# Exchange Rate Management and Regime: Quo Vadis Nigeria?

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## Abstract

This study investigated a pertinent question on the lips of every Nigerian; exchange rate regime, Quo Vadis Nigeria? Nigeria, Quo Vadis (where do we go)? under two alternative managed floating regimes; Dutch Auction System and post Dutch Auction System regimes, within the Autoregressive Distributive Lag methodology using monthly data covering from July 2002 to July 2017. The results for the full sample show that none of the selected macroeconomic variables has a significant short run relationship with the nominal effective exchange rate. In the long run, all the variables, except interbank rate, show negative relationship with nominal effective exchange rate. However, while the effects of oil prices, interbank rate and the prime lending rate are significant, the effects of inflation and stock prices are insignificant. The results for the Dutch Auction System sample show little evidence of a negative short run relationship between nominal effective exchange rate and inflation while oil prices, prime lending rate, interbank rate and stock prices all show no evidence of a short run relationship with exchange rate. On the contrary, oil prices, prime lending rates and stock prices all show significant negative long run relationship with nominal effective exchange rate. The results for the post Dutch Auction System sample show evidence of a positive short run relationship between stock prices, interbank rate and nominal effective exchange rate. On the other hand, inflation, oil prices and prime lending rate show no short run relationship nominal effective exchange rate. However, there is evidence of a lagged positive relationship between inflation and nominal exchange rate. The cointegration test for post Dutch Auction System sample gives inconclusive results. We therefore, conclude that the choice of exchange rate regime matters for macroeconomics performance in Nigeria and that the closure of the Dutch Auction system by the monetary authorities significantly altered the relationship between nominal exchange effective exchange rate and macroeconomic variables.

**Keywords:** Exchange rate regimes; Macroeconomic variables; Dutch auction system.

## 1. Introduction

The record on exchange rate behaviour is central in assessing macroeconomic performance. The main issue which has attracted the attention of scholars, policy makers and international businessmen and investors is whether the choice of exchange rate regime matters for business cycles and the overall macroeconomic performance, especially in the developing countries. It is believed that countries with more flexible exchange rate regimes achieve faster growth and macroeconomics stability than countries with fixed exchange rates (Edwards and Yeyati, 2005; Levy-Yeyati and Sturzenegger, 2003; Rodrik, 2007), and changing from one regime to another has serious macroeconomic implications (Ye *et al.*, 2014). However, despite this common view, many studies have reported evidence suggesting that the choice of exchange rate regime does not influence the behaviour of macroeconomic variables as well as their interactions (Baxter and Stockman, 1989; Combes *et al.*, 2016; Dedola and Leduc, 1999; Singh, 2002).

In Nigeria, different variants of flexible or managed floating exchange rate regime have been adopted since the third quarter of 1986 when the structural adjustment programme (SAP) was introduced (see Table 1). Among these variables is the Dutch Auction system (DAS). DAS is a system in which exchange rate is determined through a bidding process involving the central bank (CBN) and authorized dealers who are usually commercial banks. The DAS also has two variants; namely, Retail Dutch Auction System or RDAS and the wholesale Dutch Auction system or WDAS.

The retail variant of the Dutch Auction system (RDAS) was first adopted by CBN in April 1987, two quarters after the introduction of SAP. The main objective is to achieve a realistic exchange rate for Naira under a flexible but managed system. The adoption of the RDAS was also to ensure professionalism in the bidding process and to enhance transparency in the management of foreign exchange (Central Bank of Nigeria, 2011; Ndako, 2015). Under the RDAS, the CBN allowed buyers to purchase foreign currency through their authorized dealers only at the bid rates they requested or specified so that the exchange rate (ruling rate) was the marginal rate that cleared the market. In spite of the successes recorded, the RDAS was closed on July 2, 1987, following the merger of the first and second-tier foreign exchange market to form the enlarged foreign exchange market. The RDAS Systems was reintroduced in December 1990, July 2002, January 2009 and September 2013 after other measures adopted failed to achieve the desired policy objectives. The RDAS continued to be in operation until February 18, 2015 when the system was finally closed.

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The wholesale version of Dutch Auction system (WDAS) was first adopted on February 20, 2016 when the CBN closed the RDAS. The adoption of the WDAS was mainly to consolidate the success of the RDAS and further liberalize the foreign exchange market (Central Bank of Nigeria, 2011). Although, both RDAS and WDAS are operationally the same, the main difference between them is that while WDAS encourages authorized dealers to make bulk purchase which may be in excess of the actual amount requested by their customers who are the end-users, bidding under RDAS is only based on the actual request by end-users. The WDAS was closed in January 2009 when the CBN reversed its exchange rate policy in favour of RDAS. However, it was reintroduced in July same year following what the CBN described as improvement in the revenue from crude oil sales (Ndako, 2015). Again, the CBN announced the closure of WDAS in September 2013.

This study investigates the relationship between exchange rate and macroeconomic variables in Nigeria within the ARDL framework using monthly data from 2002 to July 2017. Our main objective is to provide evidence on the relationship between nominal exchange rate and key macroeconomic variable; namely, inflation, interest rate, oil prices and stock prices on exchange rate under alternative regimes; namely DAS and post DAS regimes. We argue that the closure of the RDAS/WDAS in February 2015 which was predicated on the falling global oil prices and widening margin between the interbank and RDAS rates significantly alters the relationship between the nominal effective exchange rate and the selected macroeconomic variables. To the best of our knowledge, none of the previous Nigerian studies consider this line of specify inquiry.

