Analysis of Inflation Dynamics in Nigeria (1981 – 2015)

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This study examined the dynamics of inflationary process in Nigeria over the period 1981 – 2015, using the bounds testing approach to cointegration. Empirical results indicated that inflation in Nigeria proxied by CPI exhibited a strong degree of inertia. The econometric results showed that past inflation and average rainfall appeared to have been the main determinants of inflationary process in Nigeria over the study period. We also found strong evidence of the importance of money supply in the inflation process, lending credence to the dominance of the monetarist proposition on inflation dynamics in Nigeria. Thus, the paper recommended among others, the continuous moderation of growth in money supply by the central bank and adopting consumers' expectations of inflation as an input into the monetary policy process.

Key words: Inflation, Money Supply, Rainfall, Cointegration.

JEL Classification: C22, E31, E51

1.0 Introduction

Inflation means continuous rise in general price level of goods and services in an economy; and is of primary concern to all stakeholders. Inflation even in the absence of economic shocks, displays the tendency of reproducing itself from one period to the next (see Novaes 1993, Durevall 1999, and Campêlo and Cribari-Neto 2003). In other words, inertial inflation is when prices keep rising because of past inflation, despite the lack of structural reasons for that to happen.

Thus, the importance of inflation is premised on the distortions that high inflation can exert on domestic macroeconomic conditions, with the potential to derail the economy from the path of sustainable economic growth and development. Inflation adversely affects the overall growth, financial sector development and the vulnerable poor segment of the population. It also induces uncertainty, discourages savings, promote consumption, poses serious threat to macroeconomic stability and result in high social costs (see

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Chaudhary and Ahmad 1996, Qayyum 2006, Greenidge and Dacosta 2009, Ratnasiri 2009, Aurangzeb and Haq 2012, Bawa and Abdullahi 2012).

Considering such adverse impacts of inflation on the economy, there is a consensus among the world's central banks that price stability should be the prime objective of monetary policy. Consequently, the maintenance of price stability continues to be the overriding objective of monetary policy in Nigeria. The emphasis given to price stability in the conduct of monetary policy is with a view to promoting sustainable economic growth and development as well as strengthening the purchasing power of the domestic currency, amongst others. Thus, a good understanding of the factors driving inflation is required.

Friedman (1963) argued that "inflation is always and everywhere a monetary phenomenon in the sense that it is and can be produced only by a more rapid increase in the quantity of money than in output". Furthermore, several empirical studies has supported the monetarist proposition that money is indeed a significant variable in determining the behavior of consumer prices and a critical channel of monetary policy transmission in both advanced and developing economies (see Moser, 1995; Fakiyesi, 1996; Kuijs, 1998; Qayyum, 2006; Wolde-Rufael, 2008; Ratnasiri, 2009; Bashir et al, 2011 and Kabundi, 2012). The monetarist view, however, has not always been widespread (see Butt and Jamal, 1988 and Chaudhary and Ahmad, 1996), as the literature is replete with many other factors that could affect the level of inflation. Mordi et al (2007) grouped these factors into fiscal (financing of budget deficits), balance of payments or supply side factors (exchange rate movements) and institutional factors (the level of independence of the monetary authority). Others were structural factors, agro climatic conditions and inflation inertia.

Nigeria has witnessed high and volatile inflation rates since 1970s. Masha (2000) indicated that the high inflation episodes in the country since the 1970s were largely driven by the growth of money supply and some factors reflecting the structural characteristics of the economy. These factors included climatic conditions, wage increases, the structure of production, currency devaluation and changes in terms of trade. Adenekan and Nwanna (2004) indicated that by 1988 and 1989, inflation had skyrocketed to more than 50 per cent in Nigeria. Furthermore, Bawa and Abdullahi (2012) stated that in spite of the fact that inflation declined to about 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 according to Mordi *et al* (2007) 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.

