Exchange Rate Depreciation and Inflation in Nigeria (1986–2008)

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Abstract

The research paper examined the impact of exchange rate depreciation on inflation in Nigeria for the period 1986–2008, using Auto Regressive Distributed Lag (ARDL) Cointegration Procedure. The research found that exchange rate depreciation, money supply and real gross domestic product are the main determinants of inflation in Nigeria, and that Naira depreciation is positive, and has significant long-run effect on inflation in Nigeria. This implies that exchange rate depreciation can bring about an increase in inflation rate in Nigeria. The paper also found that inflationary rate in Nigeria has a lagged cumulative effect. The research paper therefore concludes that although Naira depreciation is relevant in ensuring an improvement in the production of exportable commodities, it must not be relied upon as a potent measure for controlling inflation in Nigeria. The paper therefore recommends the need for policy-makers to employ exchange rate depreciation as a measure to compliment other macro-economic policies to stabilize the volatile inflationary rate in Nigeria.

Keywords: Exchange rate depreciation; inflation rate; ARDL Cointegration.

1. Introduction

The problem of how to reduce inflation has been a central issue among policy makers since the 1970s. Although available data show that the Nigerian economy has on the average experienced moderate inflation in the pre-SAP period, the unfavourable consequences of inflation have since assumed an intolerable dimension [1]. Several authorities have attributed it to the expansion of public expenditure arising from the increase in oil revenue, which culminated into a vast expansion of aggregate demand and the inelastic supply of domestic output.

The rapid growth in money supply arising from the monetization of oil earnings also exerted an upward pressure in general price level. When the price of crude oil slumped during the 1st half of 1980's, Nigeria's crude oil, which sold at slightly above US$41 per barrel in early 1981, fell to less than US$9 by August, 1986. This triggered off a series of developments in the economy. One example of such developments is the state of fiscal crisis as reflected in the persistent budget deficit, which culminated to approximately ₦17.4 billion in the five years between 1980 and 1984. Monetary policy became highly expansionary as a large part of the deficit incurred during this period were financed through the creation of credit thus the local domestic credit to the economy recorded an average annual growth rate of 29.9% in 1980–84 and most of the increase was attributable to net claim by government. However, the inflation in 1984, which stood at almost 40%, is often explained in terms of acute shortage of imported goods and services imposed by inadequate foreign exchange earnings, a derivation of the steep fall in crude oil prices [12].

SAP was adopted in July 1986 to among other things get the price right using the foreign exchange rate reform as its central tool [24]. In pursuit of this, the second tier foreign exchange market was introduced in late September 1986 and since that time, the naira has depreciated sharply against the US dollar and the other major currencies. This development shows that a depreciation of the naira has a role to play in Nigeria's recent inflationary trends.

In addition to the above, the frequent fiscal deficit operation in the last two decades in which budget deficit is financed through banks has further exerted upward pressure on the general price level. This suggests that the current inflation may have been caused by these factors. While the channels through which exchange rate depreciation affect prices are well known, the extent to which this phenomenon engenders price inflation in Nigeria is one of the reasons for the study.

This paper therefore examines the extent to which exchange rate depreciation will cause inflation in Nigeria, using the recent Autoregressive (ARDL) bounds testing cointegration procedure developed by Pesaran et al [32]. The period covered by the work is 1986 to 2008. The paper proceeds as follows: section 2 provides the literature review that discusses empirical findings on inflation function. This is followed by methodology of the study, which is section 3. Section 4 is a profile of exchange rate development in Nigeria. Section 5 is empirical results of cointegration tests and section 6 concludes the paper.

Study Objectives

(a) To ascertain whether exchange rate depreciation is a significant determinant of inflation in Nigeria.
(b) To ascertain the stability of the inflation function in Nigeria over the sampled period.
(c) To make recommendations based on findings.