The remainder of this paper is arranged as follows: The next section provides a review of both theoretical and empirical literature. Section 3 describes the variables, data and methods of analysis. In section 4, we analysed the study data and discuss the empirical findings. The study is concluded in section 5.

**Table-1.** Exchange policy and regimes in Nigeria (1986 – 2015)

| Date | Exchange rate policy | Regime |
|------|---------------------|--------|
| **Pre-SAP period (1959- September 26, 1986)** | | |
| 1959-1967 | Exchange rate parity with the British pounds (BP) | Fixed |
| 1962 | Exchange rate control Act which recognized only one official market | Fixed |
| November 1967 | Naira move independently of BP but pegged to US dollars (USD) | Fixed |
| 1970 | Pegged to BP | Fixed |
| 1971 | Pegged against a basket of currencies which includes Deutsche mark, the swiss Franc, the French franc, the Dutch guilder, the Japanese yen, and the Canadian dollar | Fixed |
| Jan 1,1973 | Introduction of Naira | Fixed |
| 1978 | Peg Naira to basket of currenciesusing import-weighted approach | Fixed |
| September 26, 1986: introduction of SAP, second tier foreign exchange market (SFEM) | | |
| April 1987 | RETAIL Dutch Auction system (RDAS) was introduced | Flexible |
| July 2, 1987 | First-tier and Second -tier Foreign exchange market was merged | Flexible |
| 1988 | Autonomous foreign exchange market (AFEM) | Flexible |
| January 1989 | Enlarged interbank foreign exchange market (IFEM) was introduced to replace the AFEM | Flexible |
| 1998 | Bureau the exchange (BDC) was introduced | Flexible |
| December 1990 | Reintroduction of the RETAIL Dutch Auction system (RDAS) | Flexible |
| 1994 | Exchange rate officially fixed | Fixed |
| 1995 | Guided deregulation, AFEM reintroduced | Dual |
| January 1999 | Official fixed rate abolished | Flexible |
| October 1,1999 | Interbank foreign exchange market (IFEM) was introduced to replace AFEM | Flexible |
| July 22, 2002 | Reintroduction of the RETAIL Dutch Auction system (RDAS) | Flexible |
| February 20, 2006 | Wholesale Dutch Auction System (WDAS) replaced RDAS | Flexible |
| January 2009 | Reintroduced of the RETAIL Dutch Auction System (RDAS) | Flexible |
| July 2009 | Wholesale Dutch Auction System (WDAS) was reintroduced | Flexible |
| September 2013 | RETAIL Dutch Auction System (RDAS) was reintroduced | Flexible |
| February18, 2015 | RETIAL Dutch Auction System (RRDAS) was closed | Flexible |

**Sources:** CBN; Understanding Monetary policy series 2011(No 8) and 2015(No 52

# 2. Literature Review
## 2.1. Exchange rate and Macroeconomic Variables
It is common knowledge that choice of exchange rate management has implication for macroeconomics variables. This section reviews the theoretical link between exchange rate and macroeconomic variables such as inflation, interest rate oil prices and stock prices.

### 2.1.1. Exchange Rate and Inflation
Economic theory suggests a direct link between inflation and exchange rate. A rise in the domestic price level causes misalignment in exchange rate and leads to domestic currency depreciation and vice versa. Also, for an

economy that depends mainly on import, currency depreciation makes imported goods costlier and leads to higher inflation. Thus, there is bidirectional causation between exchange rate and inflation.

### 2.1.2. Exchange Rate and Interest Rates

The theoretical relationship between exchange rate and interest rate is well known. If the domestic interest rates are high, foreign demand for domestic currency would increase because more and more foreigners would invest in the domestic financial assets to take advantage of the relative higher returns on those assets. This would increase the capital inflow and strengthen the domestic currency. Therefore, causality runs from interest rate to exchange rate.

### 2.1.3. Exchange Rate and Oil Prices

Theoretically, the nature of the relationship between oil prices and exchange rate of a country depends on whether the country is an oil exporter or imports oil. A positive oil price shock increases the wealth of an oil exporting country but reduces that of oil importing country. This has been described as wealth effect (see Krugman, 1983; (Golub, 1983). This, the domestic currency of a country that exports oil is expected to appreciate when oil prices are rising and depreciate when oil prices are falling.

### 2.1.4. Exchange Rate and Stock Prices

There are two theoretical approaches to the link between exchange rate and stock prices; the flow-oriented and the stock-oriented approaches. According to the flow-oriented approach (or the traditional theory), a depreciation of the domestic currency would make exports cheaper and more competitive which would lead to an increase in the foreign demand for local goods. Consequently, local firms would expect higher cash flows and their prices in the stock market would increase (Dornbusch and Fischer, 1980). Thus, causality runs from exchange rate to stock prices. On the other hand, stock-oriented approach or portfolio balance theory holds that causality runs from stock prices to exchange rate (Branson, 1983; Frankel, 1983). An upward trend in the stock market would signal better economic prospects and attract more capital flow. This would increase the demand for the local currency and force exchange rate to appreciate.