Extensive research to address inflationary problems in Nigeria by investigating its main determinants were conducted, with varying results largely pointing to the above factors, depending on the methodology applied and objectives set to achieve, among others. Thus, it is commonplace that the determinants of inflationary pressures in Nigeria are multi-dimensional. There was, however, still no consensus regarding its ultimate source, be it monetary or structural factors. In addition, some authors have estimated the size of inflation inertia in order to give a better guide, on how much, past inflation impacts on determining its current level. In Nigeria, Adenekan and Nwanna (2004), Odusanya and Atanda (2010) and Imimole and Enoma (2011) estimated 0.64, 0.39 and 0.69 degrees of inflation inertia, respectively. Thus, this study added to the literature by varying on the period covered, methodology adopted, variables used, and frequency of data among other factors to examine inflation dynamics in Nigeria. This helps to validate past findings or bring forth new issues on the subject for further research. Thus, this paper re-examined the determinants of inflation in Nigeria, utilizing the bounds testing approach to cointegration.

The rest of the paper is organized as follows. Section two reviews related literature and section three describes the research methodology comprising the New Keynesian Phillips Curve (NKPC) framework, the inflation model and data used. The econometric results are discussed in section four; and section five concludes the paper.

2.0 Literature Review

Numerous empirical studies have been conducted on the determinants of inflation and inflationary process in many countries, both developed and developing, including Nigeria. This section reviewed some of these studies for proper identification of techniques to adopt and explanatory variables to include in the model for the inflationary process in Nigeria.

Durevall (1998) investigated the inflationary process in Brazil for the period 1968 to 1985. The author showed that the degree of inertia, as indicated by the

coefficient value of lagged inflation, was 0.41. Furthermore, he found that an increase in money growth or oil-price inflation, increases overall inflation. Also, inflation increases when the rate of devaluation of the exchange rate increases, while it decreases when output growth goes up. Metin-Őzcan *et al* (2004) examined inflation dynamics in Turkey between 1988 and 2000. Results from the univariate techniques indicated that CPI inflation and all their selected price inflations have strong inertia. They found significant positive correlations between the dynamics of housing rents and the CPI, and both the US Dollar and German Mark exchange rates and the CPI.

Using Libyan annual data for the period 1964 – 2010, Cevik and Teksoz (2013) adopted the cointegration and error correction models to investigate inflation dynamics. The study found inflation inertia to be a key determinant of consumer price inflation in Libya. The result also indicated that government spending, money supply growth, global inflation, exchange rate pass-through and imposition and subsequent removal of international sanctions played central roles in the Libyan inflation process. Kabundi (2012) employed single-equation error correction model based on the quantity theory of money to identify the main factors underlying inflation in Uganda. The study showed that both external and domestic factors affects inflation in Uganda, amongst which are money growth, world food prices, domestic supply and demand effects in the agricultural sector, energy prices and inflation inertia.

Butt and Jamal (1988) explored the factors affecting inflation in Pakistan by applying the "monetarist approach". The study indicated, in contrast to Friedman (1963), that monetary growth variables have failed to provide adequate explanation of the inflation process in Pakistan, hence, monetary policy may not be a very effective tool for restoring price stability in the country. They showed that changes in expected cost of holding money balances play significant role in the inflationary process in Pakistan. They however added that import prices seem not to be a large factor in the inflation process, as inflation in Pakistan mainly originates domestically. On the other hand, Chaudhary and Ahmad (1996) tested monetary and structural variables to identify the major determinants of inflation in Pakistan. Unlike Butt and Jamal, they found that only constant growth in money supply does significantly affect inflation, but remarked that inflation is not purely a monetary phenomenon in Pakistan. Their result indicated that structural variables such as growth of the services sector, deficit financing of the budget

through public debt and import prices were significant determinants of inflation in Pakistan.

Coppin (1993) examined the determinants of inflation in a tourism-dependent economy of Barbados during the 1980s. The study indicated that the levels of real output (proxied by real tourism activity), imported inflation and interest rates were the significant determinants of inflation during the period. He argued that domestic prices may have also been impacted by institutional processes associated with the government's annual budget. Using Turkish data, Lim and Papi (1997) found that monetary variables (initially money, more recently the exchange rate) play significant role in the inflationary process. They added that public sector deficits and inertial factors also contribute to the inflationary pressures. The study remarked that policy makers' commitment to active exchange rate depreciation on several occasions in the past 15 years that preceded their study also contributed to the inflationary process.

