$\Delta y_t = \beta_0 + \delta y_{t-1} + \varepsilon_t \qquad (9)$$
$$\Delta y_t = \beta_0 + \delta y_{t-1} + \beta_1 t + \varepsilon_t \qquad (10)$$

Augmented Dickey-Fuller (ADF) test:

The ADF test belongs to a category of tests called 'Unit Root Test', which is the proper method for testing the stationarity of a time series. The Augmented Dickey-Fuller test checks through these models:

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$$\Delta y_t = (\rho - 1) y_{t-1} + \sum_{j=1}^{n} \beta_j \Delta y_{t-j} + \varepsilon_t \qquad (11)$$

$$\Delta y_t = \alpha + (\rho - 1) y_{t-1} + \sum_{j=1}^{n} \beta_j \Delta y_{t-j} + \varepsilon_t \qquad (12)$$

$$\Delta y_t = \alpha + \delta_t + (\rho - 1) y_{t-1} + \sum_{j=1}^{n} \beta_j \Delta y_{t-j} + \varepsilon_t \qquad (13)$$

Hypotheses Tests are specified as :

$H_0 : \rho = 1 \quad vs \quad H_1 : \rho < 1$

$H_0 : \alpha = 0 \quad vs \quad H_1 : \alpha \neq 0$

$H_0 : \gamma = 0 \quad vs \quad H_1 : \gamma \neq 0$

The test statistic is specified as :

$T_\rho = \dfrac{\hat{\rho}}{S.E.(\hat{\rho})}$ *ADF*(I, n, α) *is compared with the appropriate value of Dickey Fuller table*

The null hypothesis for the tests is that the data are non-stationary, and it is rejected for this test so we want a p-value of less than 0.05.

ARDL Bounds Test for Cointegration:

In order to empirically analyse the long-run relationships and short-run dynamic interactions among the variables of interest we apply the Autoregressive Distributed Lag (ARDL) cointegration technique the ARDL bounds test is based on the assumption that the variables are I(0) and I(1) (Pesaran et al, 2001).

Short Run and Long Run Estimation of the ARDL model 1:

The short-run equation in our model is given as follows:

$$INFR_{t-1} = \beta_0 + \beta_1 D(YGAP)_{t-1} + \beta_2 D(MS)_{t-1} + \beta_3 D(TGE)_{t-1} + \beta_4 D(TIMP)_{t-1} + \beta_5 D(NEXR)_{t-1} + ECM(-1) \qquad (14)$$

Where "D" represents the first difference operation of the variables, ECM (-1) is the one period lag of the model residual. The parameters β_1 to β_5 are the short-run coefficients of the model while the coefficient of ECM (-1) is the long-run speed of adjustment of the model. The sign of the coefficient of ECM (-1) should be negative and significant as well for holding the long-run equilibrium (Dhungel, 2014).

The long run equation can be stated thus:

$$INFR_t = \beta_0 + \beta_1 YGAP_t + \beta_2 MS_t + \beta_3 TGE_t + \beta_4 TIMP_t + \beta_5 NEXR_t + \mu_{1t} \qquad (15)$$

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Short Run and Long Run Estimation of the ARDL model 2:

$$INFR_{t-1} = \lambda_0 + \lambda_1 D(AMIGDP)_{t-1} + \lambda_2 D(INTR)_{t-1} + \lambda_3 D(PPMS)_{t-1} + \lambda_4 D(UEMPR)_{t-1} + ECM(-1) \quad (16)$$

Where "D" represents the first difference operation of the variables, ECM (-1) is the one period lag of the model residual. The parameters λ_1 to λ_4 are the short-run coefficients of the model while the coefficient of ECM (-1) is the long-run speed of adjustment of the model. The sign of the coefficient of ECM (-1) should be negative and significant as well for holding the long-run equilibrium (Dhungel, 2014).

