Determinants of inflation in Nigeria (1970 – 2010)

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Keywords

Abstract

Price instability (inflation and deflation) has been found to affect economic growth, standard of living likewise the value of the currency, which in turn influences the nation's exchange rate. The major issue of discourse therefore in developing countries such as Nigeria centers on discovering its (price stability) trend and determining factors. A travel around theories on inflation such as the monetary theory by Milton Friedman, rational Expectation Theory by (Sergeant and Wallace), structuralist model of imported inflation by Frisch exposes us to some key determinants of price stability (proxied by inflation), which include: money supply, interest rate, income level, aggregate output, exchange rate etc. these numerous theories of inflation therefore necessitated the need to use an hybrid model of inflation.

In a bid to empirically justify these determinants in the case of Nigeria, this study employs time series econometric technique, using Augmented Dickey Fuller (ADF) and Philips Perron (PP) tests (test for ascertaining the presence of unit root and stationarity of the series) and cointegration tests, which is used to explore the presence of long-run relationship amongst the series. An Error Correction Model is also used to capture the convergence of the inflation determining factors to achieving long run equilibrium. It uses yearly data between 1970 and 2010, and found that expected inflation, measured by the lagged term of inflation, money supply, significantly determine inflation, while trade openness, capturing the tendencies of imported inflation, income level, exchange rate and interest rate are found not to be significant with all showing signs that conform with a priori in the short run. In the long run likewise, none of the variables is found to be significant, which explains that price of goods and services responds instantaneously to policy changes.

The study recommends that government provide an enabling environment to industries, so as to gear up output, which will in turn help reduce home-made inflation. The study also recommends a continuous contractionary monetary policy to reduce inflation in Nigeria.

Introduction

A continuous and persistent increase in the general level of prices (inflation) has in several times been characterized by an upsetting impact on economic well-being, since it causes the cost of living to rise and the value of investments to fall (Greenidge and Dacosta, 2009). An implication of the above statement therefore is the fact that to keep the cost of living to the barest minimum, inflation (price instability) must be well managed by the monetary authority of any country. Historically, the origin of the current inflation dates back to the 1970s, when the revenue accruing to the government from the non-renewable oil resource rose precipitously. This unprecedented and unexpected increase in public expenditure caused by oil revenues thereafter brought about a vast expansion in aggregate demand (Aiyede, 2002). The increasing inflationary pressure then was also brought about by increased money supply, which is as a result of the monetization of the earnings from oil likewise the Udoji award, which exerted upward pressure on the general price level in the country.

The price of crude oil slumped in the world market during the first half of 1980s. Thus Nigeria's crude oil, which sold at slightly above U.S $41 a barrel in early 1981, fell precipitously to less than US $9 by August 1986. This triggered a series of developments in the economy. One example is the state's fiscal crisis, as reflected in the persistent and substantial budget deficit which cumulated to approximately N17.4 billion in the five years between 1980 and 1984. Monetary policy became highly expansionary as a large part of the deficits incurred during this period were financed through the creation of credit. Indeed, the total domestic credit to the economy recorded an average annual growth rate of 29.9% between 1980-84 and most of the increase was attributable to net claims by the government, simultaneously, two-digit

inflation at a mean yearly rate of 20.2% was registered and clearly evident, perhaps, in support of the monetarist proposition. But the inflation in 1984, which stood at about 22.6% is often explained in terms of acute shortages of exported goods and services imposed by inadequate foreign exchange earnings, a derivative of the steep fall in crude oil prices. This event led to the depreciation of the naira as at this period, which also enhanced the inflationary pressure in the country. Associated with this is the substantial budget deficit operated annually by the various tiers of Government in the last decade, part of which is financed through bank credit directly affecting the money base. This phenomenon also exerts upward pressure on the general price level. However, the rate has been relatively stable lately, patrolling around 10% to 15% between 2004 and 2010, which still tells of the critical task in the hands of the monetary authority. All of these above stated concerns suggest that there are many sources of the current inflation, and in order to control the growing tendencies of inflation in any economy, it is imperative to first understand its key and major determinants.

The main goal of this study is to empirically examine the main determinants of inflation in Nigeria within a dynamic framework. Specifically however, the paper seeks to explore the trend of inflation in Nigeria and also examine the extent to which inflation depends on exchange rate, money supply and economic growth in the Nigeria economy both in the short run and the long run.