Laryea and Sumaila (2001) found that output and monetary factors were the main determinants of inflation in Tanzania in the short-run, while parallel exchange rate also played a key role, in addition to output and monetary factors, in the long-run. They remarked that inflation in Tanzania is engineered more by monetary factors than by real factors judging by the magnitudes of elasticities of price with respect to both money and output. They concluded that inflation is a 'monetary phenomenon' in the country. Similarly, Wolde-Rufael (2008) indicated that money supply and deficits financing seem to have a significant effect on the Ethiopian inflationary process. According to the authors, controlling the growth of money supply and narrowing the budget deficits can be essential policy tools for Ethiopia's long-term macroeconomic stability and growth. Adu and Marbuah (2011) applied the bounds testing approach to empirically analyzed factors that account for inflation dynamics in Ghana. The study identified a combination of structural and monetary factors including real output, nominal exchange rate, broad money supply, nominal interest rate and fiscal deficit, as determinants of inflation. They however, stated that output growth has the strongest impact on inflation.

Oyejide (1972) explored the impact of deficit financing on inflation and capital formation in Nigeria by relating the domestic money supply to inflation using Fisher's equation. The study found a direct correlation between the general price level and measures of deficit financing over the study period

(1957 – 1970); and concluded that less emphasis on deficit financing may limit the growth of price inflation in the country. In Akinnifesi (1984), factors such as changes in money supply, lagged changes in money supply, credit to government by the banking system, government deficit expenditure, industrial production and food price indices were variables captured, while annual data for 1960 – 1983 were used in the empirical estimation. The study showed that changes in the above factors jointly explained inflationary tendencies in Nigeria. The study, however, emphasized that increases in government expenditure financed by monetization of oil revenue and credit from the banking system were responsible for the expansion of money supply, which in turn, contributed significantly to inflationary tendencies.

Asogu (1991) focused on the econometric investigation of the nature and causes of inflation in Nigeria. The study found that increase in real GDP or supply situation, especially food, and low cost of production of consumables tended to ameliorate inflation. He added that increase in government expenditures – deficits financing, tend to increase the money supply and worsen the depreciation of the exchange rate, which in turns intensify the inflationary pressure. The author noted that the monetary model does not adequately explain the inflation process in Nigeria. Moser (1995) developed an error correction model of the inflation process in Nigeria based on money market equilibrium condition to analyze the dominant factors influencing inflation in Nigeria using annual data spanning from 1960 to 1993. The author found that monetary expansion, driven mainly by expansionary fiscal policies, explains to a large degree the inflationary process in Nigeria. Other factors were devaluation of the Naira and agro-climatic conditions.

Fakiyesi (1996) identified the major determinants of inflation in Nigeria using data from 1960 to 1994. The author found that monetary expansion, exchange rate, growth in real income and the level of rainfall were significant in explaining the movement of inflation in Nigeria; while Onwioduokit (1999) showed that fiscal deficit causes inflation in Nigeria, and that it takes at least two years to impact on inflation. In another development, Masha (2000) indicated that inflation in Nigeria is driven from both the demand and the supply side. The demand side pressures arise from changes in monetary aggregates, while the supply side pressures arise from the salient characteristics of the economy including climatic conditions, the structure of production, currency devaluations, wage increases and changes in terms of trade.

Olubusoye and Oyaromade (2008) analyzed the main sources of fluctuations in inflation in Nigeria utilizing the error correction mechanism and annual data from 1970 to 2003. They indicated that lagged CPI, expected inflation, petroleum prices and real exchange rate significantly propagate the dynamics of inflationary process in the country. They added that efforts of the monetary authorities to achieve price stability would continuously be disrupted by volatility in the international price of crude oil. Variables included in their analysis were expected inflation, fiscal deficit/GDP, GDP, interest rates, money supply, oil prices, average rainfall and real exchange rate.

Using Nigerian data, Odusanya and Atanda (2010) analyzed the dynamic and simultaneous inter-relationship between inflation and its determinants for the period 1970 and 2007. They adopted cointegration and error correction modeling to analyze the role of variables like GDP growth, broad money growth, fiscal deficit/GDP ratio, interest rate, import/GDP ratio, exchange rate and inflation inertia; in inflationary process in Nigeria. The data indicated that only GDP growth and inflation inertia were significant in explaining the inflationary process in Nigeria. The paper estimated 0.39 as the degree of inflation inertia. Furthermore, Adenekan and Nwanna (2004) investigated the dynamic interrelationships among prices, money and exchange rates, as well as the role of each variable in the determination of inflation in Nigeria. They adopted cointegration and error correction techniques and annual time series data for the period 1959 to 2002. The study supported the monetarist arguments as the fundamentals to the explanation of inflation in the country, and that activities in the monetary sector ultimately transmit to the exchange rate regime through the inflationary consequences of monetary expansion. Inflation inertia, at 0.64, was the most important determinant of inflation in Nigeria.