The long-run equation can be stated thus:

$$INFR_t = \lambda_0 + \lambda_1 AMIGDP_t + \lambda_2 INTR_t + \lambda_3 PPMS_t + \lambda_4 UEMPR_t + \mu_{2t} \quad (17)$$

RESULTS AND DISCUSSION

Table 4.1: Results of ADF Unit root test of Stationarity

Variables	Maxlag (SIC)	ADF test statistic @ Levels	ADF test statistic @ First Difference	Critical Value @ 1%, 5%, or 10%	Remark
LNINFR	9	-2.859205	-5.514859	-3.632900***	Stationary@ Order 1
LNYGAP	9	0.774304	-7.898749	-3.632900**	Stationary@ Order 1
LNM2	9	-3.839289	-6.273837	-3.689194***	Stationary@ Order 0
LNTGE	9	5.237694	5.121126	-3.689194***	Stationary@ Order 0
LNTIMP	9	0.711353	-2.192627	-3.626784	Stationary@ Order 1
LNEXR	9	2.238119	-3.303326	-2.948404**	Stationary@ Order 1
LNAMIGDP	9	3.117156	-3.664253	-2.945842***	Stationary@ Order 0
LNINTR	9	-2.411968	-5.904707	-3.639407**	Stationary@ Order 1
LNPPMS	9	1.683178	-0.900786	-3.653730	Stationary@ Order 1
LNUEMPR	9	-1.240854	-5.286051	-3.632900**	Stationary@ Order 1

Source: Computed by the author using E –views 9 outputs;

*Note: *, **, *** implies significant at 1%, 5%, or 10% level of significance.*

The results of the ADF unit roots tests of the series in table 4.1 show that all the variables are stationary at first difference except money supply, Total Government Expenditure and Agricultural and Manufacturing Industries GDP that is stationary at levels. The variables are therefore integrated of order 1 and 0 i.e. I (1) and I (0). The ADF maximum lag is based on Schwarz Information Criterion (SIC). The null hypothesis of unit root is therefore not accepted since the ADF test statistics are greater than the critical values at the indicated levels of significance. Thus, inflation and the modelled variables are stationary and follow an integrating I (1) and I (0) processes. Having determined that ADF unit roots tests variables are integrated

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of order 1 and 0 and are stationary, the researcher moved on to verify whether the combination of the variables is cointegrated and as such employed the ARDL bound test.

Table 4.2 Result of ARDL Bounds Test to Co – integration for Models 1 and 2

Model 1	**Result**		**Model 2**	**Result**
F – Statistic Value	= 7.695691		**F – Statistic Value**	= 3.610597
Critical Value Bounds			Critical Value Bounds	
Significance	I0 Bounds	II Bounds	I0 Bounds	II Bounds
10%	2.26	3.35	2.45	3.52
5%	2.62	3.79	2.86	4.01
2.5%	2.96	4.18	3.25	4.49
1%	3.41	4.68	3.74	5.06

Source: Computed by the author using E –views 9 outputs;

From the results in table 4.2, the null hypotheses of no long-run relationships are rejected as the F – statistic values of 7.695691 and 3.610597 are greater than the critical upper (II) bounds values of 3.35 and 3.52 at 10% level of significance for the two models respectively. This confirms the existence of long-run relationships among the variables. A lag length of four (4) was automatically selected based on Akaike Information Criterion (AIC). Having established the existence of long-run relationships, short-run and long-run impacts of the explanatory variables are estimated. The results of the short-run and long-run impact of the explanatory variables on inflation are presented in tables 4.2.1 and 4.2.2 for the two models respectively.