2. Literature Review

The earliest theory regarding the determination of price level, and changes in price level is the quantity theory of money. This theory in its simplest form postulates a direct proportional relationship between money supply and price level. According to the theory if money supply were doubled, prices would increase proportionately. Several studies after this formulation have shown that money supply is significant in explaining inflation in both advanced and developing economies. Among such studies are those of Akinifesi [4], Owosekun and Odama [31], Osakwe [30], Adeyokunu and Ladipo [5], Moser [23], Tanzi [36], Ikhide [20], and Aigbokhan [3].

Several empirical studies that have undertaken to identify the possible determinants of inflation in Nigeria and elsewhere have identified exchange rate as another inflation determining variable. Honoham and Lane [18] for instance, reported a variety of regressions, explain annual inflation differentials across the Eurozone over the period 1999-2001, and found a substantial role for the variation in nominal effective exchange rate movements in explaining divergent inflation rates. Honoham and Lane [19] in a related study confirm that exchange rate matter for EMU inflation rates during the periods of Euro appreciation (2002-2003) as well as during the periods of Euro depreciation (1999-2001). Aigbokhan [3] showed that the level of real exchange rate was a primary determinant of the rate of inflation in Mexico during the 1980s and 1990s.

Chhibber [8] developed a detailed econometric model, which takes into account both monetary and structural factors while investigating the causes of inflation in Zimbabwe. Their investigation shows that monetary growth, foreign price, exchange rate, interest rate, unit labour cost and real income, are the chief determinants of inflation in this country.

A similar macroeconomic model of inflation was employed for Ghana by Chhibber and Shafik [9]. This study, which covered the period 1965–1988, suggests that the growth of money supply is one key variable explaining the Ghanian inflationary process. Such variables as official exchange rate and real wages could not exert any significant influence on inflation. However, significant positive relationship was found between the parallel exchange rate and the general price level. Still on the issue of inflation, Chhibber [8] proposed that there is only one relationship between exchange rate and price inflation. Basing his argument on empirical studies of some African countries, one of his main conclusions is that devaluation could exert upward pressure in the general price level through its increased cost of production in the short-run. As far as Chhibber is concerned, the extent to which devaluation of a local currency will engender inflation is largely a function of the impact of such policy measure on the revenues and expenditures (budget) of government, together with the monetary policy that is simultaneously pursued.

Elbadawi [13] writing on inflationary process, stabilization and the role of public expenditure in Uganda showed that the precipitous depreciation of the parallel exchange rate was the principal determinant of inflation. This conclusion obviously agrees with the findings of Chhibber and Shaffik [9] with respect to Ghana.

A major factor identified in almost all the papers is the strong influence of imported inflation as a propagating factor in inflationary process. Since the incidence of imported inflation is synonymous with fixed exchange rate regime, a case for policy of flexible exchange rate was suggested as an anti-inflation measure. Supporting this

conclusion, Owosekun [31] argued that flexible exchange rates would minimize the impact of imported inflation.

Looking at the figures in the inflation/exchange rate schedule in absolute terms (Table 1) it is observed that for most of the period (1986–1995), inflation rate was increasing as exchange rate was increasing in absolute values. From this observed relationship, it is clear that this kind of variation in exchange rate affects the rate of inflation positively. It is also noted that since a problem created by appreciation in a currency can best be solved by depreciation of the currency, it is not completely out of place to agree with the earlier conclusion recommending flexible exchange rate as an anti-inflationary measure.

Traditional economics has it that the aim of devaluation is to make import dearer and export cheaper, and that to make devaluation effective, domestic prices must remain unchanged. A situation where devaluation of a national currency is found to be affecting domestic prices does not go well with any country, as the impact of such a measure is sure to be compounded, as each successive devaluation will create its own price spiral until the initial effect is neutralized. However, this will not arise if domestic production is enough to match the extra demand created by the devaluation.

It has been observed that the trend in the Nigerian economy following the introduction of Structural Adjustment Programme (SAP), and the associated massive devaluation accompanied by subsequent oil subsidy removal is in consonance with the above view [6]. According to him:

The devaluation of the naira is supposed to work without changing domestic prices, but devaluing the naira leaves the price of oil unchanged internationally as the price of oil is always determined in US Dollar.