Mordi et al (2007) showed that monetary expansion resulting either from an increase in domestic credit or government fiscal operations, mainly determines inflation in Nigeria. They added that inflation was also being affected by exchange rate depreciation and increases in food output. They found inflation inertia to be prevalent and persistent. Imimole and Enoma (2011) examine the impact of exchange rate depreciation on inflation in Nigeria. Their study utilized Autoregressive Distributed Lag (ARDL) bounds test cointegration procedure and annual time series data for the period 1986 to 2008. Their result revealed that inflation inertia was 0.69; while exchange rate depreciation, money supply and real GDP were identified as the main determinants of inflation in Nigeria.

Olatunji et al (2010) also look at the factors affecting inflation in Nigeria using cointegration and error correction modeling. The authors indicated that exports, imports, consumer price index for food, interest rate and exchange rate were important in explaining the inflationary process in Nigeria. Bayo (2011) investigated the determinants of inflation in Nigeria between 1981 and 2003 using the ordinary least square estimation procedure. The study indicated that fiscal deficits, money supply, interest and exchange rates significantly impacted on the rate of inflation in Nigeria. Omotosho and Doguwa (2012) indicated that periods of high inflation volatility were associated with periods of specific government policy changes, shocks to food prices and lack of coordination between monetary and fiscal policies. They added that the announcement of fuel price hikes, announcement of an upward review in the wages of public sector workers, food crises and exchange rate instability also led to major positive inflationary shocks in the economy.

From extant literature, it has become clear that empirical studies on inflationary process have confirmed that past inflation (inertia) impacts it current level. The magnitude has not been widely studied using Nigeria data. However, several studies have emphasized the role of monetary variables and structural factors in the determination of inflation.

3.0 Analytical Framework and Econometric Methodology

3.1 Analytical Framework

The NKPC methodology has been widely used in the empirical literature to depict relationship between inflation, inflation expectations and the real marginal cost of production. It indicates that the rate of inflation will increase when real marginal costs increase and there are expectations for higher prices by economic agents in the future. Calvo (1983) described the basic NKPC in the standard form as:

$$\pi_t = \beta E_t \pi_{t+1} + \lambda mc_t \quad (1)$$

where π_t is the inflation rate, $E_t \pi_{t+1}$ is the expected inflation at time t+1 and mc_t is the average real marginal cost (in per cent deviation from its steady state level). The slope coefficient λ depends on the primitive parameters of the model. It is represented as:

$$\lambda = \frac{(1-\theta)(1-\beta\theta)}{\theta} \quad (2)$$

where $1-\theta$ is the frequency of price adjustment and β is the subjective discount factor. Inflation rate was defined as:

$$\pi_t = P_t - P_{t-1} \quad (3)$$

Which is an approximation to the percentage change of the price level from time t – 1 to t. Consequently, substituting equations (2) and (3) into equation (1) yields the consumer price inflation function within the NKPC framework:

$$P_t - P_{t-1} = \pi_t = \beta E_t \pi_{t+1} + \frac{(1-\theta)(1-\beta\theta)}{\theta} mc_t \quad (4)$$

Rotemberg and Woodford (1997) and Balakrishnan and Lopez-Salido (2002) indicated that under certain restrictions on technology in a steady state, real marginal costs are proportionately related to the output gaps. With this, and following Cevik and Teksoz (2013), we use the output gap as a proxy for the real marginal cost, leading to the standard new NKPC formulation:

$$\pi_t = \beta E_t \pi_{t+1} + \kappa(y_t - y_t^*) \quad (5)$$

where $y_t$is the actual output while y_t^* is the potential output.

