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RELATIONSHIP BETWEEN INTEREST RATE AND EXCHANGE RATE IN NIGERIA: DOES THE BANKING SECTOR DEBT LEVEL MATTER?

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Abstract
This study examines how the exchange rate responds to interest rate changes in the presence of a high debt level in the banking sector in Nigeria. Using the Pesaran, Shin and Smith's Bounds testing approach to analyse their level relationships, we estimated an Autoregressive Distributed Lag (ARDL) model with annual data for the period of 1981 to 2019. We constructed an interaction variable between the level of debt dummy and the interest rate to examine the marginal effect of interest rate under the condition of high debt. The results show that high interest rates, in the presence of a low debt level of the banking system, tends to induce exchange rate appreciation, possibly as capital inflows increase. However, in the presence of a high debt level in the banking system, the reverse effect is found to be the case: higher interest rates tend to induce exchange rate depreciation. This, we argue, could be because investors may be scared away by the fear of bankruptcy in the system. This finding, we argue, underscores the potentially important role of corporate debt level in determining the efficacy of monetary policy for exchange rate stabilisation. It is, therefore, recommended that monetary authorities should keep a close watch on the debt profile of the banking system, making sure it doesn't reach an alarming level.

Keywords: Exchange Rate, Interest Rate, Monetary Policy, Banks Debt, ARDL
JEL Classifications: F3 F31 E52 G21

Introduction

Since the exit from the rigidly fixed exchange rate regime in 1986, the Nigerian economy has had to find a means of stabilising violent fluctuations in the exchange rate that are typically associated with flexible regimes, especially in the context of export earnings instability. Different exchange rate reforms have been implemented to curb such instability. These reforms include but are not limited to; the Whole Sale Dutch Auction System (WDAS) in 2006, before which Autonomous Foreign Exchange Market (AFEM) and Inter-Bank Foreign Exchange Market (IFEM) were implemented in 1995 and 1999 respectively. Recently, to deepen the liquidity and supply of Foreign Exchange (FX), the CBN introduced the Investors and Exporters FX Window (I&E Window) also Known as Nigerian Autonomous Foreign Exchange (NAFEX) on April 21, 2021[1].. Similarly, a policy of the "Naira 4 Dollar scheme" for diaspora remittances was introduced by the CBN on March 5, 2021, to deepen the Dollar supply[2]. Furthermore, in a more recent development, to unify the exchange rate of the Naira and further curb depreciating pressure, the Central Bank of Nigeria announced the ban of Foreign Exchange sales to Bureau de Change (BDC) Operators as well as the processing of applications for BDC licence on Tuesday, July 27, 2021.

In addition, monetary policy was also reformed in 1986 from direct control to a market-based approach. The market-based approach allows the central bank to use indirect instruments, including the interest rate, in the conduct of monetary policy (CBN, 2017:67). Since the shift to a flexible exchange rate regime and indirect market-based approach to monetary policy in 1986, monetary policy has been

[1] This was contained in a circular referenced FMD/DIR/CIR/GEN/08/007
[2] This also is contained in a circular referenced TED/FEM/PUB/FPC/01/003.

assigned a greater role in exchange rate management in Nigeria. Monetary policy has, therefore, relied on indirect market-based techniques, key amongst is the use of interest rate (and discretionary use of CBN's balance sheet to achieve exchange rate stability objective). Indeed, under a flexible exchange rate regime, as Sanusi (2002) noted, the primary objective of monetary policy, which is to ensure price stability, is inextricably intertwined with exchange rate stability.

Although several theoretical models are suggesting a link between interest rate and exchange rate stability, the effectiveness of monetary policy in stabilising exchange rate volatility has been an empirical question for several reasons. For instance, in the context of an import-dependent, an oil-exporting economy with open capital account and flexible exchange rate regime, the so-called *trilemma* constrains the use of monetary policy (interest rate) in addressing domestic objectives (say output and price stabilisation) while exchange rate (flexibility) serves as the absorber of external shocks via its fluctuations. However, monetary authorities often try to stabilise the exchange rate with the use of monetary policy instruments - interest rate. Tightening through raising the interest rate, for instance, affects the foreign exchange market (Adamu & Sanusi, 2016). By raising yields of domestic financial assets, capital inflows may increase if foreign investors (portfolio, direct and debt instruments) find the domestic assets more attractive[3]. This would raise the supply of foreign currency relative to domestic and exert an appreciating pressure on the domestic currency. The converse would be the case for a monetary policy easing. In the context of a peg, or managed float with an open capital account, however, the relationship between interest rate and exchange rate depends on several intervening factors including the level of corporate debt. For instance, Goderis and Loannidou (2008) show that, contrary to the conventional wisdom, a high interest rate in the presence of a high level of corporate debt would, instead of appreciating, depreciate the currency.