The devaluation of the naira was also recognized in the work of Moser [23] as an important variable in the inflationary process in Nigeria. It was found that concurrency fiscal and monetary policies had a major influence on the impact of the depreciation of the naira on inflation. As observed by Oyejide [33] exchange rate depreciation often leads to increased local currency cost of imported inputs (raw materials and intermediate capital goods) and final goods via the cost-push inflation channel. He noted that since non-tradable goods cannot be imported, an excess demand for them would translate into increased prices given the fixed nature of domestic supply in the short-run. This price increase according to him feeds directly into domestic inflation via the demand-pull route.

Omotor [28] examined the impact of price response to exchange rate changes in Nigeria using annual from 1970-2003. Evidence from the paper revealed that exchange rate policy reform is important in the determination of inflation in Nigeria. Other studies, which have reached similar conclusions, are Odedokun [26], Odusola and Akinlo [27], Nnanna [24], Lu and Zhang [22].

Having considered the literature and evidences available to us, we have been able to establish a case for the influence of exchange rate, though among other variables like money supply, government expenditure, etc., on inflationary process in Nigeria. Empirical evidence maintain that since the incidence of inflation was found to be synonymous with fixed exchange rate, and a case for the policy of flexible exchange rate was suggested as anti-inflationary, we have therefore deemed it fit to include exchange rate variable during the period of flexible exchange rate regime to capture the impact of exchange rate depreciation on inflation in Nigeria. The relevance of this action rests on the fact that, with the introduction of SAP, there was a shift from the hitherto managed exchange rate regime to a market based system which resulted in a substantial depreciation of the domestic currency as table 1 in the appendix has shown.

It is important too to state here that before the adoption of the market based system, the main objective of exchange rate policy was to operate an independently managed exchange rate system that would influence real economic variables in the economy and bring down the rate of inflation. Consequently, a policy of progressive appreciation of the naira was pursued over the period and was aided by the oil boom that occurred at the same period. The sudden switch to market based system was engineered by a wide practice of foreign exchange management [7, 34] especially among Western countries pre-occupied with balance of payments problems [35]. The International Monetary Fund inspired the choice that it must be floating exchange rate. This was why it was made part of the conditionality for rescheduling our external debt [8].

Besides, Japan, USA and other detribalized countries of Western Europe employed it to solve problems of excess capacity [25] and to reach balance of payment equilibrium [35].

3. Methods

3.1 Data Sources

The analysis of exchange rate depreciation and inflation in Nigeria is based on a twenty-three year data series (1986–2008) compiled from data in various issues of the Central Bank of Nigeria (CBN) Annual Reports, Statistical Bulletin (Golden Jubilee edition) and Statement of Accounts and National Bureau of Statistics (NBS) digest of statistics. The choice of 1986 as the starting point of our analysis stems from the fact that in that year the Structure Adjustment Programme (SAP), which resulted in massive depreciation of the naira, was implemented (see table 1 in the appendix). Unavailability of data did not permit the extension of the time profile beyond 2008.

3.2 Theoretical Framework

It has been observed by researchers like Aigbonkhan [3] and Omotor [28] that inflation in Nigeria is affected by the following variables: exchange rate, money supply, government spending, real GDP, and inflationary expectation. Based on this relationship we present a functional form of these variables on inflation in Nigeria. Thus,

$INFR = F(EXCR, MS, GEXP, RGDP, INF_{t-1})$ .....(1a)

From equation 1a, Inflation depends on exchange rate, money supply, real GDP, and lagged inflation. It expected from theory that an increase in exchange rate, money supply, government spending and lagged inflation will increase inflation. This relationship is evident in the work of Aigbonkhan [3] and Omotor [28]. Real GDP is expected to have a negative relationship with inflation, i.e., as output of the economy increases inflation will reduce, because more goods are available in the system. We can specify equation 1a in an operational form for easy estimation below.