3.2 The Model

In line with the work of Cevik and Teksoz (2013), we used the past values of inflation and monetary aggregates as a proxy for inflation expectations, as agents tend to formulate inflation expectations in a backward-looking manner. The hybrid model of consumer price inflation can now be formulated as follows:

$$\pi_t = \alpha\pi_{t-1} + \beta m_{t-1} + \gamma(y_t - y_t^*) + e_t \quad (6)$$

where $\pi_{t-1}$is the lagged inflation, $m_{t-1}$is the lagged money supply growth, and $(y_t - y_t^*)$ is the output gap, measured as the deviation of output from its potential level. Given the important role of crude oil in the country's economy and the role of rainfall in influencing food prices (which constitute a significant percentage of the CPI inflation in Nigeria), crude oil prices and average rainfall were included in our model in line with previous empirical studies (see Olubusoye and Oyaromade, 2008; Lim and Papi, 1997; Bayo, 2011; Cevik and Teksoz, 2013; Fakiyesi, 1996 and Masha, 2000) as follows:

$$\pi_t = \alpha\pi_{t-1} + \beta m_{t-1} + \gamma(y_t - y_t^*) + \varphi rain + \xi oilp + u_t \quad (7)$$

where $rain$ is the average rainfall and $oilp$ is the average world crude oil prices. Lagged inflation, money supply growth and world crude oil prices were, *a priori*, expected to have positive coefficients while output gap and average rainfall were expected to be negative.

3.3 Estimation Procedure

We adopt the Autoregressive Distributed Lag (ARDL) approach (i.e. the bounds testing approach to cointegration) popularized by Pesaran *et al*. (2001) to examine the dynamics of inflation in Nigeria. This approach has some econometric advantages over the Engle-Granger (1987) and maximum likelihood based approach proposed by Johansen and Juselius (1990) and Johansen (1991) cointegration techniques. Firstly, the bounds test does not require pre-testing of the series to determine their order of integration since the test can be conducted regardless of whether the series are purely I(1), purely I(0), or mutually integrated. Second, the ARDL framework is relatively more efficient in the case of small and finite samples. Third, we obtain unbiased estimates of the long run model by applying the ARDL methodology (Harris and Sollis, 2003).

We adopted the unrestricted autoregressive distributed lag model developed by Pesaran *et al* (2001) to estimate equation 7 so as to test for the existence of long-run relationship among the variables. The ARDL model takes the following form

$$\begin{aligned}\pi_t = {} & c_0 + \sum_{i=1}^{p} \alpha_i \Delta\pi_{t-i} + \sum_{i=0}^{p} \beta_i \Delta lm_{t-i} + \sum_{i=0}^{p} \gamma_i \Delta(y_t - y_t^*)_{t-i} \\ & + \sum_{i=0}^{p} \varphi_i \Delta lrain_{t-i} + \sum_{i=0}^{p} \xi_i \Delta loilp_{t-i} + \delta_1 \pi_{t-1} + \delta_2 lm_{t-1} \\ & + \delta_3 (y_t - y_t^*)_{t-1} + \delta_4 lrain_{t-1} + \delta_5 loilp_{t-1} \\ & + \mu_t \end{aligned} \quad (8)$$

Where Δ is a difference operator, L is logarithm, t is time, c_0 is an intercept term, $\alpha, \beta, \gamma, \varphi \; and \; \xi$ and δ_1 to δ_5 are the coefficients of their respective variables and p_s are the lag lengths. Other variables are as defined earlier. To examine the existence of long-run relationship following Pesaran et al (2001),

the study first test, based on Wald test (F-statistics), for the joint significance of the coefficients of the lagged levels of the variables, i.e.

$$H_o: \delta_1 = \delta_2 = \delta_3 = \delta_4 = \delta_5 = 0$$
$$H_1: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq \delta_5 \neq 0$$

The asymptotic critical values bounds, which were tabulated in Pesaran et al (2001), provide a test for cointegration with the lower values assuming the regressors are I(0), and upper values assuming purely I(1) regressors. If the calculated F-statistics exceeds the upper critical value, the null hypothesis is rejected, implying that there is cointegration. However, if it is below the lower critical value, the null hypothesis cannot be rejected, indicating lack of cointegration. If the calculated F-statistics falls between the lower and upper critical values, the result is inconclusive.