Therefore, conventional wisdom suggests that a higher interest rate (or monetary policy tightening) would make taking short positions in the currency under speculative attack prohibitively more expensive for speculators, thereby making tightening an effective tool for defending the currency. However, as Goderis and Loannidou (2008) argues, in the presence of a high level of corporate debt, the higher interest rate could raise the debt servicing costs, thereby making the tightened policy stance less credible and raise expectations for devaluation and speculative attack on the very currency the policy intended to defend[4]. The relationship between interest rate and exchange rate may, therefore, depend contingently on the level of corporate debt (see Goderis & Loannidou, 2008).

In Nigeria, evidence from several Communiques of the Central Bank of Nigeria's Monetary Policy Committee suggests that foreign reserves and exchange rate considerations have been important in deciding monetary policy actions. This indicates the monetary authorities' belief that there is a strong relationship between the interest rate (monetary policy) and the exchange rate in Nigeria. While this may be empirically true, as suggested by several studies (see for instance Musa & Sanusi, 2020; Adamu & Sanusi, 2016; Flood & Jeanne, 2005; Gudmundsson & Zoega, 2006; Hassan, Abubakar, & Dantama, 2016), several empirical questions regarding this relationship remain unsettled in the case of Nigeria. For instance, in the context of the debate highlighted above relating to the role of corporate debt level, what is the role of corporate debt level in the relationship? Are monetary tightening (or raising interest rate) always associated with an appreciation of the exchange rate irrespective of the level of corporate

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[3] The effect of a higher interest rate on the exchange rate may also depend on whether the rate was raised during a crises period or in crises environment. For instance, raising the interest rate during a crises period may be ineffective in defending a currency because doing so could create expectations for widespread bankruptcies (Basurto and Ghosh, 2001): this is especially more likely where the level of corporate debts are high. Consequently, instead of causing appreciation, the higher interest rate may cause depreciation.

[4] Bensaid and Jeanne (1997) present a stylised model where raising the interest rate enable the government to defend the exchange rate but at a cost to the government. Speculators, being aware of this cost, expect the government to stop defending the currency and therefore take a speculative position against the currency. This would eventually lead to depreciation when the government no longer bears the cost. This cost can be a result of pre-existing government indebtedness, corporate debt, etc. the cost of which increases with a higher interest rate. In such a case, therefore, a higher interest rate leads to depreciation, rather than appreciation.

debt? This paper, to the best of our knowledge, is the first attempt to address these empirical questions in the context of Nigeria.

The rest of the paper is organised as follows: Section 2 reviews the relevant literature. Section 3 presents the statistical methods of research and describes how the data on commercial banks' debt level was generated; section 4 presents and analyses the results; while section 5 concludes the paper.

Literature review

Theoretical framework

Raising the interest rate is a policy tool used by Central Banks to manage exchange rate fluctuations or defend a currency against a speculative attack in a situation of persistent currency depreciation like the Naira. This simply refers to adopting a higher interest rate in a tight monetary space to keep existing investors and maintain their confidence level, and also attract other investors across the globe to appreciate the currency via capital inflow as well as obtain exchange rate stability. This will minimise the exposure of economic agents to foreign exchange rate risk in their decision-making process.

The behaviour of exchange rate is determined by many economic fundamentals, but one of the key fundamental determinants of exchange rate movement from the monetarist perspective as well as the present global financial setting is the interest rate (Copeland, 2005). However, despite the enormous theories on exchange rate issues documented in the literature, there is no single theory that provides a policy framework that fits the dynamics of all nations at every point in time. Therefore, this leaves a gap for the adoption or adaptation of a theory to serve as a framework for addressing research problems. Thus, with the recent introduction of the Investors & Exporters FX window which is a more flexible exchange rate system by the CBN, and policy strategies by the Securities and Exchange Commission (SEC) to ensure perfect capital mobility in its 2015 to 2025 Capital Market Master Plan[5] (CMMP) (such as, improve market liquidity, improve ease and access of doing business, introduced alternative trading platforms, create an enabling environment supportive of new products, and facilitate the internationalization of Nigerian Capital Market), this study, therefore, adopts the Mundell-Flemming (M-F) model as a theoretical framework. The M-F model in its monetary policy framework explains how exchange rate behaves (under different exchange rate regimes) in the event of interest rate policy changes (as a result of changes in the money supply) in a small open economy with perfect capital mobility (Copeland, 2005)[6]. Retaining these assumptions, the below headings present a brief policy picture of the workings of the model.