## Literature Review

Introduction
Inflation is defined as a persistent and appreciable rise in the general level of prices (Jhingan, 2002). This therefore implies that not every rise in the price level is termed inflation as such a rise must be constant, enduring and sustained. The rise in the price should have effect on almost every commodity and should not be transient.

Essentially, inflation is measured using three approaches; (1) Gross National Product (GNP) implicit deflator; (2) the Consumer Price Index (CPI) and (3) the wholesome or producer price index (WPI or PPI). The period to period which could be year on year or month on month changes in the consumer price index (CPI) and Wholesome Price Index (WPI) are seen as direct measures of inflation. in practice, none of the measures is considered as aptly measuring inflation. as noted by Fatukasi (2006), the Consumer Price Index (CPI) approach, though it is the least efficient of the three is used to measure inflation rates in Nigeria as it is easily and currently available on monthly, quarterly and annual basis (CBN, 1991), this assertion is however corroborated on the fact that Demberg and McDougall in their discourse explicitly refer to inflation as a continuing rise in prices as measured by an index such as the Consumer Price Index (CPI) or by the implicit price deflator for Gross National Product (Jhingan 2002)

Inflationary Trend in Nigeria
As explored in figure 1 below, it is obvious that Nigeria as a nation has been battling with the challenge of price instability, an instance of the general price level; measured by inflation hovering around a single digit and double digit figure.

Figure 1: **Diagram showing inflationary trend in Nigeria (1970 to 2010)**
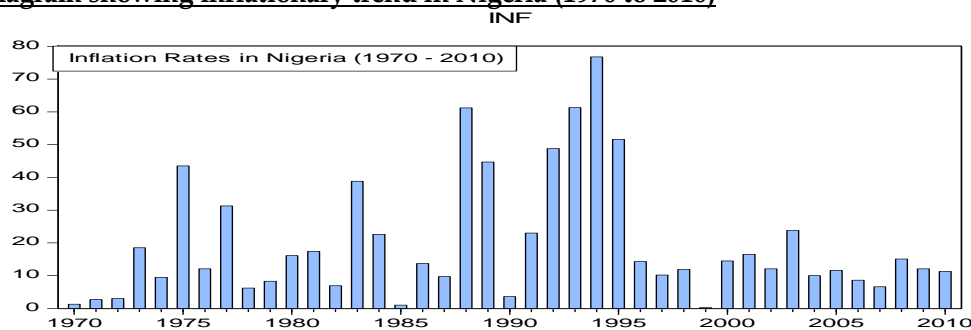
The figure above shows the unfriendly fluctuation of the inflation rates over time, with the all time highest inflation rate recorded in 1994 (76%), whose high rising started in 1991 (23%), which is typical of the military regime, known for excessive spending not matched with increased productivity. Unlike countries like Zimbabwe and Argentina that have been known to experience more than 3-digit inflation rate, the graph reveals that Nigeria has never experienced a 3-digit inflation but has predominantly been faced with a double-digit inflation for over 30 years out of the 41 years of study.

Furthermore, the graph reveals stability of price level around an unfriendly rate; 15% and 11% between 2008 and 2010.

Empirical Framework

Inflation rates in excess of 10 per cent have always been an issue of major concern, demanding serious policy actions, which are geared towards its stabilization (Dornbush, 1987). In line with the monetarists' belief, inflation is a consequence of too many money chasing few goods, which is often connected to money creation; one of the ways of financing budget deficit (a common practice since the 1920s) (Bakare, 2011).

An important conclusion from various econometric models employed by of Ajayi (1988) indicates that inflation in Nigeria is determined largely by developments in the external sector, but complemented by internal influences. Specifically, their finding demonstrates that the openness of the economy is highly correlated with inflation.