Once cointegration is established, the conditional ARDL long-run model can be estimated as:

$$\pi_t = c_0 + \sum_{i=1}^{p} \alpha_i \pi_{t-i} + \sum_{i=0}^{p} \beta_i lm_{t-i} + \sum_{i=0}^{p} \gamma_i (y_t - y_t^*)_{t-i} + \sum_{i=0}^{p} \varphi_i lrain_{t-i} + \sum_{i=0}^{p} \xi_i loilp_{t-i} + \mu_t \quad (9)$$

In the next step, we obtain the short-run dynamic parameters by estimating an error correction model associated with the long-run estimates. This is specified as follows:

$$\pi_t = c_0 + \sum_{i=1}^{p} \alpha_i \Delta\pi_{t-i} + \sum_{i=0}^{p} \beta_i \Delta lm_{t-i} + \sum_{i=0}^{p} \gamma_i \Delta(y_t - y_t^*)_{t-i} + \sum_{i=0}^{p} \varphi_i \Delta lrain_{t-i} + \sum_{i=0}^{p} \xi_i \Delta loilp_{t-i} + \vartheta ecm_{t-i} + \mu_t \quad (10)$$

where ecm is the error correction representation of equation (8) and ϑ is the speed of adjustment.

3.4 Data

Quarterly data covering the period 1981:Q1 to 2015:Q4 were used for the study. The dataset, which included the Consumer Price Index – CPI (November 2009 = 100), broad money supply, real GDP (1990 constant basic prices) and average rainfall, were compiled from the Statistics database and Statistical Bulletin of the Central Bank of Nigeria. We obtained the average international crude oil prices from the World Bank commodity prices database (the pink sheet). We estimate the output gap by applying the Hodrick-Prescott (HP) filter to decompose real GDP into trend and cyclical components as in Cevik and Teksoz (2013). We use a smoothing parameter value of 1,600 for quarterly data as indicated by Hodrick and Prescott (1997).

4.0 Empirical Results

4.1 Unit Root Tests

Even though the ARDL framework does not require pre-testing the variables for stationarity, the tests could justify the use of the ARDL bounds testing approach to cointegration or otherwise. Consequently, we used the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to ascertain the time series properties of the variables. Results from the ADF unit root tests presented in table 1 indicated that the null hypothesis of a unit root cannot be rejected for all the variables except the output gap and average rainfall, where the hypothesis was rejected at the 1 per cent level. The ADF tests on the first difference of the variables resulted in a strong rejection of the null hypothesis of a unit root for all the variables at the 5 per cent level. The Phillips-Perron test also report three of the variables as I(1) series and the two others as I(0). Thus, while output gap and average rainfall were I(0) series, three other variables were I(1) series, lending support to the use of bound testing approach to cointegration.

Table 1: Unit Root Test Results

	Level		First Difference	
Variable	ADF	PP	ADF	PP
LCPI (π)	-1.7791	-1.7873	-2.9440**	-8.4394*
Money Supply (LM)	-0.4120	-0.4083	-12.5522*	-12.5530*
Output Gap (Y_t - Y_t*)	-4.5412*	-13.3949*	-7.8572*	-23.8989*
Oil Prices (LOILP)	-1.1566	-1.3786	-9.6165*	-9.2754*
Average Rainfall (LRAIN)	-4.1426*	-20.0332*	-9.5757*	-37.7904*

* and ** indicate significance at 1 and 5 per cent levels.

The MacKinnon critical values were -3.48, -2.88 and -2.58 at 1, 5 and 10 per cent levels for both ADF and PP Tests

4.2 Bounds Test for Cointegration

We examined the long run relationship amongst the variables in the model by conducting the ARDL bounds test proposed by Pesaran et al. (2001). The critical values for the bounds test are documented in Pesaran et al. (2001) and are based on assumptions regarding whether the variables in the model are I(0) or I(1). The results of the ARDL bounds test are presented in Table 2. The results indicated no cointegration, as it was inconclusive at the 5 per cent level, with the calculated F-statistics falling between the lower and upper critical values. Consequently, output gap (QGAP) was dropped from the model, and results from the new model showed that the null hypothesis of no cointegration amongst the included variables is rejected at the 5 per cent level. The F-statistic was 4.09, which was higher than the upper bound of the critical values at the 5 per cent level (4.01) and implies the presence of a long run relationship amongst the variables. A maximum lag of 4 was chosen in the ARDL cointegration test since the study utilized quarterly series. The optimal lag length was chosen in line with Schwarz Bayesian Criterion (SBC) and the selected ARDL representation for the model was ARDL (2, 2, 0, 1).