3.3 Model Specification

From the above theoretical framework therefore, the inflation function for Nigeria as it relates to this investigation may be specified in log linear form as follows.

$$\ln INFR_t = a_0 + a_1 \ln INFLR_{t-1} + a_2 \ln EXCR_t + a_3 \ln MS_t + a_4 \ln GEXP_t + a_5 \ln RGDP_t + U \ldots (1b)$$

Where;

$\ln INFR_t$ = Nigeria Inflation Rate in the Current Period

$\ln INFR_{t-1}$ = One Year Lagged Value of Nigeria Inflation Rate

$\ln EXCR_t$ = Nominal Exchange Rate of the Naira in Terms of US Dollar in period t.

$\ln MS_t$ = Nominal Money Supply (broadly defined) in period t

$\ln GEXP_t$ = Government Expenditure in the Current Period

$\ln RGDP_t$ = Real GDP in the Current Period

U_t = NID $(0, \sigma^2\varepsilon)$ denoting an independent (I), normal (N) distribution with a mean of zero $(E(\varepsilon_t) = 0)$ and a variance $(V(\varepsilon_t) = \sigma^2\varepsilon$; since these are constant parameters, an identical distribution holds at every point in time.

The Autoregressive Distributed Lag (ARDL) version of the above model is expressed in equation 2 as follows:

$$\ln INFR_t = \sum_{i=1}^{k} a_{1i} \ln INFR_{t-i} + \sum_{i=0}^{k} a_{2i} \ln EXCR_{t-i} + \sum_{i=0}^{k} a_{3i} \ln MS_{t-i} + \sum_{i=0}^{k} a_{4i} GEXP_{t-i} + \sum_{i=0}^{k} a_{5i} RGDP_{t-i} + u_t \ldots\ldots(2)$$

The primary aim of the study is to estimate the long run relationship between inflation and exchange rate depreciation. The correct specification of such a long-run relationship that will capture the short-run deviations that might have occurred in estimating the long-run cointegrating equation requires an error correction term [29, 30].

Following Pesaran et al [32], the error correction representation of the above ARDL model (2) is given by

$$\Delta \ln INFR_t = a_0 + \sum_{i=1}^{k} a_1 \Delta \ln INFR_{t-i} + \sum_{i=0}^{k} a_2 \Delta \ln EXCR_{t-i} + \sum_{i=0}^{k} a_3 \Delta \ln MS_{t-i} + \sum_{i=0}^{k} a_4 \Delta \ln GEXP_{t-i} + \sum_{i=0}^{k} a_5 \ln RGDP_t$$
$$+ \delta_1 \ln INFR_{t-1} + \delta_2 \ln EXCR_{t-1} + \delta_3 \ln MS_{t-1} + \delta_4 \ln GEXP_{t-1} + \delta_5 \ln RGDP_{t-1} + U_t \ldots\ldots(3)$$

Where, the parameters αi: i = 1, 2, 3, 4, 5 are the short-run dynamic coefficients, while the parameters δi: i = 1, 2, 3, 4, 5 function as the long-run multipliers of the underlying ARDL model.

Theoretically, it is expected that

$a_1 > 0$; $a_2 > 0$; $a_3 > 0$; $a_4 > 0$; $a_5 < 0$.

This means that with the exception of real GDP, all coefficients on the variables are expected to have positive signs.

3.4 Data Estimation Procedure

This study has used the recent autoregressive distributed lag (ARDL) bound testing procedure developed by Pesaran et al [32] to examine the cointegration (long run) relationship between inflation and its determinants (in particular, between inflation and exchange rate). The choice of this test is based on the following considerations. First unlike most other conventional multivariate cointegration procedures, which are valid for large samples, the bound test is suitable for a small sample size study [15]. Given that our sample size is limited with total 23 observations only, this approach will be appropriate. Secondly, the bound test does not impose a restrictive assumption that all the variables under study must be integrated of the same order. The F-test has a nonstandard distribution and depends on: whether the variables included in the ARDL model are I(0) or I(1); the number of regressors in the system; and whether the ARDL contain an intercept and / or a trend. According to Pesaran et al [32], to apply the bounds test procedure, a conditional Vector Error Correction Model (VECM) of interest can be specified to test the cointegration relationship between inflation, exchange rate, money supply government expenditure and real GDP variables as equation 3 has shown.