Imimole and Enoma (2011) posit that there is one and only one relationship between exchange rate and price inflation. Basing their argument on empirical studies of some African countries, they concluded that devaluation could exert upward pressure on the general price level through its increased cost of production in the short-run. Focusing on Uganda, Elbadawi's (1990) research revealed that rapid monetary expansion and the precipitous depreciation of the exchange rate were the principal determinants of inflation during 1988-1989. He concluded from the comprehensive review of exchange rate and price movements that devaluation of the official exchange rate is inflationary. Canetti and Greene (1991) employ analytical econometric technique to evaluate the relative contributions of exchange rate movements and monetary expansion to price inflation in the African countries during 1978-89 and the broad conclusion that emerged is that exchange rate movement and monetary growth explain the inflationary trend in the studied countries. In countries such as Sierra Leone, Tanzania and Zaire, the bi-variate and tri-variate Granger tests point out that the exchange rate has significant causal relationship with inflation. With respect to the role of money supply, the statistical test identified causation from money to prices in the Gambia, Sierra Leone and Uganda. As for Nigeria and Zambia, the various tests performed could not identify any significant causal relationship between money supply, exchange rate and inflation.

London (1989) had examined the role of money supply and exchange rate in the inflationary process in 23 African countries. The pure monetarist model was employed and the results revealed that in the period of 1974-1985, the growth of money supply, expected inflation and real income were significant determinants of inflation in the sample countries. The author however argued that because the results obtained only give account of the period averages of the countries studies, they should be seen as suggestive rather than definitive. The exchange rate was later introduced as one of the explanatory variables in the pure monetarist model. The results of this indicate that exchange rate movements had a significant impact on the inflationary process in the 1980s. Conversely, the growth of the money supply played a decreasing role in the course of inflation on the continent. This possibly suggests that structural elements have been the proximate cause of inflation in recent years.

In examining exchange rate depreciation and inflation in Nigeria, Egwakhide (1994) found that depreciation of the exchange rate exerts upward pressure on inflation – but it takes a minimum period of one year before this is reflected on price inflation. Acceptance of this result implies acceptance of the fact that the country's inflation is caused by both monetary and structural factors.

According to Ajakaiye and Ojowu (1994), the influence of exchange rate depreciation on the structure of sectional price is not invariant with respect to the prevailing pricing regime. The indication is that the pricing regime under which exchange rate depreciation causes the structure of sectoral prices to change the most may not necessarily be under which the inflationary pressure will be the greatest. In their study, whereas exchange rate depreciation will cause the greatest changes in the structure of sectoral prices under the mixed mark-up pricing regime, it will cause the greatest upward pressure on prices under the universal flexible mark-up pricing regime.

Pinto (1990) identified the determinants of parallel market premium as demand for domestic money, the rate of inflation another terms of trade and argued that inflation rises because the devaluation involved in unification of both the official and parallel exchange rates eliminates revenues from export earnings.

Fakiyesi (1996) analyzed the main factors which influence inflation in Nigeria with a view to determining the relevant policy instruments that could reduce it. The study found that monetary expansion has been the dominant factor influencing inflationary growth in Nigeria, alongside exchange rate.

Fullerton and Ikhide (1993) in their study of "inflation Dynamics in Nigeria" indicated that the considered devaluation of naira in the late 1980s and the 1990s in the midst of rising prices, might have considerably promoted inflation. It was, however shown that exchange rate coefficients are not statistically significant, hence the emphasis was on monetary factor alone.

Theoretical Framework

Several literatures have explored a number of theories on inflation; theories explaining the behavior of inflation and its determinants. Some of the major theories include the Quantity theory of money, Keynesian Demand Pull theory, the monetary theory put forward by Milton Friedman, also are the Cost push theory and the rational expectation theory by Lucas, McCallum, Sargeant and Hansen. All of these theories in their individual piece made attempt to uncover the peculiar nature of inflation, which has been seen to be a persistent general rise in the price of goods and services, based on the tenets of their schools of thought.

John Maynard Keynes (1883 – 1946) and his cohorts in their support for the demand pull inflation theory, opine that inflation is majorly caused by 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 rapid inflation is and to reduce inflationary tendencies in any economy, entails initiating policies that reduce those components of total demand.

The monetary theorists on the other hand, favoured money matters as key factor influencing the behavior of inflation in any economy. In Milton Friedman's submission, only money matters, and monetary policy is potential in ensuring economic stabilization as against the fiscal policy, which is vehemently supported by the Demand Pull theory. According to the monetarists, money is the dominant but not elusive determinant of inflation in an economy.

Against the backdrop of the argument on monetary matters in the country recently, this study is hinged on the theoretical submission of the monetary theory of inflation, which can be represented by the model below:

$P = f (y, ms , i)$

Where y represents changes in real income, ms means money supply and i refers to the cost of holding cash; interest rate (Greenidge and Dacosta, 2009).