Monetary expansion, flexible exchange rate and perfect capital mobility in the M-F model

In an open economy, monetary policy is very effective under a flexible exchange rate system. For example, a monetary expansion would exert downward pressure on the domestic interest rate, thus leading to capital outflow, domestic currency depreciation, increase in net exports and output and vice versa for a monetary contraction.

Monetary expansion, fixed exchange rate and perfect capital mobility in the M-F model

In an open economy, monetary policy is not effective under a fixed exchange rate system because of the monetary authority's commitment to maintaining the exchange rate target, and thus money supply cannot be affected. The monetary authority maintains the exchange rate target via its intervention in the foreign exchange market by buying and selling foreign currency in the event of excess demand (due to capital inflow) and excess supply (due to capital outflow) of domestic currency respectively. For example, a monetary expansion would exert downward pressure on the domestic interest rate, thus leading to capital outflow, domestic currency depreciation and therefore, the monetary authority would have to sell foreign currency to close the excess supply gap to maintain the exchange rate target. This would in turn have no beneficial effect on output but a loss in foreign reserves.

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[5] http://sec.gov.ng/wp-content/uploads/2016/09/PART-A_CCMP.pdf

[6] See, Flemming (1962), Mundell (1962), Mundell (1963), Mundell (1968) for original references of the M-F model.

Empirical literature

The relationship between high-interest-rate policy and exchange rate or interest rate defence of a currency has received considerable attention in the international finance literature. A significant quantum of studies in other countries aside from Nigeria has shown how interest rate policy affects the exchange rates or speculative attacks on currencies. For instance, Caporale *et al.* (2005) examined the effect of monetary tightening on the exchange rate in four Asian countries (The Philippines, Thailand, South Korea and Indonesia) during Asian crises. Using a bivariate Vector Error Correction Model (VECM) and data set from 1991:2-2001:10, the study found that monetary tightening helped defend the currency during periods of tranquillity, however, it showed a reverse effect during the crises.

Chen (2006) used the Markov Switching specification of the nominal exchange rate with time-varying transition probabilities in four Asian countries (Indonesia, Korea, the Philippines, and Thailand), Mexico and Turkey. The study utilised weekly data from 03:01:1997 to 30:08:2002 for the four Asian countries and 07:01:1994 to 30:08:2002 for Mexico. However, monthly data was used for Turkey from 1990:1 to 2002:8. The study founds that raising nominal interest rates leads to a high probability of switching to a crisis regime. This supports other studies view that high-interest rates may be unable to defend the exchange rate. Similarly, Bautista (2003) examines interest rate-exchange rate interaction using dynamic conditional correlation (DCC) analysis – a multivariate Generalized Autoregressive Conditional Heteroskedasticity (GARCH) method using weekly data for the Philippines from January 1988 to October 2000. The results of the study present evidence of ineffective interest rate defence of the currency. In addition, Gudmundsson and Zoega (2016) using VECM and monthly data from 2009:1-2015:2 analysed the effect of interest rate on the exchange rate in Iceland under a capital control regime. They found that a currency is not likely to depreciate in an effective capital control regime in the event of cutting interest rates in small steps from a very high level.

Similarly, Flood and Jeanne (2005) derived a model and showed that an interest rate defence of a fixed exchange rate is effective only if the underlying fiscal situation is sound. That is, if the fiscal condition is unsound, the currency would be weakened by the harmful effect of the high-interest rate on the public finances. Also, Goldfajn and Gupta (2003) examined the effectiveness of tight monetary policy in stabilising exchange rates in the aftermath of currency crises using an unbalanced panel regression model. They analysed large data sets from 1980-98 for eighty countries. They found that tight monetary policy facilitates the reversal of currency undervaluation, however, the results are not robust in the presence of a banking crisis. Goderis and Loannidou (2008) using data from 1986:1-2002:12 for a sample of countries by constructing a cross-section of large speculative attacks found that a higher interest rate lowers the probability of a successful speculative attack if the level of short-term corporate debt is low. Short-term corporate debt was introduced as an additional factor to capture balance sheet vulnerabilities and to examine if it affects the ability of a monetary policy to defend a fixed exchange rate.

From the above reviewed studies, it can be seen that the response of the exchange rate to interest rate policy, though can be linear theoretically, can also be dependent on some additional factors in reality, such as fiscal soundness, short-term debt level, level of capital mobility and banking crisis. This study aims to fill the gap in the Nigerian literature by analysing commercial banks debt level as an additional factor to the relationship.

Moreover, the literature in Nigeria also has documented studies that show how exchange rate responds to monetary policy or interest rate policy. However, the determinants of exchange rate are also not left untouched. Mordi (2006) mentioned several economic fundamentals as the determinants of the exchange rate, some of which are; interest rate movements, inflation, Gross Domestic Product (GDP) growth rate, external reserves, etc. Having established the strong linkage between interest rate to exchange rate in Nigeria, several other studies that will follow shows the magnitude and direction of the response of exchange rate to Monetary or interest rate policy.

