Re-examining Exchange Rate Regimes and Inflation Nexus: An ARDL Analysis for Nigerian Case

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Abstract: This paper seeks to re-examine the effect of exchange rate regimes on inflation in Nigeria. This is pertinent because exchange rate has remained devastated in Nigeria while the problem of high inflation lingers. Contrary to most studies on Nigeria, we tested the stability of our inflation model. We used the Autoregressive Distributed Lag (ARDL) approach for our analysis. The result shows that the past one year value of exchange rate has a negative and significant impact on the current inflation rate. Inflation rate increased more during the fixed exchange regime compared to the floating exchange rate regime. During the floating exchange rate regime, as the exchange rate increases, the inflation rate decreases and vice versa. The implication is that the floating exchange rate regime policy is preferable for combating increases in inflation rate compared to the fixed exchange rate. In addition, the lags of money supply have a direct relationship with inflation rate. The past two years value of interest rate also has a direct relationship with inflation rate. It is necessary that future studies on Nigeria consider wider spectrums of exchange rate regimes than ours.

Keywords: exchange rate regimes; inflation; autoregressive distributed lag

JEL Classifications: C31; E63; F31

1. Introduction

Exploring how the different exchange rate regimes adopted by different countries relate with their inflation rates has remained an interesting puzzle in the macroeconomic literature.[4] This is particularly the case in most developing countries, especially in Africa, where exchange rate has remained devastated while the problem of high inflation lingers. It is no longer news in Nigeria that the

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[4] See (Thygesen, 1978; Guisinger & Singer, 2010; Obansa, Okoroafor, Aluko & Eze, 2013).

country has experimented different policies within the ambient of fixed and exchange rate systems over the years. Of course, the objective of doing so have been to make prices stable and achieve other macroeconomic goals (Inyiama & Ekwe, 2014). We know from the Bible that unstable persons are limited in achievements, no wonder Nigeria has not been able to bring back its exchange rate to what it was in the 1960s and I970s.[1]

In Nigeria at present, people do not value the Naira compare to the powerful currencies such as pounds sterling, euro and dollars. The Naira virtually loses respect in the minds and hands of Nigerians whenever its value is lower than that of another currency. Depreciation of the Naira is worsen by a situation where most citizens are losing hope in the country. Therefore, a right exchange rate policy that would stabilize the exchange as well other macroeconomic factors including inflation is necessary to restore the hope of the citizens. Failure to do so may portend a greater damage to the Nigerian economy even more than what Singer Prebisch termed perpetual deterioration of developing countries due to high proportion of commodity goods in the trade baskets. Up to 1979, exchange rate was stable in Nigeria.[2] Therefore, at different times, researchers have criticized the Structural Adjustment Programme (SAP) because it did more harm to the economy of Nigeria than good. The progressive depreciation of the Naira began during the SAP era.

Although, inflation has a long history of instability in Nigeria due to wrong policy prescriptions and its implementations as well as constant fall in the value of the Naira, maintaining a moderate inflation rate has been an arduous task to the Central Bank of Nigeria since the SAP period (Afolabi & Efunwoye, 1995). It has been noted that Nigeria majorly practiced the fixed exchange system prior to the SAP but since then the flexible exchange rate system is practiced in most of the later years.

Further studies on the connection between exchange rate system practiced and inflation control in Nigeria is quite necessary given that both variables have performed woefully in the country over the years. This paper, therefore, answers the following questions: (i) is there any long run relationship between the fixed-cum-flexible exchange rate regimes and inflation rates in Nigeria? (ii) is the inflation function for Nigeria stable over time? (iii) what are the determinants of inflation rate in Nigeria?.

We organize the paper into five sections. Following the introduction in this section is the literature review in part two. The methodology and discussion of findings are

[1] See (Gbosi, 2005).
[2] See (Ewa, 2011).

in sections three and four, respectively. The fifth section gives the conclusion and recommendations.