Methodology

Empirical Model

With reference to the study of Greenidge and Dacosta, (1999), in which they explored the behavior of inflation against oil price inflation, world price inflation, real output gap, interest rate, rate of unemployment, excess money and exchange rate using the model below;

π = f(Oilπ, Pwπ, Ygap, r, U, EM, E).

The model for this study, which is a modification of the model above is specified below:

π = f(πt-1,Y, r,Ms, E Trop)

Where π = inflation; πt-1 = one year lag of inflation; Y = level of output; Ms = Money Supply; E = Exchange Rate and Trop = measuring trade openness.

The above deterministic model is however specified below to capture the stochastic error term *u*,

$$\pi t = \alpha + \alpha_1 \pi_{t-1} + \sum_{i=1}^{n} \beta_t x_t + u$$

Where π = *inflation*; $\sum_{i=1}^{n} \beta_t x_t$ represents all independent variables "n" (except the one year lag of inflation)

earlier pointed out and their coefficients and *u* represents the stochastic error term.

Method of Analysis and Sources of Data

Inflation is measured by the log of changes in the consumer price index as evident in the data generation process. Also, in line with the monetary theorists, change in real level of output is used instead of its levels. Broad money (M2) is used in indexing money supply as against narrow money, which does not capture all transactions carried out using money and its equivalence. The external or foreign factors are trade openness and the exchange rate. According to Oaikhena and Udegbunam (2012), Openness effectively captures the effect of the external sector on domestic price changes. It is however note worthy to emphasize that income, exchange rate are after having adjusted them against price level except interest rate, which tends to give negative signs. This is done in order to avoid multicollinearity problem in the model. Also, all the variables except the dependent variable are expressed in logarithmic form in order to normalize the series, which upon their graphical inspection indicates tendencies of abnormality and also in order to aid the discussion about the relationships in percentage. The interest rate is not logged since its data generation process takes a logarithmic form (converting CPI to inflation).

It is expected that more supply of money without a matching level of production will result into high inflationary tendencies, also a negative relationship between exchange rate and interest rate on one hand and inflation as reflected in the adopted model of the study Greenidge and Dacosta (2009). As pointed out by the expectation theory led economists, consumers' expectations have a tendency to increase inflation in an economy, which therefore implies that there is an expected positive relationship between the inflation and its lagged term. An increased level of output is expected to cause a decrease in inflation as aggregate supply is in such instance filling up the excess demand, which initially is the cause of the inflationary gap. The effect of the OPN variables on inflation is rather unclear due to the measurement of the variables. It could be positive when export rises further than import or negative in a reverse situation.

The Ordinary Least Square estimation technique within the Error Correction Model framework is employed in this study. The choice of the ECM is due to the fact that it accounts for the explanatory potent of the regressors in both the short run and long run as well as ascertaining the dynamics of attaining long run equilibrium, an issue, which is the key in most inflation theories.

In order to do justice to the above, unit root test; Augmented Dickey Fuller and Philips Perron was conducted on the series in order to detect the presence of unit root, the presence of which could make the regression result spurious (Granger and Newbold, 1974). The unit root test also helps ascertain the order of integration of the series, which is necessary to explore the long run relationship amongst the variables via the co-integration test.

Testing for cointegration can be performed in a single and multiple equation framework. However, given that the study is discussed in a single equation, we restrict the test to that of the single equation

model; Engle-Granger and Philip Ouliaris. Eagle and Granger's criteria for performing co-integration test is that if two time series variables, p_1 and q_t, are both non-stationary in levels but stationary in first-differences, then there could be a linear combination of p_t and q_t, which is stationary. The two time series variables that satisfy this requirement are deemed to be co-integrated. A necessary condition for co-integration is that they are integrated of the same order.

Empirical Result

Unit Root Tests

In order to ascertain whether the series are random walk, random walk with drift or random work with drift and deterministic trend, the series are plotted on a graph and it was observed that all the series except trade openness and interest rate are random walk with drift and deterministic trend, as they appear to be random walk with drift. This observation was carefully taken care of when testing for unit root. The result of the stationarity test using Augmented Dickey Fuller (ADF) and Philips Perron are presented in table 1(a) and table 1(b) below:

Table 1(a): Unit Root Test using ADF

Variable	ADF (level)	ADF (First Diff)	Order of integration
Trop	-1.7746	-4.7072***	1
Ms	-2.4951	-3.6457***	1
Y	-2.6395	-4.8562***	1
E	-2.2107	-3.6511**	1
R	-1.3035	-3.1989**	1
INF	-3.1529	-4.9073***	1

Source: Computed from E-views 7.1

Lag length = 2, except for Exchange rate, which is 1.
** and *** denotes significance at 5% and 10% level of significance.