There are three steps in testing the cointegration relationship between inflation and its explanatory variables. To determine the presence or otherwise of unit root as well as the order of integration of the variables in the regression, the Augmented Dickey Fuller (ADF) unit root test was employed. Series that are found to be stationary were adopted, and those found not stationary were differenced to make them stationary [14, 16].

The first step is to test for the null hypothesis of no cointegration (long-run relationship) against the existence of a long-run relationship between inflation, exchange rate depreciation and other explanatory variables denoted as:

Ho: $\delta_1 = \delta_2 = \delta_3 = \delta_4 = 0$

That is, there is no cointegration among the variables in equations 3. This was tested against the alternative denoted as:

$$H_A: \delta_1 \neq \delta_2 \neq \delta_3 \neq \delta_4 \neq 0$$

That is, there is cointegration among the variables in equations 3. In doing this, we estimated equations 3 by ordinary least square (OLS) technique. The presence of cointegration is traced by conducting an F-test for the joint significance of the coefficients of the lagged levels of the variables. This testing procedure which is based on the computed F-value from the above estimation is usually a test of the hypothesis of no cointegration among the variables against the presence of cointegration among the variables. Since the F-test has a non-standard distribution irrespective of whether the variables are 1(0) or 1(1), two sets of critical values generated by Pesaran et al [32] were used. One set assumes that all variables are 1(0) and the other assumes that they are all 1(1). If the computed F-statistics falls above the upper bound critical value, then the null of no cointegration is rejected. If it falls below the lower bound, then the null cannot be rejected. Finally, if it falls between the lower and upper bound, then the result would be inconclusive. However, Canetti and Greene [8] argued that in such an inconclusive case, an efficient way of establishing cointegration is by applying the ECM version of the ARDL model. Secondly, according to Pesaran et al [32], if a unique long run relationship exists among the variables of interest, we estimate a conditional ARDL long run model for inflation rate (INFR) based on equation 3 above. The lags length in the ARDL model is selected based on Schwarz Bayesian Criteria (SBC). For our annual data, Pesaran et al [32] suggested a maximum of two lags. In the third and final step, we obtain the short run dynamic elasticity estimates.

4. A Profile of Nigeria's Exchange Rate Development

Between 1960 and 1967, the Nigeria currency was adjusted in relation to the British Pound in a one to one relationship between them. Between 1967 and 1974, another fixed parity was maintained with the American Dollar. This system was abandoned between 1974 and 1976, when an independent exchange rate management policy that pegged the naira to either the US dollar or the British pound sterling was put in place. During this period, a policy of gradual appreciation of the naira was pursued. Because of the huge earnings from crude petroleum export over the period, Nigeria persistently ran appreciable external surpluses in the balance of payments, which supported the appreciation of the naira. The exchange rate over-valuation that followed helped to cheapen imports of competing food items as well as agro-based and industrial raw materials. As a result, there was rapid expansion in the importation of these goods to the detriment of local production of similar goods. When it became obvious that aggregate import demand had outstripped total foreign exchange available for imports, trade restriction through import licensing scheme was introduced. Towards the latter part of 1976, arising from the changing fortunes to Nigeria's economic circumstances, a policy reversal was effected in the management of the naira exchange rate. There was a deliberate policy to depreciate the naira, through this was not systematic. However, a major policy reversal was effected in September 1986 when the fixed exchange rate regime had to be discarded and the flexible exchange rate regime was put in place following the adoption of the SAP. With the adoption of SAP, foreign exchange allocation and import licensing procedures were abolished and transactions in foreign exchange were subjected to market forces under an auction system. This new exchange rate policy helped to remove the over-valuation problem to the extent that the naira now became under-valued. As noted by Honoland and Lane [18, 19], exchange rate depreciation had since resulted in the dramatic increase in the naira price of imports and this is expected to discourage importation and the naira cost of imported items have also risen astronomically. Table 1 in the appendix shows that the very year SAP commenced, exchange rate stood at ₦2.02:US$1.00 but depreciated to an average of ₦4.02, ₦8.04 and ₦9.91 to US$1.00 in 1987, 1990, and 1991 respectively. It further depreciated to ₦17.30 and ₦22.05:US$1.00 in 1992 and 1993 respectively. Following the persistent depreciation of the exchange rate, it became necessary for the exchange rate policy to be completely reversed in 1994 with the re-introduction of a fixed exchange rate regime. By this new arrangement, the exchange rate of the naira was pegged at ₦21.8861 = US$1.00. The dismal performance of the economy as the end of that year compelled the authorities to re-introduce the market-based approach under the autonomous foreign exchange market (AFEM) from January 1995 until October 1999. The exchange rate which depreciated from the fixed rate of ₦21.8881:US$1.00 in 1994 to an all height of ₦81.00:US1.00 in 1995, barely one year after it was fixed, depreciated further to ₦84.38:US$1.00 and ₦92.65:$15$1.00 in 1998 and 1999 respectively. It further depreciated to ₦128.75 between 2002 and 2005. However, relative stability was achieved from 2003 with the rate actually appreciating between 2005 and 2008.