### 2.2. The Review of Related Literature

The relationship between exchange rate and macroeconomic variables has continued to attract the attention of scholars in international macroeconomic and finance literature. The main issue of concern is whether the choice of exchange rate regime has a significant influence on the interaction among these macroeconomic variables. While some studies find empirical support for the view that the choice of regime plays a neutral role and does not change the behaviour of macroeconomic variables (Baxter and Stockman, 1989; Combes *et al.*, 2016; Dedola and Leduc, 1999; Singh, 2002), others find support that the choice of exchange rate regime does indeed matter (Edwards and Yeyati, 2005; Egwaikhide *et al.*, 2014; Erdem and Omen, 2015; Levy-Yeyati and Sturzenegger, 2003; Ye *et al.*, 2014).

### 2.3. Studies Supporting the Neutrality View

Baxter and Stockman (1989), examine the performance of output, consumption, trade flows, government consumption and real exchange rates under alternative exchange-rate regimes using a sample of 49 countries. Consistent with the regime neutrality hypothesis, they find little evidence of systematic differences in the behavior of these macroeconomic variables or international trade flows under alternative exchange-rate systems.

Using a two-country, two-sector general equilibrium business cycle model with nominal rigidities incorporating deviations from the law of one price, Dedola and Leduc (1999) find that although; exchange rate changes substantially under a flexible regime, the variability of selected macroeconomic fundamentals such as output, money supply and interest rates is not significantly influenced by exchange rate regimes.

In India, Singh (2002), examine exchange rates volatility by fitting a GARCH model to both weighted and unweighted real exchange rates at quarterly frequency. Consistent with the regime neutrality hypothesis, he finds that GARCH effects remain unchanged regardless of the choice of sample period.

A cross exchange rate regimes based on "de jure" and "de facto" classifications, using monthly data from 1980 to 2006. They find evidence of regime neutrality and that changes in the mean of most of the macroeconomic variables are not significantly different from each other under the de facto regimes.

Combes *et al.* (2016), examine the link between exchange rate regime and crisis in both developed and developing countries from 1980 to 2009. Consistent with the regime neutrality theory, they find that the choice of exchange rate regime plays unimportant role when it comes to the likelihood of crisis irrespective of the type of crisis (banking, currency or debt crisis). Thus, the argument that some regimes are more prone to crisis than others is countered.

### 2.4. Studies Supporting the Non-Neutrality View

In a study of 183 counties over the period from 1974 to 2000, Levy-Yeyati and Sturzenegger (2003) examine the relationship between exchange rate regimes and economic growth. The study classifies exchange rate regimes based on the actual behavior of the relevant macroeconomic variables. The findings of the study support the non-neutrality hypothesis and suggest that exchange regimes have significant influence on the real economic performance for developing countries. Particularly, fixed exchange rate regime is found to be associated with slower

growth rates and higher output volatilities in those countries. However, for developed countries, the findings suggest a weak connection between exchange rate regimes and macroeconomic performance and growth.

Edwards and Yeyati (2005), examine the dynamic interaction between terms of trade and real per capita GDP growth under alternative exchange rate regimes for 183 countries for the period from 1974 to 2000 using the error correction method. They find evidence suggesting that terms of trade shocks amplify in countries with more rigid exchange rate regimes and that the effects are larger for negative shocks than positive shocks. The results also show that countries with more flexible exchange rate regimes achieve faster growth than countries with fixed exchange rates.

Ye *et al.* (2014), examine the impact of exchange rate regimes on the foreign exchange exposure of emerging market firms. Based on a sample of 1523 films from 20 countries from December 1999 to December 2010, the results show that the magnitude of exposure is greater for firms operating in countries with pegged arrangements than for those operating in countries with floating arrangements. The results also show that exchange rate regime has significant explanatory power for firms' exchange rate exposure and that switching from pegged to floating regime significantly increases the foreign exchange exposure.

The empirical work by Erdem and Omen (2015) consider the impacts of both domestic and external factors along with exchange rate regimes (ERRs) on business cycles in both advanced and emerging market countries. Specifically, the study analyzes a panel of 23 advanced countries and 27 emerging market economies (EME) to determine whether exchange rate regimes matter for both business and growth cycles. The results show that both external and domestic shocks have more impact under the managed floating regimes than the floating regimes. They, therefore, conclude that the choice of exchange rate regimes has implications for both business cycles and growth cycles in both EMEs and advanced countries.

## 2.5. Empirical Studies in Nigeria

In Nigeria, Bakare (2011), empirically analyzes the consequences of the foreign exchange rate reforms on private domestic investment over the period from 1978 to 2008 using annual data. The results show that floating exchange rate regime has a significant negative influence on private domestic investment_

Using the vector autoregressive (VAR) methodological framework, Egwaikhide *et al.* (2014), examine the relationship between exchange rate and monetary aggregates under the two broad regimes; namely, fixed and flexible (managed float) exchange rate regimes in Nigeria. Based on yearly time series data from 1961 to 2013, the results show, among other things, that the contribution of exchange rate to the shocks to inflation, interest rate, money supply and real GDP is more substantial under the managed floating regime than under the fixed exchange rate regime.

Recently, Obi *et al.* (2016), consider the relationship between exchange rate regimes and output growth in Nigeria between 1970 and 2014 using the Generalized Method of Moments. They find that the deregulated exchange rate regime positively influenced output growth while the fixed exchange rate regime adversely affected economic growth. Thus, the choice of exchange rate regime matters for economic performance in Nigeria.