Table 2: ARDL Bounds Test for Cointegration

Variable	F-statistic	Lags	Critical Values - Restricted Intercept and no trend			Decision
			Significance Level	I(0)	I(1)	
LCPI, LM, QGAP, LOILP, LRAIN & INTERCEPT	**3.27**	4	1%	3.41	4.68	No Cointegration
			5%	2.62	3.79	
			10%	2.26	3.35	
LCPI, LM, LOILP, LRAIN & INTERCEPT	**4.09**	4	1%	3.74	5.06	Cointegration
			5%	2.86	4.01	
			10%	2.45	3.52	

Critical values were obtained from Pesaran et al. (2001). Table CI(iii), Case III

4.3 Regression Results

The results for both the long run and short run are presented in table 3. Results from the long run model showed that only one of the coefficients yielded the anticipated sign. In addition, two variables were statistically significant at 1 per cent levels, while average rainfall was not significant. The short run model revealed that inflation inertia and money supply were significant in determining inflation and in conformity with the a*priori* expectation. The adjusted coefficient of determination (adj. R^2) of the model showed that these variables jointly accounted for about 32.6 per cent of the movements in inflation. Both models were robust to the inclusion of constants, which were significant at the 5 per cent levels.

Money supply growth has been an important contributor to the rise in inflation in Nigeria. It was associated with an increase in consumer prices, with the estimated coefficients remaining statistically significant at the 1 per cent levels in both the long and short run. In addition, its one period lag was also found to be positive and significant at the 5 per cent level in the short run. This indicated that inflation in Nigeria is a monetary phenomenon consistent with the traditional quantity theory of money, and can be moderated through the adoption of sufficiently tight monetary policy actions overtime.

Meanwhile, lagged inflation appeared to be a major determinant of current inflation in Nigeria, as inflation inertia, measured by the estimated coefficient of lagged inflation, was found to be statistically significant with a relatively large positive impact on current inflation. The significance of lagged inflation indicated that the Nigeria inflationary process has been influenced by its past behaviour in line with adaptive expectations hypothesis. Lagged inflation explains stickiness in prices, with periods of high inflation tending to persist and conversely periods of low inflation will also persist.

Given the important role of food commodities in Nigeria CPI inflation, agro climatic conditions – rainfall – may impact its inflation process overtime. Even though average rainfall was insignificant in the long run, which was in line with Moser (1995), results from the ARDL estimates[2] indicated that its one period lag value was negative and significant at the 5 per cent level. This indicated that good weather conditions reflected in higher rainfall in the previous period may have led to good harvest and lower food prices in the current period.

Table 3: Regression Results

Estimated Long-run Coefficients - Dependent Variable: LCPI			
Variable	Coefficient	T-statistics	P-value
C	-6.1399	-7.8774	0.000
LM	0.9176	15.1819	0.000
LOILP	-0.9339	-4.1467	0.000
LRAIN	0.0499	0.6215	0.535
Error Correction Representation of the Selected ARDL Model - Dependent Variable: DLCPI			
Variable	Coefficient	T-statistics	P-value
C	-0.2762	-2.3264	0.022
DLCPI(-1)	0.3290	4.0550	0.000
DLM	0.2053	3.0691	0.003
DLM(-1)	0.1410	2.1703	0.032
DLOILP	-0.0420	-2.9211	0.004
DLRAIN	0.0076	3.2976	0.001
ECM_{t-1}	-0.0450	-2.9230	0.004
R-Squared			0.3662
R-Bar-Squared			0.3263
DW Statistics			2.0709
F-Statistics			12.2298 (0.000)
Serial Correlation LM Test (12 lags)			1.8022 (0.057)
Auto Regressive Conditional Heteroscedasticity (ARCH) test of the residuals			1.8037 (0.055)

[2] The microfit results of the ARDL estimates was not included here but is available on request

Oil price carried the wrong sign in both the long run and short run models, and coefficients were significant at the 1 per cent levels. This may have reflected the sustained growth in real GDP over the 2005 – 2015 period, resulting from high crude oil prices in the international commodity markets, which served to moderate inflation growth during the period.