Table 1(b): Unit Root Test using Phillips-Perron

Variable	PP (level)	PP (First Diff)	Order of integration
Trop	-2.5367	-10.8089***	1
Ms	-1.7381	-3.5791**	1
Y	-1.8966	-6.9165***	1
E	-2.1851	-5.0506***	1
R	-1.4554	-8.9144***	1
INF	-3.6520**		0

Source: Computed from E-views 7.1

Lag length = 2, except for Exchange rate, which is 1.
** and *** denotes significance at 5% and 0% level of significance.

The tables above show that all the variables are I(1) series, except for inflation, which is stationary at levels using the Philips-Perron test. This however is insignificant as all the series will then be treated as I(1) series.

Co-integration Test

Having discovered that the series are I(1), it therefore informs the need to difference them before OLS can be used. The implication of this however is that the model then becomes a short run model, since the lagged component of the series would have been included. However, long run economic relationship amongst the variables can still be uncovered via the co-integration test (Dimitrious, 2005). This co-integration test is based on the argument that "given that time series have unit roots, a long run relationship could possibly exist between such series. it therefore implies that the residual of such regression should be statitionary at levels using the ADF, since there is a unique stochastic trend amongst the variables.

Table 2 shows result of the co-integration test, using Engle-Granger and Philips-Ouliaris test.

Table 2:   Result of Engle-Granger and Philip-Ouliaris Cointegration Tests

Test type	Tau-stats	Prob	Z-stats	Prob
Engle-Granger	-6.5333	0.0136	-40.9324	0.0137
Philip-Ouliaris	-6.5291	0.0137	-41.3477	0.012

Source: Computed from E-views 7.1; the computation uses MacKinnon (1996) P-values.

Given the p-values in the table above, it is revealed that there is long run relationship between inflation and the explanatory variables, as the null hypothesis of no cointegration cannot be accepted at 5% level of significance.

Error Correction Model

The fact that there exists a co-integrating relationship amongst the variables does not mean regressing them gives us satisfactory parameter estimates. Therefore, differencing the series is the possible solution, since it was discovered that the series are all stationary at first difference, thus ensuring that our regression result is not spurious. The deficiency of this however, is that information about the long run behavior of the model is hidden, since differencing the series makes the model a short run model.

To therefore account for the long run properties of the model as it is the case in this study, the relationship between inflation and its determinants can be expressed with an Error Correction Model Specification;

$$\text{INF} = \alpha o + \alpha_1 \Delta INF_{t-1} + \sum_{i=1}^{n} \beta_i \Delta x_{t-1} - \pi e_{t-1} + u_t$$

With πe_{t-1} being the error term, and п, being the adjustment coefficient which tells us how much of the adjustment to equilibrium takes place each period. With the above specification, we are able to run regression with stationary variables and this allows us to use both long run information and short run equilibrium dynamics.

Table 3 shows the result of the parsimonious Error Correction Model. The final regression is gotten through an iterative process involving the deletion of lags which upon their introduction in the model reduces the adjusted R-squared, likewise lags with low t-statistics in line with the study of Ogun (2006).

Table 3: Result of the Estimated Parsimonious ECM of Inflation.

White heteroskedasticity-consistent standard errors & covariance				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
DINF(-1)	0.223506	0.079585	2.808384	0.0088
DINF(-2)	0.147526	0.101653	1.451280	0.1574
DLNEX	-7.516888	4.641368	-1.619541	0.1162
DLNINT	9.513309	8.356338	1.138454	0.2642
DLNMS	43.49078	14.87968	2.922830	0.0067
DLNTROP	-7.430390	8.156832	-0.910941	0.3698
DLNY	-2.355231	3.072891	-0.766454	0.4496
ECM(-1)	-1.141203	0.131784	-8.659619	0.0000
C	-4.661565	3.706188	-1.257779	0.2185
R-squared	0.832988	Mean dependent var		0.218421
Adjusted R-squared	0.786916	S.D. dependent var		19.76134
S.E. of regression	9.122041	Akaike info criterion		7.462658
Sum squared resid	2413.137	Schwarz criterion		7.850507
Log likelihood	-132.7905	Hannan-Quinn criter.		7.600652
F-statistic	18.08005	Durbin-Watson stat		1.471958