More recently, Essien *et al.* (2017), consider the real exchange rate dynamics and misalignment under different regimes in Nigeria for the period from 2000Q1 to 2016Q1 using Behavioural Equilibrium Exchange Rate (BEER) model. They find that exchange rate policy, productivity and interest rate differentials are the key determinants of real exchange rate movements. They also find that the exchange rate regimes significantly influenced the value Nigeria's currency over the sample period. Specifically, the domestic currency was overvalued by 1.22 per cent under IFEM regime (between 2000 and 2002), overvalued by 0.35 per cent under RDAS regime (between 2002 and 2006), undervalued by 0.39 per cent during WDAS (between 2006 and 2013) and undervalued by 0.25 per cent in the period succeeding the WDAS till March, 2016.

## 3. Methodology
### 3.1. Data

Monthly data (in logarithmic form) on nominal effective exchange rate, oil prices, inflation rate (All items year on year change), interest rates and stock market index (All share index) from July 2002 to July 2017 are used. It is well known that exchange rate management strategy has implications and direct consequences for these macroeconomic variables. However, two different interest rates are used; namely, interbank call rate and prime lending rate. The interbank call rate is the rate at which banks borrow money in the money market to cover temporary liquidity problems or meet regulatory reserve requirement (CBN, 2013) while the prime lending rate is the rate at which commercial banks lend money to their valuable customers. All data are sourced from the CBN database and are converted into logarithm for quality empirical analysis. All analysis are done in EVIEWS 9.

We assume that both WDAS and RDAS are the same since both have the same operations mechanisms. It is our view that the closure of the Dutch Auction System (WI)AS/RDAS) that was officially announced on February 18, 2015 by the CBN, fundamentally altered the relationship between exchange rate and the selected macroeconomic factors, so we split our data into two sub-periods; (1) the DAS sub-period and (2) the post-DAS sub-period. The first sub-period sample covers from July 2002, when DAS was reintroduced, to January 2015, when DAS was finally closed, while the second sub-period covers from February 2015 to July 2017.

The time series plot of the log of the nominal effective exchange (NEER) data over the full sample period is shown in Figure 1. As the Figure displays, it is very clear that. The nominal effective exchange rate underwent several periods of sudden changes over time which may have implication for stability of the parameter estimates for

the entire sample. However, consistent with the study objective which is to examine the behaviour of exchange rate model during and after the Dutch Auction regimes, we focus only on the large changes recorded at January 2015, which is the month preceding the closure of the Dutch Auction system. This, as we argued earlier, might have caused a fundamental change in the behaviour of exchange rate, especially regarding to its relationship with other macroeconomic variables.

**Figure-1.**
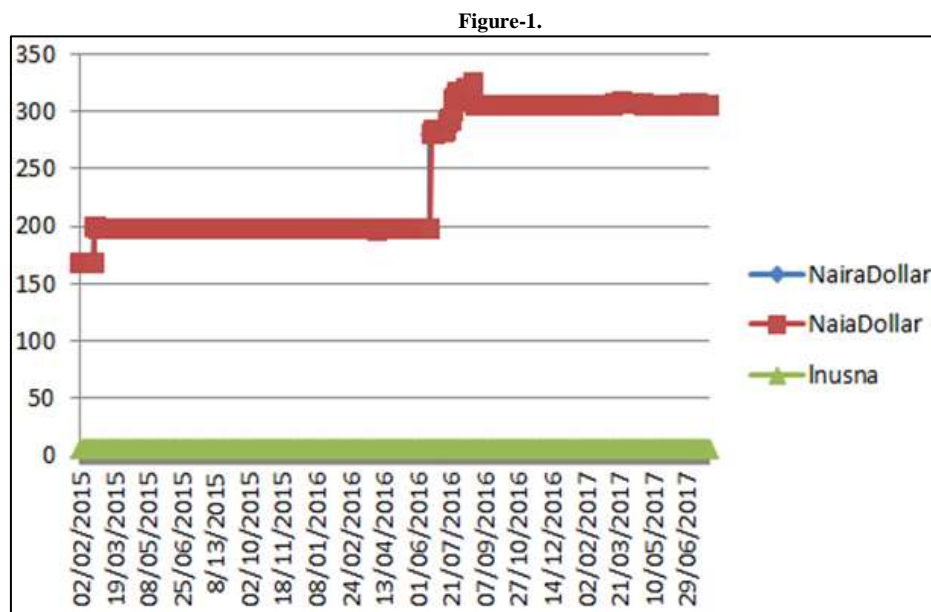


As usual, the reliability of the data is examined using the Dickey and Fuller (1979) unit root test approach. This is necessary to avoid spurious regression and perhaps, the starting point of any meaningful econometric analysis involving macroeconomic and financial time series. The ADF unit root test results are shown in tables 1, 2, 3. The lag length for the test is determined using the popular Akaike information criterion (AIC). From Table 2, the results for the entire sample suggest that the study variables have different orders of integration, with LNEER, LOIL and LASI having first order integration or 1(1), and LINFL, LIBR and LPRIME having zero order integration or 1(0) as indicated by the p-values. Zero order integration is associated with stationary at level data while first order integration is associated with stationarity at first difference. Similar results are also reported in Table 3 for the DAS sample unit root test. While LNEER, LOIL and LASI are integrated of order one, LINFL, LIBR and LPRIME are integrated of order zero. By contrast, however, the results for the post-DAS sample test in Table 4 show that all the variables are stationary at first difference, suggesting that they are all integrated of order one. These results have implication for ARDL method.