2. Literature Review

The initiation of the debate on whether it is the fixed or flexible exchange rate that is more inclined to reduction in inflation rate can be traced to the work of Fleming (1962) and Mundell (1963). These scholars argued that lowering of inflation is achieved more with fixed exchange rate than the flexible counterpart. Similarly, Chhibber (1991) concludes that devaluation of currency, which is a fixed exchange rate policy, is potent in influencing the government budgets as well as monetary policy including the inflation rate. Ghanem (2012) whose study was on the Middle East and North Africa (MENA) noted that the type of fixed exchange rate that lowers inflation is the credible one but Ghosh, Qureshi & Tsangarides (2014) submitted that the fixed exchange rate that is credible is the de jure type. However, Guisinger & Singer (2010) submitted that a de facto fixed exchange rate system would result to lower inflation if governments back up their actions with official pronouncements. Sticking to such pronouncements will make governments to be credible. A fixed (also called pegged) or flexible (also known as floating or fluctuating) exchange rate is de jure if the central bank communicates what it is doing concerning the exchange rate to the public. The reverse is the de facto such that the central bank can even do contrary to what it claims regarding its approach in handling the exchange rate issue. The study by Alesina & Wagner (2006) suggests that countries with poor institutional quality have problem with maintaining fixed exchange rate system. On the contrary, according to the study, countries with relative higher institutional quality manage their exchange rate more than what they announced.

The study by Ghanem (2012) also found that the flexible exchange rate reduces inflation more than the fixed counterpart does. Nevertheless, many countries dread to float their exchange rate such that they frequently renege (Calvo & Reinhart, 2002). Besides, the manner a country floats its exchange rate matters for its capability to borrow globally in its own currency, which has implications on its inflation rate.[1] Elbadawi (1990) found that flexible exchange rate policy involving depreciation of the currency of Uganda especially as observed in the parallel market contributed most significantly to explaining inflation variations in the country. Mainwhile, Owosekun (1975) submitted that flexible exchange rate system is less prone to imported inflation compared to the fixed exchange rate system, hence flexible exchange rate will produce a lower inflation rate in Nigeria compared to a fixed exchange rate system. This is supported by the study by Moser

[1] See (Hausmann, Panizza & Stein, 2001).

(1995) which showed increased inflation rate in Nigeria due to exchange rate devaluation policy in the fixed exchange rate regime. In addendum, Oyejide (1989) showed that exchange rate devaluation increases the cost of importation thereby fueling the price of imported inputs including final commodities, hence causing increase in inflation rate through the cost-push channel. However, inflation will modestly persist if there is an accommodation of exchange rate.[1]

The study by Ghosh et al. (2014) has revealed that low inflation is highly achievable when central banks adopt both de facto and de jure fixed exchange rate than if they use only de factor fixed method. On the other hand, Bohl, Michaelis & Siklos (2016) pointed out that in raising countries' outputs, the fixed exchange rate works best for the emerging market economies while in the G20 countries; the flexible exchange system does better. This finding is useful in the foregoing discourse since economic literature and empirics have largely established a trade-off between output and inflation.[2]

There are expansive literature on what causes changes in the inflation rates across different countries of the world including Nigeria. Country specific studies have largely used the cointegration multivariate procedures.[3] Most of the studies have found that exchange rate is one of those variables explaining changes in the inflation rate. For example, the study by Honohan & Lane (2003) on the Eurozone shows that inflation rate is explained by changes in the nominal effective exchange rate over the period 1999-2001. Similarly, in another study by same Honohan & Lane (2004), exchange rate plays a pertinent role in determining inflation rate in the EMU in both the period of depreciation of the Euro in 1999-2001 and era of appreciation of the Euro in 2002-2003. In addition, from the result of Aigbokhan (1991), the Mexican inflation in 1980s and 1990s was primarily determined by the extent to which the country's real exchange rate fluctuates. Further, Chhibber (1991) reveals that exchange rate, real income, increase in money supply, unit labour cost, foreign price and interest rate are critical in determining inflation rate in Zimbabwe. In a similar study on the Ghanaian economy, Chhibber & Shafik (1990) show that the country's inflation rate is chiefly caused by increase in the supply of money whereas factors like official exchange rate and real wages do not significantly impact on the inflation rates, although the parallel exchange rate poses significant positive impact on the inflation rates. In the same way, the study by Opolot & Mpagi (2017) reveals that among other variables including monetary aggregates, foreign prices and changes in real GDP, exchange rate poses a positive impact on inflation rate in Uganda. Also, the work by Hossain & Mitra (2017) reveals a short-run uni-directional flow from exchange rate, interest rate, economic