Prob(F-statistic)	0.000000				
Diagnostics Tests					
		F-Statistics		Probability	
Heteroskedasticity		1.842		0.1094	
Serial Correlation		2.727		0.0834	
Normality (Jarque-Bera		1.812		0.4041	

Source: Computed from E-views 7.1

The result shows that the explanatory variables explain and account for about 83% of variation in inflation, which is an evidence of a good fit of the model. The F-statistics shows that the explanatory variables are jointly significant in explaining inflation (dependent variable).

From the result in the table above, it is evident that money supply, interest rates and expected inflation (proxied by the lagged term of inflation) has a positive relationship with inflation, while trade openness and income level both show a negative relationship with inflation in the short run, all of which conform with a priori expectation. However, only money supply and expected inflation is shown to be statistically significant when testes at 5% level of significance, while the

The coefficient of the ECM is significant at 1 percent level of significance and has the correct negative sign. This indicates a feedback of approximately 114% of the previous year's disequilibrium from the long run inflation elasticity and it is significant, which suggests that any short run disequilibrium in the system will be adjusted in the long run. The coefficient is reasonably high and suggests that adjustment to equilibrium is reasonably fast. Only about 114 percent of the adjustment to long run equilibrium is completed within the first period. This also justifies the significance of some of the variables in the short-run and the non-significance of the explanatory variables in the long run.

The estimation was done to give unbias and consistent estimates even in the face of heteroskedasticity, while the result of the Breusch Pagan test (see appendix) reveals that the null hypothesis of no serial autocorrelation is not rejected at 5% level of significance. The Jarque-Bera test also affirms that the model is well specified and in the right functional form, thus confirming that the model is a well-behaved model.

Conclusion

This study found out that money supply and expected inflation significantly determine inflation, as a percent increase in money supply and expected inflation brings about 43.5% and 0.22% increase in inflation in Nigeria respectively, this finding is in line with the submission of Milton Friedman (1969) and Fakiyesi (1996) who both concluded that monetary expansion and expected inflation (London, 1989) lead to increased inflation. Also found is that as consumers expect inflation, the inflationary tendencies in Nigeria increases. This stems from the psychological being of consumers, in which an expectation of an increase in price causes demand for such product to increase, thereby culminating into inflation. a clear example of this was the period of subsidy removal ushered in by the Nigerian President, which immediately shoots up the prices of commodities in all parts of the country. Though trade openness, which measures the degree of the country's openness to the outside is found not to significantly determine inflation, but the relationship uncovered in the analysis is of importance in the study. A negative sign reveals that purchase of goods outside the shores of the country rarely contributes to inflation, which justifies the need to patronise foreign made goods as against home-made goods, which are inflation prone. Though this study is not carried out to assess the impact of denomination, but it is of the opinion of the researcher that quantity majorly determines inflation as against the beliefs of people as regards the denomination. Evident in the findings, inflation in the country is a short-run phenomenon implying that its degree of responsiveness to policies is almost instantaneous.

Recommendations and Suggestion for Further Studies

Sequel to the above findings, government should provide an enabling environment for industries and firms to thrive, as this will help check the preponderance of home-made inflation; a contractionary

monetary policy should also be pursued by the regulatory authorities to check money-induced inflation and also the price regulatory bodies should be fully equipped to function effectively, in order to address the impact of expected inflation.

Every research work certainly suffers from one limitation or the other, which is also peculiar to this research. Unavailability of data for some variables that would have helped to aptly discuss the research problem and also the fact that inflation is a macro-economic issue which is better discussed within a macro-econometric model framework also constitutes a limitation as this discourse is done within a single-equation framework. In the light of this, there should be follow-up studies to investigate other variables that are not examined, especially the impact of increase in currency denomination as against money supply on inflation. a study on this will help justify the intention of the monetary management authority of increasing the Nigerian currency denomination to N5,ooo notes. Also, a study on building a macro-econometric model for the determinants of inflation in Nigeria is also suggested.

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