For instance, Musa and Sanusi (2020) estimated an Autoregressive Distributed Lag model using data from 1989 to 2017 in Nigeria to examine how the level of capital account openness affect the relationship between interest rate and exchange rate in Nigeria. They found that an increase in interest rate depreciates the Naira in the long run regardless of whether the capital account is open or closed but only if the capital account is open in the short run, however, if the capital account is closed the Naira appreciates. Thus, the interest rate should be used to manage short-run dynamics of the exchange rate in addition to effectively enforced capital controls.

Similarly, Adamu and Sanusi (2016) estimated a GARCH (1, 1) model using data for Nigeria from 2007 to 2016 to examine the effect of additional monetary tightening (AMT) on exchange rate volatility in Nigeria. They found that AMT is effective in reducing exchange rate volatility. In addition, Oke *et al.* (2017) examine the relationship between Nigeria's exchange rate, domestic interest rate, and world interest rate from 1980:Q1 to 2015:Q4 using the VECM estimation technique. Their findings supported a tightened monetary policy that is not inflationary and economic growth bias in the long run. Ditimi *et al.* (2011) using Ordinary Least Square (OLS) technique and data for Nigeria from 1986 to 2009 examined the effect of monetary policy on macroeconomic variables in Nigeria. They found that monetary policy has a positive significant effect on the exchange rate and a negative significant effect on the money supply.

Also, Yinusa and Akinlo (2008) used data for Nigeria from 1986:1-2005:2 to estimate a VECM in their analysis of the implication of currency substitution and exchange rate volatility for monetary policy in Nigeria. They found that monetary policy may be effective in dampening exchange rate volatility and currency substitution in the medium horizon but its effectiveness in the short horizon is not certain. Hassan *et al.* (2017) examine the sources of exchange rate volatility in Nigeria from 1989:Q1 to 2015:Q4. Using Autoregressive Conditional Heteroskedasticity (ARCH) and ARDL models they found that, while interest rate and net foreign assets have a positive significant impact on exchange rate volatility, economic openness, fiscal balance and oil price have an insignificant impact.

Methodology

Model specification

To model the effect of interest rate on the exchange rate in Nigeria and how commercial banks debt level affects the relationship, we specify a simple equation relating the nominal exchange rate with its usual theoretical determinants, in line with the *interest rate parity hypothesis*, *the traditional flow model* of Mundell-Fleming and the *asset market-based approach* to exchange rate determination. Such variables as the interest rate and income (real GDP) are therefore included on the right-hand side of equation 1 below (see Castillo, 2002; and Mordi, 2006), in addition to the commercial banks' debt level (a dummy variable).

$$lnEXCH = f\ (MPR, lnRGDP, D_T, MPR * D_T, D_{99}) \qquad 1$$

$$lnEXCH_t = \phi_0 + \phi_1 MPR_t + \phi_2 lnRGDP_t + \phi_3 D_T + \phi_4 MPR_t * D_T + \phi_5 D_{99} + \mu_t \qquad 2$$

Where: *lnEXCH* = log of Exchange rate, *MPR* = Monetary Policy rate (interest rate), *lnRGDP* = log of Real GDP, D_T = Dummy variable representing commercial banks debt level with 0 for low debt level and 1 for high debt level. MPR $* D_T$ = interaction dummy between the debt level and *MPR*, D_{99} = Structural dummy which captures the shift to a democratic regime in 1999, with 1 for 1999 and 0 for all other years. Moreover, we compute Commercial Banks' Debt level (D_T) as[7]

i. the ratio of Total Debt to Total Assets of Commercial Banks.
ii. the Total Debt is computed as Total Debt = Total Liability - Capital - Total Deposits (Spaulding, n.d). Where, Total Deposits is the summation of Demand Deposits, Time, Savings and Foreign Currency Deposits and Central Government Deposits. Note that, Total Deposits is part of Total Liability but does not form part of Total Debt because the addition or withdrawal of such Deposits is at the discretion of the depositor. In other words, Deposits are monies that Banks owe to the depositors.

[7] See Appendix 1(Table A2) for the computations and full data.