[1] See (Kool & Lammertsma, 2005).
[2] See (Lohi, 2014; Hayat, Balli & Rehman, 2017).
[3] See (Aliyu & Englama, 2009; Oluba, 2008).

growth and trade openness to inflation. Laying credence to the autoregressive lag tendencies, Lagoa (2017) shows that among other variables, changes in inflation is largely accounted for by the movements in exchange rate and differences in inflation. We note that the debates on which of the exchange rate regimes lowers inflation as well as factors determining inflation both in the short run and long-run remain unsettled, hence calling for further studies.

3. Methodology

The first step in this section is to test the nature of the variables using the popular augmented Dickey Fuller (ADF) stationary test. Although new stationarity tests developed by Ng & Perron (2001) and improved by the work of Perron & Qu (2007) which are Dickey Fuller Generalized Least Squares (DFGLS) and Modified Philips Perron (MPP) have been said to be powerful and have better size compared with ADF and Philips-Perron (PP) test.[1] However, Zapata et al. (2011) has shown that the ADF like the PP test has shown similar result with the DFGLS. Since our sample is not less than thirty, hence not small, the ADF equation is still relevant. Therefore, we specify the ADF equation as follows in equation (1).

$$\Delta y_t = a_0 + a_2 t + \theta y_{t-1} + \sum_{l-1}^{m} \beta_1 \Delta y_{t-1} + \varepsilon_t \ldots\ldots\ldots (1)$$

Equation (1) represents a model of first difference of series y (Δy_t) with a_0 constant term, $a_2 t$ linear trend, θy_{t-1} lag of y, $\sum_{l-1}^{m} \beta_1 \Delta y_{t-1}$ lag difference of y and ε_t stochastic term. In the absence of deterministic part in the model, a_0 and $a_2 t$ disappear.

Given that the variables are a mixture of first difference and level series, the Autoregressive Distributed Lag (ARDL) is the appropriate methodology (see Pesaran, Shin & Smith, 2001). The ARDL is potent for long-run analysis.

Given a general ARDL model in equation (2)

$$ARDL\left(y, x_{1,} x_{2,} \ldots\ldots , x_k\right) \mathrm{mod}\, el \ldots\ldots\ldots\ldots \quad (2)$$

Where y is the dependent variable and $x_{1,} x_{2,} \ldots\ldots , x_k$ are the regressors or explanatory variables. Our dependent variable is the inflation rate (INFR) while the regressors are broad money supply (MS), exchange rate (EXCR), government expenditure (GEXP), interest rate which is represented by monetary policy rate (INTR) and dummy for the exchange rate regimes (ERR- 1 for fixed regime and 0

[1] See (Zapata, Maradiaga & Pujula, 2011).

for floating regime). The choice of variables into our model draws from the work of Imimole & Enoma (2011), Bashir, Nawaz, Yasin, Khursheed, Kan, & Qureshi (2011), Ghanem (2012), Lim & Sek (2015), Hossain & Mitra (2017) and Opolot & Mpagi (2017). Both the dependent and the independent variables were logged, hence the coefficients are elasticities. We collected the data on all the variables from the Central Bank of Nigeria Statistical Bulletin, 2015 edition and they were logged so that they could behave well in the analysis. The stability of the inflation rate was tested using the Cumulative Sum (CUSUM) technique.