The coefficient of the ECM was negative and statistically significant at the 1 per cent level, further providing additional evidence to the cointegrating relationships among the model variables. The ECM indicated that about 4.5 per cent of the deviations from an equilibrium path arising from the model is restored within a period of one quarter. To examine the errors for white noise, residual serial correlation LM and ARCH tests were conducted. Results from the two tests indicated no serial correlation and the ARCH tests showed that the residuals were homoskedastic-consistent at the 5 per cent level. The CUSUM and the CUSUMSQ tests were used to determine if the ARDL model was stable. A model is stable if its recursive residual is located within the two critical bounds. Our CUSUM test indicated that the model was stable, while CUSUMSQ test showed relative instability in some periods.

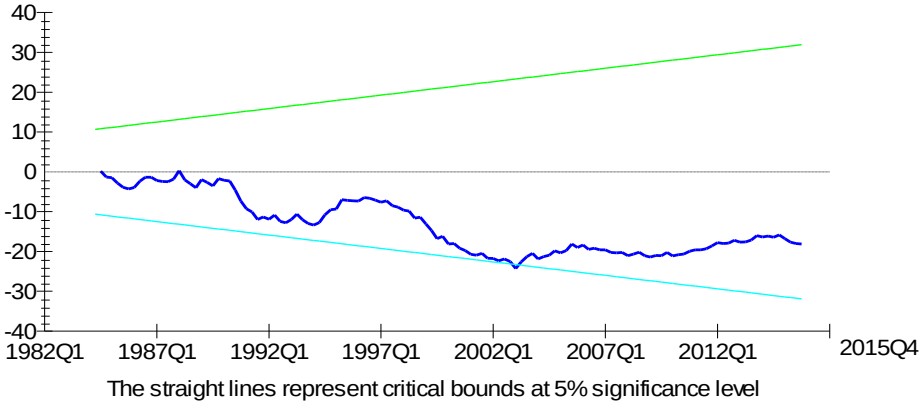

Figure 1: Plot of Cumulative Sum of Recursive Residuals

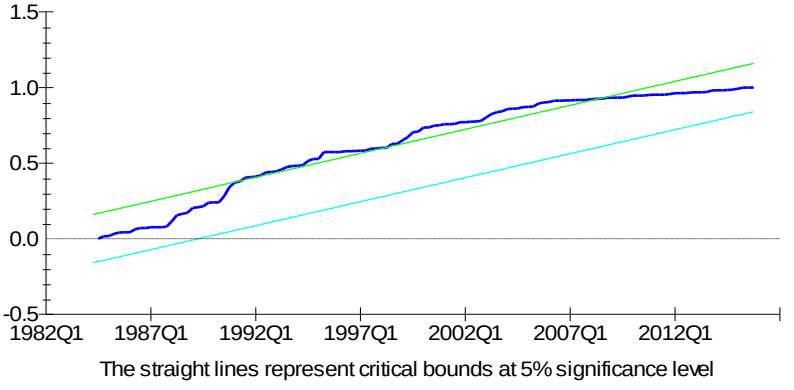

Figure 2: Plot of Cumulative Sum of Squares of Recursive Residuals

5.0 Conclusion

High inflation induces uncertainty, adversely affects financial sector development and the vulnerable poor segment of the population; and consequently, poses serious threats to macroeconomic stability resulting to high social costs. This study examines the dynamics of inflationary process in Nigeria using the ARDL bounds testing approach to cointegration. The empirical model related the behaviour of consumer prices to past inflation, money supply, average rainfall and international crude oil prices. The results showed that past inflation and average rainfall appeared to have been the main determinants of the inflationary process in Nigeria. The study also found strong evidence of the importance of money supply in the inflation process in Nigeria, lending evidence to the dominance of the monetarist proposition on inflation dynamics.

Therefore, we recommend that the monetary authority should continuously moderate the growth in money supply given its potential of exerting excessive pressure on consumer prices in Nigeria. Appropriate steps should also be taken by the central bank to obtain and analyze consumers' expectations and be built-in into the monetary policy process. Results from consumer expectations (CES) and inflation attitudes (IAS) surveys being conducted by the Bank may assist in enlightening the MPC prior to taking monetary policy decisions. Similarly, the government should pursue policies and programmes aimed at ensuring stability in the prices of agricultural products. It could do this by purchasing products from the farmers during market glut and dispose those products in periods of high prices.

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