To characterize any Debt level as high or low, it is compared with the sample average of the Total Debt to Total Assets Ratio. Any Debt level below the sample average is then considered a low Debt level while those above the average are considered high. This is then used in constructing the dummy variable $D_{T.}$

Estimation techniques

In this study, we adopt the ARDL bound testing approach developed by (Pesaran *et al.,* 2001) as the dynamic time series estimation technique to address our research objective. The approach is suitable for modelling a mixture of both I(1) and I(0) variables except I(2) variables. In addition, it models the long-run co-movements amongst the variable, it also allows us to incorporate both (long-run) equilibrium and disequilibrium movements of the exchange rate in the analysis. Thus, we represent the ARDL form of equation (2) in equation (3) below. The exchange rate is directly quoted such that a decrease represents appreciation while an increase represents depreciation. Thus, from equation (2), if any of the coefficients present a negative value (less than zero), that means appreciation and vice versa. Thus, the *a priori* expectation of the various parameters/coefficients are as follows; $\phi_1 < 0$, $\phi_2 < 0$, $\phi_3 > 0$, $\phi_4 > 0$ and $\phi_5 > 0$.

$$\Delta lnEXCH_t = \phi_0 + \sum_{i=1}^{m} \phi_1 \Delta lnEXCH_{t-i} + \sum_{i=1}^{m} \phi_2 \Delta MPR_{t-i} + \sum_{i=1}^{m} \phi_3 \Delta lnRGDP_{t-i} + \delta D_T + \Omega_1 lnEXCH_{t-1} + \Omega_2 MPR_{t-1} + \Omega_3 lnRGDP_{t-1} + \mu_t \quad 3$$

Where $\mu_t \sim iid(0; \delta^2)$, And, m = optimal lag length which is determined using Akaike info Criterion (AIC), Δ = first difference of the variables, t = time, t-1= lag one (previous year), ln = natural logarithm, ϕ_0 = constant = summation, ϕ_1 to $\phi_{3,\ \delta}$ and Ω_1 to Ω_3 are the coefficients of their respective variables and D_T = dummy variable for Debt Levels.

In addition, once it is established that cointegration exists between the variables using bound testing, the long-run relationship is modelled and estimated as in equation (4) below. In the bound testing procedure, the null hypothesis of no cointegration is tested against the alternative hypothesis which establishes the presence of cointegration. F-statistic is used in the decision procedure of the bound testing approach. The F-statistic is compared against the upper and lower bounds critical values as tabulated by (Pesaran *et al.,* 2001). If the F-statistic value is above any of the upper bound critical values, the null hypothesis of no cointegration is rejected and vice versa for the F-statistic value lower than the lower bound critical values. However, any F-statistic value in between the upper and lower bound critical values is considered inconclusive.

$$\Delta lnEXCH_t = \phi_0 + \Omega_1 lnEXCH_{t-1} + \Omega_2 MPR_{t-1} + \Omega_3 lnRDGP_{t-1} + \delta D_T + \mu_t \quad 4$$

While the short-run model is estimated in equation (5) below.

$$\Delta lnEXCH_t = \phi_0 + \sum_{i=1}^{n} \phi_1 \Delta lnEXCH_{t-i} + \sum_{i=1}^{n} \phi_2 \Delta MPR_{t-i} + \sum_{i=1}^{n} \phi_3 \Delta lnRGDP_{t-i} + \delta D_T + \vartheta ECT_{t-i} + \mu_t \quad 5$$

Where *ECT* is the error correction term and ϑ is the speed of convergence towards long-run equilibrium. Moreover, before the model estimation, a unit root test using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) are performed on all the variables to ascertain the order of integration of the variables. And finally, after the estimation, the validity of the results is established upon satisfying the requisite diagnostics and stability test. While Serial correlation, heteroskedasticity, and normality tests were used for the diagnostics test, the cumulative sums of recursive residuals (CUSUM) and cumulative sums of squares of recursive residuals (CUSUMSQ) were used for the stability test.

Data, sources and trends

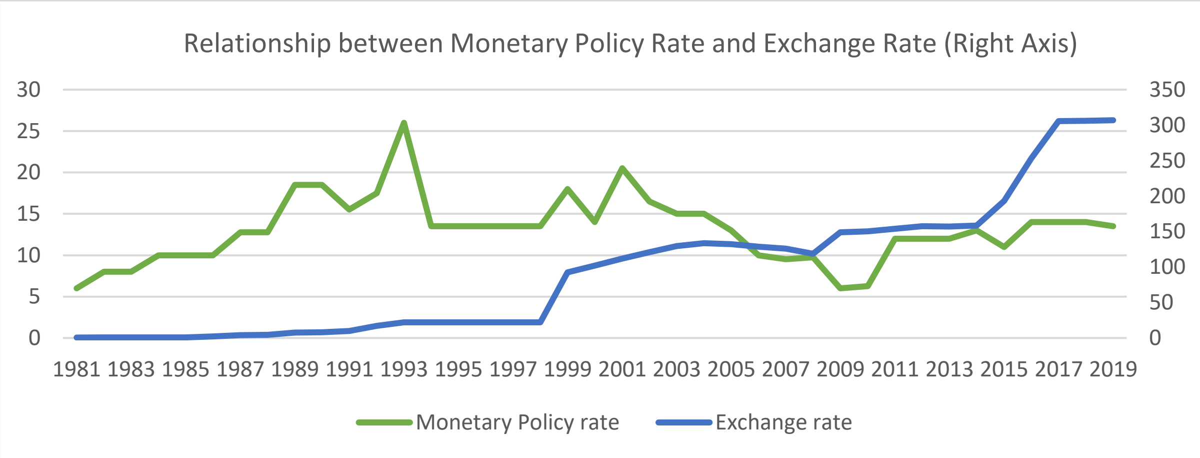
Annual data for the period 1981-2019 on the Exchange Rate, MPR, the Debt level of the banking system and Real GDP were all collected from the various editions of the Central Bank of Nigeria Statistical Bulletins[8]. We, however, constructed a dummy variable that splits the period into that of "high debt"