Emanating from equation (2), we write the equation (3)

$$A(L)y_t = c + \beta_1(L)x_{1t} + \beta_2(L)x_{2t} + ... + \beta_k(\mathrm{L})_{\mathrm{kt}} + \varepsilon_t \quad (3)$$

Where A stands for autoregressive, L stands for lag(s), β's are the regression coefficients and ε_t remains the stochastic term. An $A(L)$ =1 implies absence of lag(s) of y_t in an ARDL model, hence regarded as a distributed lag model. Also, in equation (3), y_t and x_t are believed to be stationary while ε_t is a white noise. This means that ε_t has a mean of zero, constant variance and zero autocorrelation. The choice of lags will depend on the number of variables in the equation to avoid the problem of over-parameterization and micronumerousity. However, the allowance of lags into an ARDL model improves the explanatory power of the model. As usual, econometricians often derive a dynamic error correction model (ECM) from the ARDL using transformations that are simply linear (see Bannerjee & Mestre, 1998). The ECM shows the extent to which deviations from the long-run are corrected in the short-run and must be correctly signed with a negative value. We state a general ECM in equation (4)

$$\Delta y_t = c + \beta_0 \Delta x_t - (1-\alpha_1)y_{t-1} + (\beta_0 + \beta_1)x_{t-1} + \varepsilon_t ..... \quad (4)$$

This equation connotes that the change in current value of y is an addition of two parts. First is the one that is proportional to the current value of x and the second is the deviation of y_{t-1} from the equilibrium value which tallies with x_{t-1}.

4. Empirical Results and Discussion

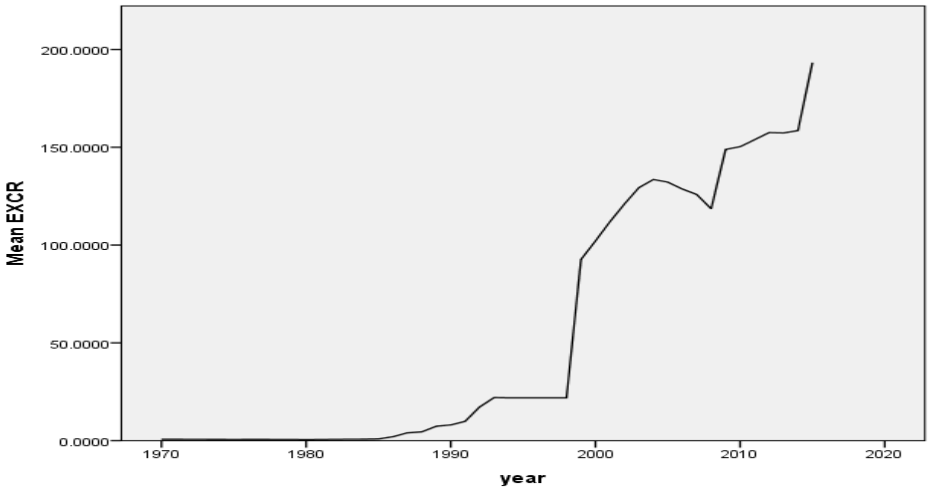

Figure 1. Exchange Rate Movement in Nigeria (1970-2015)

Beginning with the preliminary discussion, the graphical representation of the exchange rate in Nigeria in figure 1 shows that exchange rate was fixed and constant in the periods before 1986 (Structural Adjustment Programme year) while in the subsequent periods, there was a continuous increase in the exchange rate.

On the other hand, the graphical representation of the inflation rate in figure 2 shows an oscillating movement in the inflation rate. This suggests that the inflation rate should not have a unit root problem. That is, it should be stationary at level when tested.