Table 4.2.1: ARDL Short Run and Long Run Results for Model 1 (Dependent Variable: INFR)

Short-Run Result				
Variable	**Coefficient**	**Std. Error**	**t - Statistic**	**Prob.**
D(YGAP(-1))	-0.000000	0.000000	1.099854	0.3517
D(YGAP(-2))	-0.000000**	0.000000	4.399563	0.0218
D(YGAP(-3))	0.000000**	0.000000	4.297753	0.0232
D(M2(-1))	-0.049093	0.041909	1.171415	0.3260
D(M2(-2))	-0.122792	0.048234	2.545771	0.0843
D(M2(-3))	0.195874**	0.055552	3.525968	0.0388
D(TGE(-1))	-0.008316	0.106159	0.078335	0.9425
D(TGE(-2))	0.054451	0.159611	0.341149	0.7555
D(TGE(-3))	0.441590**	0.094606	4.667654	0.0186
D(TIMP(-1))	-0.231433**	0.048134	4.808131	0.0171
D(TIMP(-2))	-0.033601	0.035811	0.938297	0.4173
D(TIMP(-3))	-0.097850	0.050776	1.927083	0.1496
D(NEXR(-1))	2.454388	0.911407	2.692966	0.0742
D(NEXR(-2))	-1.787824	0.764731	2.337846	0.1014
D(NEXR(-3))	0.564948	0.603106	0.936731	0.4180

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CointEq(-1)	-1.342562	0.616350	2.178245	0.1175
Long – Run Result				
Variable	**Coefficient**	**Std. Error**	**t – Statistic**	**Prob.**
YGAP	0.000000	0.000000	0.596644	0.5928
M2	-0.026054	0.025454	1.023576	0.3814
TGE	-0.696661**	0.137372	5.071343	0.0148
TIMP	0.286901**	0.056048	5.118815	0.0144
NEXR	1.392606	0.674534	2.064545	0.1309
C	14.693464	26.410011	0.556360	0.6168
R-squared	0.981819	Mean dependent var		19.77777
Adjusted R-squared	0.806067	S.D. dependent var		18.37331
S.E. of regression	8.091207	Akaike info criterion		6.439719
Sum squared resid	196.4029	Schwarz criterion		7.800181
Log likelihood	-76.25537	Hannan-Quinn criteria.		6.897473
F-statistic	5.586392	Durbin-Watson stat		2.539296
Prob(F-statistic)	0.090235			

Source: Computed by the author using E – views 9 Outputs;

*Note: ** denotes significant variables of the model.*

The result in table 4.2.1, reveals that in the short run, the Output gap (YGAP (-2)), (YGAP (-3)), is a significant but negative and positive impact on inflation. As well as Broad Money Supply (M2 (-3)), Total Government Expenditure (TGE (-3)) and Total Import (TIMP (-1)) were significant but positive and negative impacts on inflation respectively. Specifically, a =N=1billion increase in (YGAP (-2)) reduces inflation rate by -0.00%, a =N= 1billion increase in (YGAP (-3)) increases inflation rate by 0.00%. a =N= 1billion increase in (M2 (-3)) increases inflation rate by 0.19% while, =N= 1billion increase in (TGE (-3)) increases inflation rate by 0.44%. Also, =N= 1billion increase in (TIMP (-1)) reduces inflation rate by 0.23%. While, (TGE (-2)), (NEXR (-1)), (NEXR (-3)) is insignificant but positive impact on inflation. (YGAP (-1)), (M2 (-1)), (M2 (-2)) (TGE (-1)), (TIMP (-2)), (TIMP (-3)), (NEXR (-2)), made insignificant but negative impact on inflation in the short run. Whereas, a unit increase in (TGE (-2)), (NEXR (-1)), (NEXR (-3)) increases inflation by 0.05%, 2.45%, and 0.56% respectively. While a unit increase in (YGAP (-1)), (M2 (-1)), (M2 (-2)) (TGE (-1)), (TIMP (-2)), (TIMP (-3)), (NEXR (-2)) lead to 0.00%, 0.05%, 0.12%, 0.01%, 0.03%, 0.09%, and 1.79% decline in inflation. In the long run, TGE and TIMP impacted significantly on inflation. While TGE made a negative impact, that of TIMP was positive. A =N= 1 billion increase in TGE reduces the inflation rate by 0.69% whereas a unit increase in TIMP increases inflation by 0.29%. YGAP, M2 and NEXR made insignificant but positive impacts in the long run except M2 is a negative impact in the long run. A unit increase in YGAP, M2 and NEXR increases inflation by 0.00% and 1.39% except M2 reduces inflation by 0.03%. The error correction term CointEq(-1) is well behaved as its coefficient is negative and insignificant. The coefficient of the ECT of -1.34 reveals that the speed with which the inflation rate adjusts the regressors is about 134% in the short run. The R- square value of 0.98 shows that about 98% of variations in inflation are jointly explained by variations in the explanatory variables of the model. The probability F – statistic value of 0.090235 shows that the overall model is insignificant in explaining determinants of inflation in Nigeria.