[8] See appendix I (Table A1) for reference to the data.

and “low debt”. To do this, we defined any period as a "high debt" period if the debt to asset ratio of the system is greater than the sample average (see Table A2 of the appendix), hence assign “1” to the dummy variable, otherwise, we assigned “0”.

To preview the trend relationships to the variables during the period, figures (1) and (2) show the historical trend of the relationships between Monetary Policy Rate (MPR) and exchange rate, and between Banks' debt and exchange rate, respectively. Specifically, figure 1 shows that the relationship between the MPR and exchange rate of the Naira does not appear to depict the expected theoretical link in most of the period covered. For instance, from 1981 to 1990, 1992 to 1993, 2010 to 2014 and 2016 to 2018, it is evident that as the interest rate (MPR) increased, so does the exchange rate (depreciates). Similarly, from 2005 to 2007 the exchange rate appreciates (decreased) as the interest rate decreased. In contrast, it is evident that in 1991, 2000, 2015, and 2019 and also from 1994 to 1998 and 2002 to 2004, as the interest rate decreased, the exchange rate increased (depreciates). Similarly, in 2008 the exchange rate appreciates (decreased) as the interest rate increased.

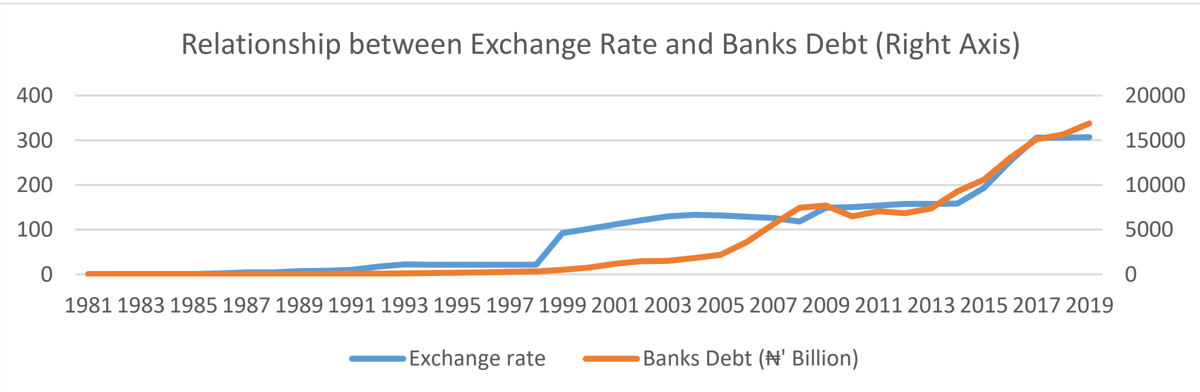
Figure 1 Relationship between Monetary Policy Rate and Exchange Rate



Source: computed by authors

Furthermore, figure 2 shows that the Debt level appears to closely move together with the exchange rate. That is, increases in the debt level appears to be associated with increases (depreciation) in the exchange rate.

Figure 2. Relationship between Exchange rate and Banks Debt



Source: computed by authors

Empirical results

The results of the unit root test which is the preliminary stage for most time series analysis are presented in table 1. The results are obtained from both ADF and PP tests to ensure robustness. The results obtained show that the variables are a mixture of I(0) and I(1), and none is I(2). This outcome warrants the use of ARDL technique.