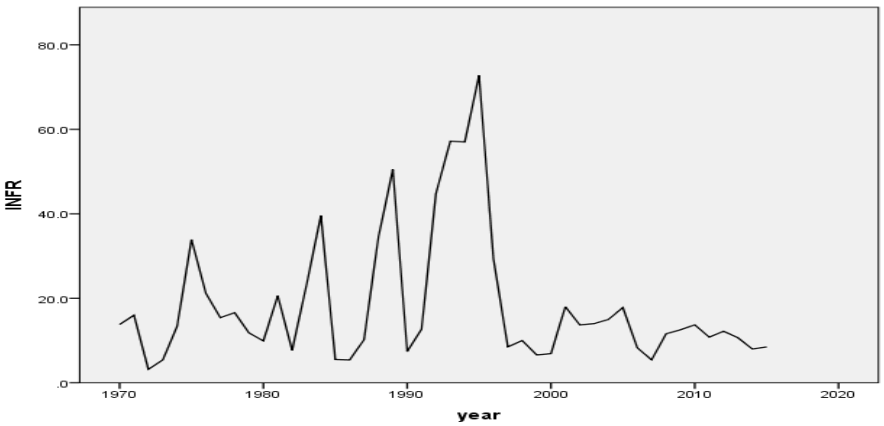

Figure 2. Inflation Rate Movement in Nigeria (1970-2015)

The result of the stationarity of the variables using the ADF procedure in Table 1 indicates that the variables are largely first difference series except inflation rate that is stationary at level for model with intercept as well as trend and intercept.

Table 1. Unit Root Test Using Augmented Dickey Fuller Procedure

Variables	Level				First difference				Order of integration
	Intercept	Trend and intercept	No intercept and trend	Lag	intercept	Trend and intercept	No intercept and trend	Lag	
LnInfr	-3.9719*	-3.9566**	-0.3735	0,0,2	-7.5633*	-7.5653*	-7.6596*	1,1,1	Mostly I(0)
LnExcr	-0.2460	-1.6172	1.8529	0,0,0	-5.3728*	-5.3084*	-4.6415	0,0,0	I(1)
LnIntr	-1.7437	-1.4953	0.1036	0,0,0	-7.7139*	-6.4356*	-7.7666	0,1,0	I(1)
LnMs	-1.5124	-2.2507	1.9357	0,1,1	-5.2055*	-5.4522*	-2.7719	0,0,0	I(1)
LnGexp	-1.7841	-0.9541	1.5462	0,0,0	-7.2114*	-7.6557*	-3.6105*	0,0,1	I(1)

Source: Computed from E-views 7

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

This result justifies the use of an ARDL model which requires a combination of I(0) and I(1) variables. Therefore, the next step involves estimating an ARDL model to determine the cointegrating relationship among the variables. Subsequently, the results are presented in Table 2.

Table 2. Parsimonious OLS estimates of the ARDL model

C	4.672572	0.699485	6.680022	0.0000
D (LN_INFR (-2))	-0.547894	0.089672	-6.110004	0.0000
D (LN_INFR (-3))	-0.327263	0.075532	-4.332782	0.0002
D (LN_EXCR (-1))	-0.518282	0.202305	-2.561885	0.0163
D (LN_INTR (-2))	1.723800	0.305144	5.649131	0.0000
D (LN_MS (-2))	2.526894	0.316819	7.975836	0.0000
D (LN_MS (-3))	1.241540	0.329874	3.763680	0.0008
D (LN_MS (-4))	0.521003	0.290805	1.791591	0.0844
ERR (Dummy)	-1.874292	0.383430	-4.888224	0.0000
R-squared	0.899152	Mean dependent var		-0.011220
Adjusted R-squared	0.850596	S.D. dependent var		0.726465
S.E. of regression	0.280799	Akaike info criterion		0.562835
Sum squared resid	2.128896	Schwarz criterion		1.147957
Log likelihood	2.461877	Hannan-Quinn criter.		0.775904
F-statistic	18.51776	Durbin-Watson stat		2.360414
Prob(F-statistic)	0.000000			

Source: Computed from E-views 7

Table 2 shows the parsimonious model of the ARDL which is obtained after considering the appropriateness of lag based on the Akaike information criterion, Schwarz criterion and Hannan-Quinn criterion as well as correcting for serial correlation. Based on the parsimonious specification, the coefficient of determination (R^2) shows that the model is good or its explanatory power is in order. The Durbin-Watson (DW) value of 2.3604 suggests the model does not suffer from serial correlation and the F-test shows there are no omissions of relevant variables in the model. In essence, there is no mis-specification problem.