5. Empirical Analysis of Cointegration Tests

Non-stationarity has generally been observed to be common feature of most time series variables, especially in macroeconomic data such as income, consumption, money prices and trade data on treating such non-stationary variables as if they are stationary can lead to spurious (misleading) regressions [17], where R^2 is approximating unity, t and f statistic look significant and valid. To avoid this kind of scenario, a formal test of the null hypotheses of non-stationarity was conducted using the Augmented Dickey Fuller (ADF) technique. The tests were run with intercept and linear trend. The Mckinnon critical values at 5 percent level of significance were obtained as -3.0294 and -3.6921 in levels and in first difference respectively. Table 5.1 present the results of the ADF test in levels, for all the data in model 1.

Table 5.1: ADF Unit Root Test (ADF Regression with Intercept and a Linear Trend).

Variables	Level	1ST Difference	Order of Integration
LnINFR	-3.2077(1)	-4.4394(1)	I(0)
LnEXCR	-0.65711(1)	-4.3476(1)	I(1)
LnMS	-4.7762(2)	-3.7859(3)	I(0)
LnGEXP	-1.6318(1)	-5.4758(1)	I(1)
LnRGDP	-1.8103(2)	-3.7933(1)	I(1)
Critical Value 5%	-3.0294	-3.6921	

Source: Extracted from Regression Output using Microfit 4.1 for Windows.

Table 5.1 shows the ADF test statistics for all the variables in their levels. The table shows that all the variables are integrated either in levels or at the first difference, I(0) or I(1). This implies that we can confidently apply the ARDL methodology for our model. The computed F-statistics of the bounds test is reported in Table 5.2 below.

Table 5.2: ARDL Bounds Test for Cointegration.

	5% level		10% level	
K	1(0)	1(1)	1(0)	1(1)
5	2.39	3.38	2.08	3.00
Computer F-statistic – FLN NFR (LNEXCR, LNGEXP, LNRGDP) = 2.5661 (.084)				

Source: Extracted from Regression Output using Microfit 4.1 for Windows.

According to the above table, the computed F-statistic F_{LNINFR} (LNEXCR, LNMS, LNGEXP, LNRGDP) = 2.5661. This value falls between the lower and upper bounds of the critical values at both 5 and 10 percent levels. This is an inconclusive case which when subjected to further verification from the ECM results as earlier suggested, indicated that there is cointegration relationship among the variables [2, 20]. Since the computed F-statistics is not below the critical value, we proceed to estimate equation 3 for the long run elasticities. The selected maximum lag length that minimized the Schwarz Bayesian Criteria (SBC) was 2. The results for the long run elasticities are reported in Table 5.3 below.

Table 5.3: Estimated Long Run Elasticities using ARDL.

Dependent Variable: LNINFR

Regressor	Coefficient	t-values	p-value
LNEXCR	1.0668	3.0424	(.011)
LNMS	2.6981	2.7543	(.019)
LNGEXP	-3.5096	-3.9656	(.002)
LNRGDP	-2.0368	-1.1716	(.266)
CONST	34.1690	1.9529	(.077)

Source: Extracted from Regression Output using Microfit 4.1 for Windows.