The ARDL method, amongst others, allows for the analysis of cointegration even when the variables have different orders of integration. Thus, variables that are 1(0) or 1(1) or a combination of both can be tested for cointegration within the ARDL framework.

**Table-2.** The ADF test result @full sample

| p-value of the ADF test @ Full sample | | | |
|---|---|---|---|
| **Variable/test specification** | **@Level** | **@First difference** | Remark |
| LNEER @Constant & Trend | 0.9073 | 0.0126 | *I(1)* |
| LOIL @Constant & Trend | 0.2110 | 0.0000 | *I(1)* |
| LINFL @Constant & Trend | 0.0182 | - | *I(0)* |
| LIBR @Constant & Trend | 0.0007 | - | *I(0)* |
| LPRIME @Constant & Trend | 0.0067 | - | *I(0)* |
| LASI @Constant & Trend | 0.1336 | 0.0001 | *I(1)* |

**Table-3.** The ADF test result @DAS sample

| p-value of the ADF test @ DAS sample | | | |
|---|---|---|---|
| **Variable/test specification** | **@Level** | **@First difference** | **Remark** |
| LNEER @Constant & Trend | 0.7663 | 0.0001 | *I(1)* |
| LOIL @Constant & Trend | 0.1906 | 0.0002 | *I(1)* |
| LINFL @Constant & Trend | 0.0348 | - | *I(0)* |
| LIBR @Constant & Trend | 0.0065 | - | *I(0)* |
| LPRIME @Constant & Trend | 0.0187 | - | *I(0)* |
| LASI @Constant & Trend | 0.1474 | 0.0015 | *I(1)* |

**Table-4.** The ADF test result @ post DAS sample

| *p*-valu*e* of the ADF test @ post DAS sample | | | |
|---|---|---|---|
| **Variable/test specification** | **@Level** | **@First difference** | Remark |
| LNEER @Constant & Trend | 0.9609 | 0.0019 | *I(1)* |
| LOIL @Constant & Trend | 0.4061 | 0.0000 | *I(1)* |
| LINFL @Constant & Trend | 0.7117 | 0.0499 | *I(0)* |
| LIBR @Constant & Trend | 0.1843 | 0.0034 | *I(0)* |
| LPRIME @Constant & Trend | 0.1594 | 0.0000 | *I(0)* |
| LASI @Constant & Trend | 0.7483 | 0.0001 | *I(1)* |

### 3.2. Methods

Consistent with our stationarity results in the previous section, we employ the ARDL methodology to examine the interaction between exchange rate and the selected macroeconomic variables. The ARDL model is a dynamic least square that ensures flexibility in the relationships between macroeconomic variables by incorporating the lagged values of both the dependent and explanatory variables as additional explanatory variables. The model also allows for cointegration test for variables that have different orders of integration. A simple ARDL specification incorporating one lag of the dependent variable and each of the explanatory variables as additional regressors is given by:

$$LNEER_t = \beta_0 + \beta_1 LNEER_{t-1} + \beta_2 LOIL_t + \beta_3 LOIL_{t-1} + \beta_4 LINFL_t + \beta_5 LINFL_{t-1} + \beta_6 LIBR_t + \beta_7 LIBR_{t-1}$$
$$+ \beta_8 LPRIME_t + \beta_9 LPRIME_{t-1} + \beta_{10} LASI_t + \beta_{11} LASI_{t-1} + u_t$$

Where; $u_t$ = error term that is not affected by both serial correlation and heteroskedasticity, LNEER = natural log of nominal effective exchange rate, LINFL = natural log of inflation, LIBR = natural log of interbank call rate, LPRIME = natural log of prime lending rate and LASI = natural log of All share index, $t$= current period (month), $t - 1$ = one lagged period or previous month.

# 4. Empirical Analysis

## 4.1. The ARDL results

The ARDL estimation results are presented in Tables 5 – 11. Akaike information criterion (AIC) is used to select the plausible ARDL specification for each sample. All estimations are based on HAC standard errors which are robust to both autocorrelation and heteroskedasticity.

## 4.2. The Full Sample Results

The estimation results for the full sample are presented in Table 5. As this Table shows, all the contemporaneous terms are insignificant, suggesting that changes in the selected variables do not immediately influence the nominal effective exchange rate. The coefficient on the one lagged value of exchange rate is positive and highly significant (beta = 0.943, p-value = 0.0000), indicating that the previous value of exchange rate has strong explanatory power for its current value. This implies that the Nigeria's nominal effective exchange rate is autoregressive. Similarly, oil prices and prime lending rate both have distributive lag effects on exchange rate, with their lag coefficients being negative and significant at 5% and 10% levels respectively. Thus, it takes up to one month for exchange rate to fully reflect the effect of changes in both oil prices and prime lending rate.

From panel A of Table 6, the error correction term has the expected negative sign and is highly significant [CointEq (-1) = -0.0563, p-value = 0.0013], suggesting that the exchange rate adjusts back to its long-run equilibrium at a speed of approximately 5% per month after deviating from it. The long run coefficients in panel B show that the nominal effective exchange rate has a negative relationship with each of the other variables in the model except the interbank rate. However, while the long run impacts of oil prices (p-value = 0.0005), interbank rate (p-value = 0.0829) and prime lending rate (p-value = 0.0017) are significant, the long run impacts of inflation (p-value = 0.9165) and stock prices (p-value = 0.1258) are insignificant. The impact of stock prices is significant at 10% level.