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The short-run and long-run results of all the variables in model 1 are well-behaved as they conform to a prior expectation except Nominal Exchange Rate which is positive and negative signed. A possible reason for this deviation is that Nominal Exchange Rate in Nigeria has been used to control the inflow and outflow of money-induced inflation rather than cost-push inflation. Again, the non-significance of the Nominal Exchange Rate in both the short and long run should be interpreted with caution as it can be a weak tool for controlling inflation due to its inconsistent positive and negative impact on inflation in both short and long runs. One striking finding about this model is that the previous inflation rate is a significant determinant of inflation in Nigeria as INFR at lag 1 and lag 3 (previous year inflation) led to a 0.51% and 1.13% increase in inflation in Nigeria.

Table 4.2.2: ARDL Short Run and Long Run Results for Model 2 (Dependent Variable: INFR)

Short-Run Result				
Variable	**Coefficient**	**Std. Error**	**t - Statistic**	**Prob.**
D(INFR(-1))	0.447135**	0.174524	2.562029	0.0161
D(AMIGDP)	0.001008	0.001602	0.629603	0.5341
D(PPMS)	-0.095238	0.223392	-0.426327	0.6731
D(INTR)	0.311873	0.579663	0.538025	0.5948
D(UEMPR)	-1.298925**	0.618475	-2.100207	0.0448
CointEq(-1)	-0.819707**	0.180548	-4.540095	0.0001
Long-Run Result				
Variable	**Coefficient**	**Std. Error**	**t – Statistic**	**Prob.**
AMIGDP	0.001230	0.001927	0.638249	0.5285
PPMS	-0.116186	0.271025	-0.428689	0.6714
INTR	0.380469	0.698403	0.544771	0.5902
UEMPR	-1.584622**	0.652513	-2.428489	0.0218
C	22.874865	14.733257	1.552601	0.1317
R-squared	0.558430	Mean dependent var		19.81998
Adjusted R-squared	0.463808	S.D. dependent var		17.83756
S.E. of regression	13.06158	Akaike info criterion		8.154084
Sum squared resid	4776.937	Schwarz criterion		8.465153
Log likelihood	-135.6965	Hannan-Quinn criteria.		8.261465
F-statistic	5.901685	Durbin-Watson stat		1.910456
Prob(F-statistic)	0.000445			

Source: Computed by the author using E – views 9 Output;

*Note: ** denotes significant variables of the model.*

Results in table 4.2.2 indicate that in the short run, AMIGDP, PPMS and INTR were non - significant but positive and negative respectively. While UEMPR made a negative and significant impact on inflation. Precisely, a unit increase in AMIGDP, INTR leads to 0.00%, and 0.31% increases in inflation rate respectively whereas a unit increase in PPMS, UEMPR leads to 0.09%, 1.29% decline in inflation rate respectively. In the long run, AMIGDP, PPMS and INTR made insignificant but positive and negative impacts on inflation while that UEMPR

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was significant and negative. Specifically, a unit increase in AMIGDP, and INTR increases the inflation rate by 0.00% and 0.38%. While, a unit increase in PPMS, UEMPR reduces the inflation rate by 0.11%, and 1.58 respectively. The coefficient of the error correction term (Coint Eq(- 1) is negatively signed and significant. The coefficient of the ECT of - 0.81 reveals that the speed with which the inflation rate adjusts the regressors is about 81% in the short run. The R-square value of 0.55 shows that 55% variation in inflation is jointly explained by variations in the explanatory variables of the model. The probability F-statistics value of 0.000445 shows that the overall model is significant in explaining determinants of inflation in Nigeria.