The estimated long run result in Table 5.3 shows that in the long run Exchange Rate (EXCR) and Money Supply (MS) have very significant effect on inflation. Exchange rate 0.019 has shown government expenditure is also significant but with the wrong sign. The result also shows that EXCR and MS are as elastic as the coefficient of

elasticities of 1.0668 and 2.6981 have shown. This means that 91 percent increase in EXCR and MS will lead to a 1.07 and 2.70 percent increase in inflation rate respectively. The RGDP variable is correctly signed but not significant at 1 and 5 percent levels. The result of the error correction representation of the selected ARDL model based on the SBC is reported in Table 5.3 below.

Table 5.4: Error Correction Representation for the Selected ARDL Model based on SBC.

Dependent variable: dLNINFR **Included observations: 18 (after adjusting end points)** **Sample period: 1988–2008.**			
Regressor	**Coefficient**	**Standard Error**	**T-Ratio (Prob.)**
dLNINFR	.69868	.16897	4.1350[.001]
dCONST	32.8880	14.8829	2.2098[.046]
dLINEXCR	1.0268	.38894	2.6400[.020]
dLNMS	2.5969	.76286	3.4042[.005]
dLNGEXP	-2.1865	.60151	-3.63501[.003]
dLNRGDP	-10.4573	2.8261	-3.7002[.003]
ECM (-1)	-.96251	.15525	-6.1997[.000]
	R^2 = 0.86896	F (7, 13) = 10.4209 (0.000)	
	= 0.76175	SE of regression = 0.39473	
	DW Stat = 2.0468	SBC = -18.7100 RSS = 1.7139	

Source: Extracted from Regression Output using Microfit 4.1 for Windows.

An examination of the estimated result above shows that the overall fit is satisfactory at the value of R^2 = 0.86896. This shows that the independent variables used in our model jointly accounted for 86.9 percent of the total variation in inflation rate. The pro-values of .001, .020, .005, .003 and .003 indicates that all the explanatory variables are highly significant (at either 1 and/or 5 percent levels) in explaining inflation in Nigeria. All the variables apart from GEXP are correctly signed. The elasticity status of our model shows that while inflation rate lagged by one year period had a coefficient of elasticity that is less than one, exchange rate, money supply and real GDP, had coefficients of elasticity that are greater than one. This shows that inflation in Nigeria is highly responsive to changes in exchange rate depreciation, money supply and real GDP. It also implies that exchange rate depreciation, money supply and real GDP are major determinants of inflation in Nigeria.

The coefficient of the ECM as could be observed in Table 5.3 is negative, and highly significant, showing that the model has a self-adjusting mechanism for adjusting the short-run dynamics of the variables with their long-run values. According to [2], a highly significant error correction term is a further proof of the existence of a stable long run relationship. This implies that there is a long-run relationship between inflation and its determinants. The speed of adjustment to equilibrium is given by the coefficient of ECM (-1) as -0.96. This speed is very high, indicating that a deviation in inflation rate from equilibrium is corrected by as high as 96 percent the following year. The F-statistic of 10.4209 is significant at 1 percent level, as the pro-value estimate of 0.000 has indicated. It shows that there is a linear relationship between the dependent variable and at least one of the independent variables. Thus, it will rightly act to correct any deviations from long-run equilibrium.

In the study also, one lagged value of inflation is found to be significant too in explaining inflation in Nigeria at 1 percent level of significance. This implies that inflation has a cumulative effect in Nigeria; in fact, a unit increase in inflation any one year will increase inflation in the subsequent year by 0.69 percent. The Durbin Watson statistics of 2.0468 indicates that there is absence of serial autocorrelation. This implies that the statistical estimates can be relied upon.