**Table-5.** ARDL regression results for full sample

| Variable | Coefficient | *p*-value |
|---|---|---|
| LNEER(-1) | 0.943673 | 0.0000 |
| LOIL | 0.047942 | 0.1132 |
| LOIL(-1) | -0.077309 | 0.0174 |
| LINFL | -0.000752 | 0.9154 |
| LINFL(-1) | 0.009851 | 0.1522 |
| LIBR | 0.245169 | 0.1728 |
| LPRIME | -0.386796 | 0.0632 |
| LPRIME(-1) | 0.039278 | 0.2833 |
| LASI | -0.060893 | 0.1199 |
| Constant | 0.991958 | 0.0013 |
| Adjusted R²    0.929980 | Prob(F-statistic)   265.1580 | Prob(F-statistic)   0.0000 |

**Table-6.** Cointegration and long run coefficient for full sample

| Variable | Coefficient | p-value |
|---|---|---|
| Panel A: Cointegration form | | |
| D(LOIL) | 0.04782 | 0.1132 |
| D(LINFL) | -0.000725 | 0.9154 |
| D(LIBR) | 0.009851 | 0.1522 |
| D(LRIME) | 0.245169 | 0.1728 |
| D(LASI) | 0.039278 | 0.2833 |
| CointEq(-1) | -0.056327 | 0.0013 |
| Cointeq =LNEER – (-0.5214*LOIL-0.0133*LINFL – 0.1749*LIBR – 2.5144 *LPRIME – 0.3837*LASI + 17.6108) | | |
| Panel B: Long run coefficients | | |
| LOIL | -0.521357 | 0.0005 |
| LINFL | -0.013346 | 0.9165 |
| LIBR | -0.174889 | 0.0829 |
| LPRIME | -2.514387 | 0.0017 |
| LASI | -0.383745 | 0.1258 |

## 4.3. The DAS Sub-Period Sample

The results for the DAS sample in Table 7 are broadly similar with those of the full sample in Table 5, with the lagged coefficient on the nominal effective exchange rate being positive and highly significant (beta = 0.895, p-value = 0.0000). This has confirmed that the Nigeria's nominal effective exchange rate is autoregressive, and thus can be predicted based on its previous values. Remarkably, there is no contemporaneous relationship in the model as all the contemporaneous terms are individually insignificant (p-value > 0.1). These contemporaneous terms are also jointly insignificant as shown by the Wald ($\chi^2$) statistic which validates the restriction that those individually insignificant coefficients are jointly zero. However, the coefficient on inflation is almost significant at 10% level. The coefficients on the lagged values of oil prices (beta, -0.059, p-value 0.0421) and prime lending rate (beta = -0.241, p-value = 0.0654) both are negative and significant while the coefficient on LASI(-l) (beta, -0.045, p-value 0.1254) is negative but insignificant. This suggests that the effect of changes in oil prices and prime lending rates on nominal effective exchange rate shows only in the intermediate period. Thus, like the full sample period, it takes at least one month for the effect of changes in oil prices and prime lending rate to fully reflect on the exchange rate under the Dutch Auction exchange system in Nigeria. The model is also very good in the sense of Adjusted $R^2$ and F-statistic, with one lagged period exchange rate, prime interest rate and oil prices jointly explaining as much as 91% of the variability of the exchange values around its mean.

The ARDL Bound cointegration test in Table 8 shows significance at 2.5% level for both 1(0) and 1(1) bounds, providing clear evidence that long-run relationships exist among the variables, irrespective of the fact that they are a mixture of 1(0) and 1(1) series. The long run coefficient in Panel B of Table 9 shows that exchange rate has a negative long-run relationship with all the selected variables, with oil prices (p-value = 0.0061), prime interest rate (p-value 0.0096) and stock prices (p-value 0.0126) showing significant effects. The exact significance (p-value = 0.1009) of the impact of inflation is approximately 10% while the effect of the interbank rate is insignificant (p-value 0.3071) at all reasonable levels. Further, like the full sample cointegration results in Table 6, the error correction term [CointEq(-1) = -0.1042] in Panel A of Table 9 has the expected negative sign and is highly significant (p-value = 0.0007), confirming the presence of a stable long run relationship in the model. Thus, under the DAS regime, exchange rate adjusted downward at a speed of about 10% per month, after exceeding its long-run equilibrium level with the selected macroeconomic variables. However, the cointegration form in panel A shows that the short run impact on exchange rate of each of the variables is insignificant. Again, the significance (p-value = 0.1051) of the impact of inflation is approximately 10%.