The short-run and long-run results of only one of the variables in model 2 are well-behaved as they conform to prior expectations except for Agricultural and Manufacturing Industries GDP, Domestic Pump Price of Premium Motor Spirit and interest rate that are positive and negative. A possible reason for this deviation of unconformity to variables mentioned has been used to control money supply-induced inflation rather than cost-push inflation. One striking finding about this model is that the previous inflation rate is a significant determinant of inflation in Nigeria as INFR at lag 1 (previous year inflation) led to a 0.44% increase in inflation in Nigeria. The results of the diagnostic test of model adequacy for the two models are presented in Table 4.2.3 and figure 4.2.4

Table 4.2.3: Summary of Diagnostic Tests for Models 1 and 2

Model 1			
Breusch – Godfrey Serial Correlation LM Test			
F-statistic	0.523530	Prob. F	0.4844
Obs*R-squared	1.499236	Prob. Chi-Square	0.2208
Correlogram – Q – Statistic Probability Value		0.295	
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	0.385450	Prob. F	0.9713
Obs*R-squared	12.90766	Prob. Chi-Square	0.8813
Jarque – Bera Test of Normality			
Jarque – Bera	4.866007	Probability	0.087773
Model 2			
Breusch – Godfrey Serial Correlation LM Test			
F-statistic	0.946412	Prob. F	0.4011
Obs*R-squared	2.375121	Prob. Chi-Square	0.3050
Correlogram – Q – Statistic Probability Value		0.895	
Heteroskedasticity Test: Breusch-Pagan-Godfrey			
F-statistic	2.142624	Prob. F	0.0797
Obs*R-squared	11.01317	Prob. Chi-Square	0.0880
Jarque – Bera Test of Normality			
Jarque – Bera	0.185877	Probability	0.911249

Source: Computed by the author using E – views.

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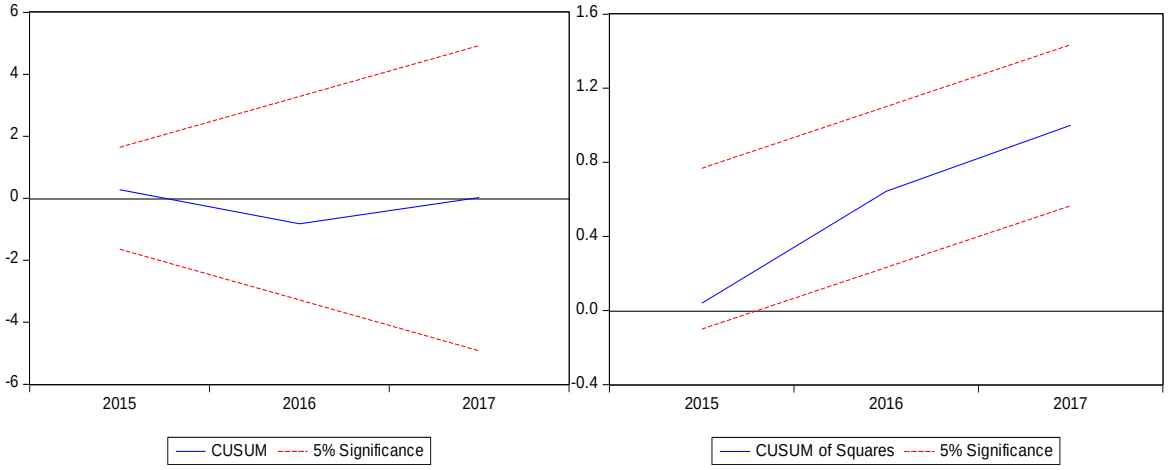
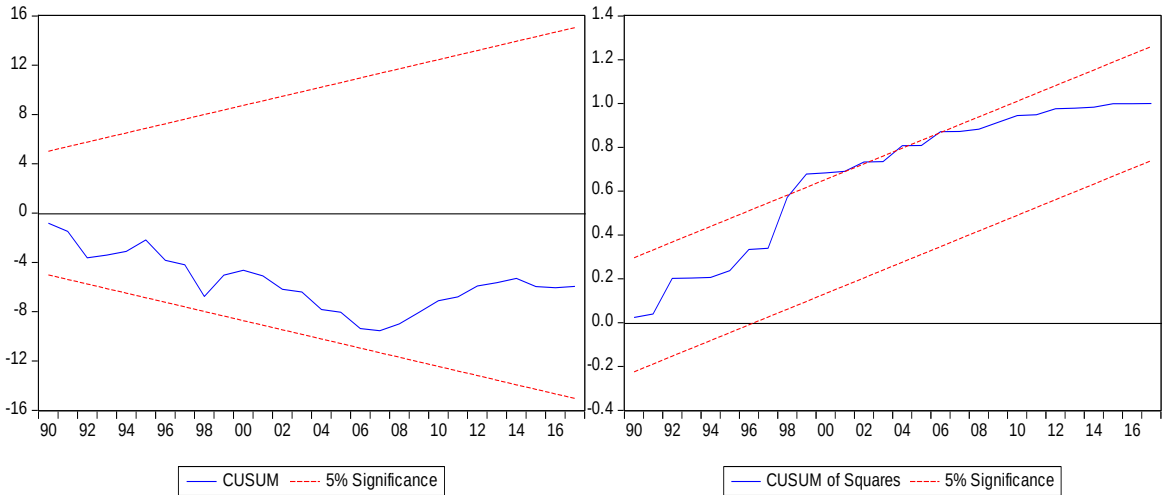
Tests critical values are computed at a 5% level of significance.