Table 1: Unit root test results [based on AIC (8 lags) optimal lag selection for ADF]

	Level		*First Difference*		*Decision*
Variable	ADF	PP	ADF	PP	
lnEXCH	-1.2776	-1.2670	-5.1999*	-5.1999*	*I(1)*
MPR	-3.2641 **	-3.2209**			*I(0)*
lnRGDP	-2.0319	-2.5540	-3.4340**	-3.3126**	*I(1)*

Source: Authors Computation, 2021 from Eviews 9.0

*Note: * ** *** indicates rejection of unit root at 1, 5 and 10% respectively.*
For the levels, we included trend and intercept, except MPR which only intercept is included as the line plots of the series indicates. However, for their first differences, line graphs indicate that only intercepts can be included.
I(0) means that the series is stationary at a level and I(1) means the series is stationary at first difference.

In addition, the optimal lag chosen to estimate the ARDL model is (lag) 3, automatically selected from Eviews based on Akaike Info Criterion (AIC). Table 2 presents the bound test obtained after estimating the ARDL model. The bound test shows that a long-run relationship exists. It shows that the F-statistic is higher than the upper bound critical values at all levels of significance (that is, 1, 5, and 10% respectively). Thus, we reject the null hypothesis of no cointegration.

Table 2: ARDL Bound Test

Test Statistic	Value	K
F-statistic	5.303814	5
	Critical Value Bounds	
Significance	Lower Bound I(0)	Upper Bound I(1)
10%	2.26	3.35
5%	2.62	3.79
1%	3.41	4.68

Source: Authors Computation, 2021 from Eviews 9.0
Note: The critical values of the upper and lower bounds are as generated by Eviews 9.0

Having established the existence of a long-run relationship, the long-run estimates and error correction estimates (short-run) of the model obtained are presented in Table 3 and 4 respectively. In table 3, although the coefficient of the policy interest rate is statistically insignificant, it is correctly signed. On average, it shows that a unit increase in interest rate will lead to about a 0.25% decrease in the exchange rate (*i.e. appreciation*) as theoretically expected. The insignificance implies that, the interest rate may not be a potent policy tool for the fine-tuning of the long-term exchange rate. Although the coefficient of the dummy "$\mathbf{D_T}$" is statistically insignificant, the negative sign indicates that, on average, the value of the exchange rate of the Naira is lower (*more appreciated*) by about 3.34% for periods of high debt level than for low debt level. However, when the dummy "$\mathbf{D_T}$" interacts with the policy interest rate, the marginal effect of the increasing interest rate on the exchange rate tends to induce *depreciation* for high debt levels. Specifically, the coefficient of the interaction dummy $MPRD_T$ shows that the marginal effect of interest rate on the exchange rate of the naira is a *depreciation* of 0.15%[9] (i.e. an extra unit increase in interest rate is associated with a 0.15% increase in the exchange rate) for a high debt level and -0.25% decrease (*or appreciation*) during periods of low debt level. This implies that an increase in interest rate will result in a *depreciation* of the Naira if the Debt level is high and *appreciation* of the Naira if the Debt level is low. The structural dummy D_{99} shows a positive significant effect on the

[9] This is gotten by adding -0.251419 (MPR) and 0.403714 ($MPRD_T$) from table 3. See appendix II for a brief explanation and Koop, G. (2005) Page 118 for details. The same applies to table 4 interaction term interpretation.

exchange rate. This implies that the average exchange rate of the Naira is *more depreciated* by about 7.23% upon the shift to democratic rule in 1999 as expected. Real GDP is evident to have a positive significant effect on the exchange rate. This implies that, on average, a 1% increase in Real GDP will lead to about a 3.91% increase in the exchange rate (*i.e. 3.91% depreciation*). Although an increase in Real GDP may expectedly lead to *an appreciation* of a currency through an increase in net exports earnings resulting from a high level of production, however, it may also lead to *depreciation* due rise in imports through the income effect, particularly if the economy is import-dependent like the case of Nigeria in our analysis.

Table 3: Estimated Long Run Coefficients using the ARDL approach.

ARDL (1, 0, 1, 2, 0, 1) selected based on AIC. *Dependent Variable* LNEXCH

Variable	Coefficient	Std. Error	t-Statistic	Prob.
MPR	-0.251419	0.158275	-1.588490	0.1243
lnRGDP	3.908229	0.404475	9.662470	0.0000
D_T	-3.344935	2.335890	-1.431975	0.1641
MPR*D_T ($MPRD_T$)	0.403714	0.198168	2.037234	0.0519
D_{99}	7.229927	2.198065	3.289223	0.0029
C	-34.424095	3.356010	-10.257447	0.0000