The bound test with the aid of Wald test and the Pesaran Table in Tables 3 and 4, respectively, show whether or not there is co-integration or long-run relationship among the variables in the model.

Table 3. Wald Test

Test Statistic	Value	Df	Probability
F-statistic	3.045924	(3, 10)	0.0791
Chi-square	9.137771	3	0.0275

Source: Computed from E-views 7

Table 4. Pesaran Table

Critical·value¤	Lower·Bound·Value¤	Upper·Bound·Value¤
1%¤	3.74¤	5.06¤
5%¤	3.539¤	4.667¤
10%¤	2.45¤	3.52¤

Source: Pesaran et al. (2001), Table CI (iii), Case 111: Unrestricted intercept and no trend.

The F-statistic (3.0459) in Table 3 falls below the lower bound (3.539) on the Pesaran table at 5% level of significance indicating no long-run association among the variables. This means that these variables will not likely co-move in the long-run. Therefore, there is no need for conducting the error correction mechanism for the model.

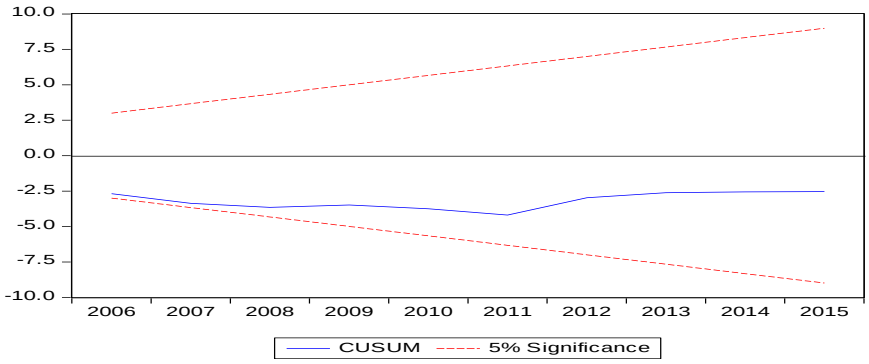

Figure 3. CUSUM Test for Stability of the Inflation Model

Figure 4. Recursive Residual Test of Stability of the Inflation Model

The graph of the recursive residual in figure 4 shows that the residuals either go outside the ±2 standard error bounds or becomes close to the bounds. This can be seen between 2006 and 2015 which corresponds to the period of massive deregulation and liberalization of the financial system in terms of interest rate and entry into the system so that SMEs can flourish and contribute meaningfully to the GDP growth of Nigeria. From the plot of the CUSUM test in figure 3, the red lines indicate both upper and lower benchmark at 5% significance level while the blue lines represent the CUSUM or recursive residuals. The graph indicates that the process is in control as the CUSUM or recursive residuals are neither greater than nor less than the benchmark. Since the measurement (CUSUM or recursive residuals) falls within the benchmark, we infer that the inflation model is stable. This result is similar to the study by Hossain & Mitra (2017) on the United States.

The relationship between the second and third lags of inflation and the current inflation is negative and significant at the 5 percent level. This suggests that the past two and three years values of inflation rate are important determinants of the current inflation rate in Nigeria. By implication, inflation rate exhibits a snowballing impact in Nigeria. This result is similar to that of Lagoa (2017) that shows that differences in inflation overtime has a great impact on the current inflation rate.