Figure 4.2.4: Result of CUSUM and CUSUM of squares Test of Stability for Models 1 and 2

Model 1



Model 2



The outcome of the diagnostic tests of model adequacy is satisfactory as the assumptions of normality, homoscedasticity and no autocorrelation are not violated. This is evidenced by the probability value of all test statistics which is greater than 0.05. The cusum and cusum of squares test of stability results show that estimated parameter coefficients are stable at a 5% level of significance. Therefore, the models are well specified, and hence the results are plausible.

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CONCLUSION AND RECOMMENDATIONS

The study concludes based on the empirical findings that the real output gap, broad money supply, total government expenditure, Total import and unemployment rate are significant determinants of inflation in Nigeria. Agricultural and Manufacturing Industries GDP, Domestic price of premium motor spirit, nominal exchange rate and interest rate are not significant determinants of inflation in Nigeria. But from their positive impact on inflation, nominal exchange rate and Agricultural and Manufacturing Industries GDP and interest rate could generate inflation if not well controlled whereas Domestic price of premium motor spirit could be used to curb inflation if well targeted since it impacted negatively on inflation. The implicated variables of the two models indicate that both demand – pull and cost – push factors are responsible for inflation in Nigeria.

In the light of the empirical findings, the study recommends as follows:

(a) The government should prioritise the productive sectors of the economy like agricultural and manufacturing industries by investing more in them and also provide the social infrastructure that would encourage the private sector to invest so as to increase its output. This should be complemented by the establishment of import substitution industries which will help to provide jobs for the teeming unemployed, bridge the output gap and reduce food imports;

(b) The monetary authority should set the interest rates at a level that would ensure sufficient supply of money for investment and productive activities but not large enough to generate inflation. This can be achieved using selective credit control to provide short, medium and long-term loans to small and medium-scale industries and businesses at lower rates of interest as they are an integral part of the growth and transformation process of an agro and oil-based economy like that of Nigeria;

(c) The government should revitalise local refineries and operate at full capacity so as to produce petroleum products in sufficient quantities and at a lower cost. Consequently, the government should reduce the pump price of all petroleum products including premium motor spirit which is the engine of economic activities in Nigeria.

(d) The exchange rate system should be maintained at a level that will neither generate inflation nor impose a threat on the Nigerian economy.

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