**Table-7.** ARDL regression for DAS sample

| Variable | Coefficient | p-value |
|---|---|---|
| LNEER(-1) | 0.895730 | 0.0000 |
| LOIL | 0.038488 | 0.1605 |
| LOIL(-1) | -0.059435 | 0.0421 |
| LINFL | -0.009041 | 0.1051 |
| LINFL(-1) | -0.002871 | 0.3519 |
| LIBR | 0.153866 | 0.2321 |
| LPRIME | -0.241442 | 0.0654 |
| LPRIME(-1) | 0.018696 | 0.4230 |
| LASI | -0.045486 | 0.1254 |
| Constant | 1.120344 | 0.0013 |
| $R^2$     0.9171 | F-statistic  173.4981 | Wald $\chi^2$(6)   7.5626 |
| Adjusted $R^2$     0.9118 | Prob(F-statistic)  0.0000 | Prob($\chi^2$ -statistic)  0.2719 |

**Table-8.** ARDL regression for DAS sample

| Test statistic | Value | |
|---|---|---|
| F-statistic (v = 5) | 3.002910 | |
| Critical Value Bounds | | |
| Significance | $I(0)$ | $I(1)$ |
| 10% | 2.26 | 3.35 |
| 5% | 2.62 | 3.79 |
| 2.2% | 2.96 | 4.81 |
| 1% | 3.41 | 4.68 |

**Table-9.** Cointegration and long run coefficient for DAS full sample

| Variable | Coefficient | p-value |
|---|---|---|
| Panel A: Cointegration form | | |
| D(LOIL) | 0.038488 | 0.1605 |
| D(LINFL) | -0.009041 | 0.1051 |
| D(LIBR) | -0.002871 | 0.3519 |
| D(LRIME) | 0.153866 | 0.2321 |
| D(LASI) | 0.018693 | 0.4230 |
| CointEq(-1) | -0.104270 | 0.0007 |
| Cointeq =LNEER – (-0.2009*LOIL-0.0867*LINFL – 0.0275*LIBR – 0.8399 *LPRIME – 0.2570*LASI + 10.7446) | | |
| Panel B: Long run coefficients | | |
| LOIL | -0.200898 | 0.0061 |
| LINFL | -0.086710 | 0.1009 |
| LIBR | -0.027530 | 0.3071 |
| LPRIME | -0.839894 | 0.0096 |
| LASI | -0.256961 | 0.0126 |
| Constant | 10.744649 | 0.0000 |

## 4.4. The Post DAS Sub-Period Sample

The positive and significant effect of the one period lagged exchange rate on the current exchange rate is also evident in the post DAS sub-sample period as shown in Table 10. However, unlike the previous cases, there are contemporaneous relationships in the model for the post DAS sub-sample period, with the coefficients on LASI (beta 0.288, p-value = 0.0318) and LIBR (beta 0.03 58, p-value = 0.0761) showing significance at 5% and 10% levels respectively. Further, the coefficient on inflation at lag 1 which was previously insignificant is now significant, while the lagged coefficient on oil prices and prime lending rate, both which were previously significant, are now insignificant. Meanwhile, the model is very well behaved and is as good as the previous models as shown by the adjusted $R^2$ (= 0.944) and the F-statistic (p-value = 0.0000), with the included regressors significantly explaining about 94% of the variation in exchange rate. Again, all the explanatory factors that are individually insignificant are also jointly insignificant as evidenced by the Wald test, which approves the restriction that those coefficients are jointly zero.

The ARDL Bound cointegration test in Table 11, perhaps not surprising, gives inconclusive results, with the F-statistic falling between the 1(0) and 1(1) bounds. That is, the value of the F-statistic (3.0029) is greater than up to 2.5% critical value for 1(0) bound at 2.96, but less than all the critical values at 1(1) bound. This does not necessarily imply that the selected macroeconomic variables are not likely to have long-run impacts on the nominal effective exchange rate in the post DAS regime, given that we are just about two and half years into the new exchange rate regime. The sample size may have affected the cointegration results as 30 observations at monthly frequency are not rich enough to produce any meaningful long- run results.

**Table-10.** ARDL regression for post DAS sample

| Variable | Coefficient | *p*-value |
|---|---|---|
| LNEER(-1) | 0.409404 | 0.0034 |
| LOIL | -0.045801 | 0.7475 |
| LOIL(-1) | -0.161063 | 0.1833 |
| LINFL | -0.699699 | 0.1121 |
| LINFL(-1) | 1.028904 | 0.0253 |
| LIBR | 0.035875 | 0.0761 |
| LPRIME | 0.835875 | 0.1653 |
| LPRIME(-1) | -1.35500 | 0.2083 |
| LASI | 0.288042 | 0.0318 |
| Constant | 1.263377 | 0.3743 |
| $R^2$ 0.962418 | F-statistic 54.06241 | Wald $\chi^2$ (5) 3.8886 |
| Adjusted $R^2$ 0.944616 | Prob(F-statistic) 0.0000 | Prob($\chi^2$ -statistic) 0.5656 |

**Table-11.** Bound cointegration test for post DAS sample

| Test statistic | | Value |
|---|---|---|
| F-statistic (v = 5) | | 3.002910 |
| Critical Value Bounds | | |
| Significance | $I(0)$ | $I(1)$ |
| 10% | 2.26 | 3.35 |
| 5% | 2.62 | 3.79 |
| 2.2% | 2.96 | 4.81 |
| 1% | 3.41 | 4.68 |

# 5. Summary and Conclusions

This study examines the macroeconomic implications of exchange rate management in Nigeria under two alternative managed floating regimes; DAS and post DAS regimes, within the ARDL methodology using monthly data covering from July 2002 to July 2017. In particular, the study seeks to determine whether the closure of the Dutch Auction System (DAS) in February 2015 significantly affects the relationship between nominal effective exchange rate and key macroeconomic variables such as inflation, interest rate, oil prices and stock prices.