6. Conclusion

The premise of this work has been exchange rate depreciation and inflation in Nigeria. The work covers the period of 1986–2008, using the Autoregressive Distributed Lag Bounds Test cointegration procedure. The results show that inflation in Nigeria is highly responsive to exchange rate depreciation, money supply and real GDP. A long run relationship was also found to exist between inflation and exchange rate depreciation,

indicating that the model has a self-adjusting mechanism for correcting any deviation of the variables from equilibrium. The implication of this is that additional effort need to be put in place to increase the volume of export products to make up for the extra demand that may be created by the depreciation. The paper also found that inflation rate in Nigeria has a lagged cumulative effect. Although exchange rate depreciation may not directly control inflation, it helps to restructure the price mechanism of both import and export, such that Naira depreciation subtly tends to moderate prices in Nigeria, especially imported price inflation. It is therefore suggested that policy makers should not totally rely on this instrument to control inflation, but should use it to complement other macro-economic policies. More so, policies should be put in place to increase domestic production of export commodities, which are currently short-supplied.

Competing Interests

The authors declare that they have no competing interests.

Authors' Contributions

Both authors contributed equally to this work.

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APPENDIX

Table 1: Naira Exchange Rate Movements in the Official Foreign Exchange Markets.

	Official Foreign Exchange Market	
Year	**Rate (N:$) (1)**	**Depreciation/Appreciation (%) (2)**
1986	2.02	55.9
1987	4.02	49.8
1988	4.54	11.5
1989	7.39	38.6
1990	8.04	8.1
1991	9.91	18.9
1992	17.30	42.7
1993	22.05	21.5
1994	21.9	-0.7
1995	81.0	73.0
1996	81.3	0.3
1997	81.6	0.5
1998	83.8	2.6
1999	92.7	9.6
2000	102.1	9.2
2001	111.9	8.8
2002	121.0	7.5
2003	129.4	6.5
2004	133.5	3.1
2005	132.1	-1.0
2006	128.7	-3.1
2007	125.8	-2.2
2008	118.6	-6.1

Notes: In column 2, (-) show appreciation of the naira while (+) is depreciation.
Source: Central Bank of Nigeria Statistical Bulletin (Golden Jubilee Edition).

Table 2: Macroeconomic Indicators.

Year	INFR	EXCR	Ms_2	RGDP	GEXP
1986	5.39	2.02	27389.8	205971.4	16223.70
1987	10.18	4.02	33667.4	204806.5	22018.70
1988	56.04	4.54	45446.9	219875.6	27749.50
1989	50.47	7.39	47055.0	23672.9.6	41028.30
1990	7.50	8.04	68662.5	267550.0	60268.20
1991	12.70	9.91	87499.8	265379.1	66584.40
1992	44.81	17.30	129085.5	271365.5	92797.40
1993	57.17	22.05	198479.2	274833.3	191228.90
1994	57.03	21.9	266944.9	275450.6	160893.20
1995	72.81	81.0	318763.5	281407.4	248768.10
1996	29.29	81.3	370333.5	293745.4	337217.60
1997	10.67	81.6	429731.3	302022.5	428215.20
1998	7.86	83.8	525637.8	310890.1	487113.40
1999	6.62	92.7	699733.7	312183.5	947690.00
2000	6.94	102.1	1036079.5	329178.7	701059.40
2001	18.87	111.9	1316869.1	356994.3	1018025.60
2002	12.89	121.0	1599494.6	433203.5	1018155.80
2003	14.03	129.4	1985191.8	477533.0	1225965.90
2004	15.01	133.5	2263587.9	527576.0	1426200.00
2005	17.85	132.1	2814846.1	561931.4	1822100.00
2006	8.24	128.7	4027901.7	595821.6	1938002.50
2007	5.38	125.8	5809826.5	634251.1	2450896.70
2008	11.60	118.6	9167067.6	674889.0	3240820.00

Source: 1. CBN Annual Reports and Statement of Accounts (Various Issues).
2. CBN Statistical Bulletin (Golden Jubilee Edition).

Where: INFR – Inflation Rate
EXCR- Exchange Rate
MS2 – Broad Money supply
RGDP- Real Gross domestic Product
GEXP – Government Expenditure