Similarly, the current and past two and three years values of money supply has a direct relationship with inflation rate. The positive sign displayed by money supply meets the theoretic and a priori expectation since increase in money supply when money demand is unchanged causes increase in the general price level thereby reduces the real value of money. This finding is similar the long-run result by Bashir et al. (2011) but contradict the study by Lim & Sek (2015) who reported a short-run negative nexus between money supply and inflation. Although such outcome between money supply and inflation is unpopular in the literature.

The past two years value of interest rate has a direct relationship with inflation rate. This does not conform to economic theory since increase in interest rate often reduces money supply, hence reduces inflation. However, if Nigeria's interest rate increases relative to the interest rate of other countries rates, all things equal, this will make investors to gain from the higher Naira rates by switching from their currency to Naira-denominated securities. The net result is an increase in inflation of the Naira if government does not intervene. Our result is somehow similar to that of Inyiama & Ekwe (2014) and Hossain & Mitra (2017) that show a uni-directional causality from interest rate to inflation in Nigeria and United States, respectively. Also, the past one year value of exchange rate has a negative and significant impact on the current inflation rate. This implies that a depreciation of the Naira leads to a reduction in the rate of inflation. This is a-theoretic because depreciation of the currency is expected to boost net export if the country is a net export State thereby increases aggregate demand and fuels inflation if it is not controlled. The findings of Opolot & Mpagi (2017) as well as Inyiama & Ekwe (2014) are contrary to ours. The latter found a slight significant positive impact of exchange rate on inflation in Nigeria, although they also found no causality between inflation and exchange rate in the country. However, such a finding is cumbersome. Mainwhile, similar to the work of Lagoa (2017) on the Euro zone, Imimole & Enoma (2011) found exchange rate among other variables including money supply and GDP as the pertinent factors determining inflation in Nigeria. Such finding is not specific compared with our result. It is also pertinent to note that ERR switches from 1 to 0 and the coefficient of ERR is -1.8743. This means that the percentage impact of *ERR* on inflation rate is 100 [$exp(-c)$ - 1], that is, 100[exp(-4.7)-1]. This indicates a 99 percent negative impact on the inflation rate as ERR moves from 1 (fixed regime) to 0 (floating regime). In other words, within the floating exchange rate regime, as the exchange rate increases, the inflation rate decreases and vice versa. This suggests that the floating exchange rate regime policy is preferable for controlling rising inflation rate compared to the fixed exchange rate. This reinforces the position of most authors in the literature including the IMF.[1]

[1] For instance, see (Owosekun, 1975; Elbadawi, 1990; Ghanem, 2012).

5. Conclusion and Recommendations

This paper has examined exchange rate regimes and inflation in Nigeria. We used the Autoregressive Distributed Lag Bounds test cointegration technique. The system of exchange rate in Nigeria has oscillated between the flexible and fixed counterpart. The paper therefore used a dummy variable to show the difference between the two regimes and its effects on inflation in the country. This study has reinforced that monetary policy remains effective in the short-run since a co-integration nexus in the model was not found. It has re-established that flexible exchange system rate remains a better option for increasing the value of the Naira provided institutional challenges are holistically dealt with. We do not object to using variants or a mix of the flexible exchange system provided a correct dose of the policy is prescribed. However, we support the de jure type of the flexible exchange rate and are against the de facto. Mainwhile, the Central Bank of Nigeria must be credible and the independence of the Bank must be achieved. It is imperatives that future studies on Nigeria consider wider spectrum of the exchange rate regimes. In specific terms, we make the following recommendations. First, the government of Nigeria must continue to ensure that it achieves exchange and interest rates stability in order to stem inflationary tendencies. Second, to curb inflation, there is the need for high transparency in monetary policy implementations. Third, the policy linkage between monetary policy instruments in the country should remain very strong in the short–run. Fourth, achievement of price stability can be enhanced if the exchange rate regimes are explicit and correctly identified by the public. In all, there should be effective structural reforms in place in order to reap the benefits of right policies implemented in Nigeria.

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