The full sample results show that none of the selected macroeconomic variables (oil prices, inflation, interbank interest rate, prime lending rate and stock prices) has a significant short run relationship with the nominal effective exchange rate. In the long run, all variables, except interbank rate, show negative relationship with nominal effective exchange rate. However, while the effects of oil prices, interbank rate and prime rate are significant, the effects of inflation and stock prices are insignificant. Further, exchange rate adjusted towards its equilibrium level with the macroeconomic variables suffering a shock at a speed of approximately 5% per month.

The results for the DAS sample show little evidence of a negative short run relationship between nominal effective exchange rate and inflation while oil prices, prime lending rate, interbank rate and stock prices all show no evidence of a short run relationship with exchange rate. On the contrary, oil prices, prime lending rates and stock prices all show significant negative long run relationship with nominal effective exchange rate. The speed at which exchange rate adjusted towards its long-run equilibrium after deviating from it is approximately 10%.

The results for the post DAS sample show evidence of a positive short rim relationship between stock prices, interbank rate and nominal effective exchange rate. On the other hand, inflation, oil prices and prime lending rate show no short run relationship with nominal effective exchange rate. However, there is evidence of a lagged positive relationship between inflation and nominal effective exchange rate. However, the cointegration test for the post DAS sample gives inconclusive results.

On balance, contrary to the regime neutrality view, our results show that the closure of the Dutch Auction System by the monetary authorities significantly alters the relationship between nominal exchange effective exchange rate and macroeconomic variables. Thus, in agreement with most of the previous Nigerian studies, the choice of exchange rate regime matters for macroeconomic performance in Nigeria.

# References

Bakare, A. S. (2011). The consequences of foreign exchange rate reforms on the performances of private domestic investment in Nigeria. *International Journal of Economics and Management Sciences,* 1(1): 25-31.

Baxter, M. and Stockman, A. C. (1989). Business cycles and the exchange-rate regime: Some international evidence. *Journal of monetary Economics,* 23(3): 377-400.

Branson, W. H. (1983). A model of exchange-rate determination with policy reaction: Evidence from monthly data. NBER Working Paper No, 1135, . 1-33.

CBN (2013). *Central bank economic report.* CBN Publication Department, 2013.

Central Bank of Nigeria (2011). *Exchange rate management in Nigeria. Understanding monetary policy series.* CBN Publication Department.

Combes, J. L., Linea, A. and Sow, M. (2016). Crises and Exchange Rate Regimes: Time to break down the bipolar view? *Applied Economics,* 48(46): 4393-409.

Dedola, L. and Leduc, S. (1999). On exchange rate regimes, exchange rate fluctuations, and fundamentals (No. 99-16).

Dickey, D. A. and Fuller, W. A. (1979). Distribution of the estimation for autoregressive time series with a unit root. *Journal of the American Statistcal Association,* 74(366): 427-31.

Dornbusch, R. and Fischer, S. (1980). Exchange rates and the current account. *The American Economic Review,* 70(5): 960-71.

Edwards, S. and Yeyati, E. L. (2005). Flexible exchange rates as shock absorbers. *European Economic Review,* 49(8): 2079-105.

Egwaikhide, F., Onyilola, Adeniyi and Olanipekun, D. B. (2014). *Empirical exposition of monetary policy under a flexible and managed float exchange rate regime: Any lesson for nigeria? Exchange rate policy and economic management in Nigeria - is there a need for a paradigm shift?* , 52 vols. Abuja: Central Bank of Nigeria. 29 -52.

Erdem, F. P. and Omen, E. (2015). Exchange rate regimes and business cycles: An empirical investigation. *Open Economies Review,* 26(5): 1041-58.

Essien, S. N., Uyaebo, S. O. and Omotosho, B. S. (2017). Exchange rate misalignment under different exchange rate regimes in Nigeria. *CBN Journal of Applied Statistics,* 8(4): 1-21.

Frankel, J. A. (1983). *Monetary and portfolio-balance models of exchange rate determination. economic interdependence and flexible exchange rates.* JS Bhandari and BH Putnam ed.

Golub, S. S. (1983). Oil prices and exchange rates. *The Economic Journal,* 93(371): 576-93.

Levy-Yeyati, E. and Sturzenegger, F. (2003). To float or to fix: evidence on the impact of exchange rate regimes on growth. *American Economic Review,* 93(4): 1173-93.

Ndako, U. B. (2015). *The dutch auction system (das) of exchange rate management in nigeria. Understanding monetary policy series, no 52.* Central Bank of Nigeri: Abuja, Nigeria.

Obi, K., Oniore, O. and Nnadi, K. U. (2016). The impact of exchange rate regimes on economic growth in Nigeria. *Journal of Economics and Sustainable Development,* 7(12): 115-27.

Rodrik, D. (2007). The real exchange rate and economic growth. *Brookings Papers on Economic Activity,* 39(2): 365-439.

Singh, T. (2002). On the LARCH estimates of exchange rate volatility in India. *Applied Economics Letters,* 9(6): 391-95.

Ye, M., Hutson, E. and Muckley, C. (2014). Exchange rate regimes and foreign exchange exposure: The case of emerging market firms. *Emerging Markets Review,* 21(2014): 156-82.