Source: Authors Computation, 2021 from Eviews 9.0

Table 4 presents the estimates of the short-run dynamics of the relationship between interest rate and exchange rate as well as all other exogenous variables in the model. The estimates show that most of the exogenous variables are statistically significant. The monetary policy rate (interest rate) is shown to have a statistically significant (negative) *appreciating* impact on the exchange rate in line with the conventional wisdom. This implies that, on average, a unit increase in interest rate will lead to about 0.05% decrease (*appreciation*) in the exchange rate of the Naira. The dummy "$\mathbf{D_T}$" is also statistically insignificant, indicating that, on average, the exchange rate is lower (*more appreciated*) by about 0.41% during the period of high debt level than during periods of low debt level. However, when the dummy "$\mathbf{D_T}$" interacts with the policy interest rate, the marginal effect of the increasing interest rate on the exchange rate tends to be a *depreciation* in periods of high debt level. Specifically, the interaction dummy ($MPRD_T$) shows that the marginal effect of interest rate on the exchange rate of the naira is a *depreciation* of 0.03% (i.e., -0.05 + 0.08 = 0.03: an extra unit increase in interest rate is associated with 0.03% increase in the exchange rate) if the Debt level is high and -0.05% decrease (*appreciation*) if the Debt level is low. This implies that an increase in interest rate will result in a *depreciation* of the Naira in place of a high Debt level and *appreciation* of the Naira if the Debt level is low.

In addition, the structural dummy D_{99} shows a positive significant effect on the exchange rate. This implies that the average exchange rate of the Naira is *more depreciated* by about 1.23% upon the shift to democratic rule in 1999 as expected. Real GDP appeared to have a positive but statistically insignificant impact on the exchange rate. This implies that, on average, a 1% increase in Real GDP will lead to about 0.41% increase in the exchange rate (*i.e. 0.41% depreciation*)[10].

Furthermore, the error correction term (ECM) which measures the speed of adjustment of any disequilibrium towards a long-run equilibrium state is negative and statistically significant at 1% as expected. The ECM coefficient of -0.209268 shows about 20.9% convergence to equilibrium in the long run in one year following a shock.

[10] See the analysis of Real GDP in Table 3.

Table 4: Error Correction Representation for the selected ARDL Model
ARDL (1, 0, 1, 2, 0, 1) selected based on AIC.

1981-2019	*Dependent Variable* LNEXCH			
Variables (Regressors)	Coefficient	Std. Error	t-Statistic	Prob.
Δ (MPR)	-0.052614	0.025155	-2.091581	0.0464
Δ (lnRGDP)	0.414253	0.750423	0.552026	0.5856
Δ (D_T)	-0.412275	0.267498	-1.541228	0.1353
Δ (D_T(-1))	0.374695	0.155043	2.416713	0.0230
Δ MPR*D_T(MPRD_T)	0.084484	0.029483	2.865523	0.0081
Δ (D_{99})	1.227268	0.157131	7.810497	0.0000
Ecm(-1)	-0.209268	0.066965	-3.125025	0.0043

Cointeq = LNEXCH - (-0.2514*MPR + 3.9082*LNRGDP -3.3449*D_T + 0.4037*MPRD_T + 7.2299*D_{99} -34.4241)

R-squared	0.995198
Adjusted R-squared	0.993351
F-statistic	538.8393
Prob(F-statistic)	0.000000
Durbin-Watson stat	1.846375

DIAGNOSTICS TEST

Residual Diagnostics Test	F-Statistic (prob. F)	Prob. Chi-Square	Decision
LM Serial Correlation test	0.461143 (0.7121)	0.5521	Do not reject H_0
BPG Heteroskedasticity test	1.534793 (0.1831)	0.1855	Do not reject H_0
Jarque-Berra Normality test	1.304713	0.520817	Do not reject H_0

Source: Authors Computation, 2021 from Eviews 9.0

Finally, the post-estimation diagnostics and stability tests show evidence of validity and stability of the estimated model respectively. While the diagnostic tests show that the residuals are normally distributed and the model is free from serial correlation and heteroskedasticity, the stability tests from CUSUM and CUSUMSQ tests in figures 3 and 4 below demonstrate evidence of stability of the model. The stability of a model is measured if the statistic stays within the 5% critical bound (Brown *et al.*, 1975).

Figure 3: CUSUM test

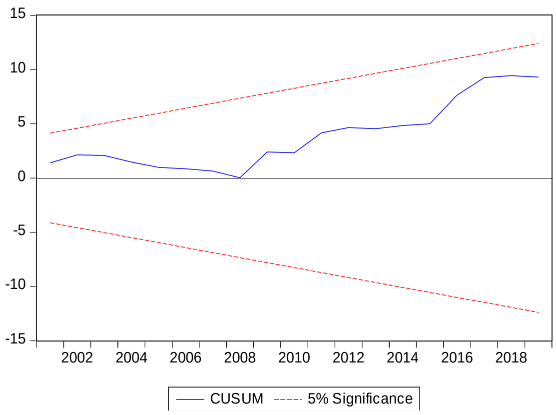
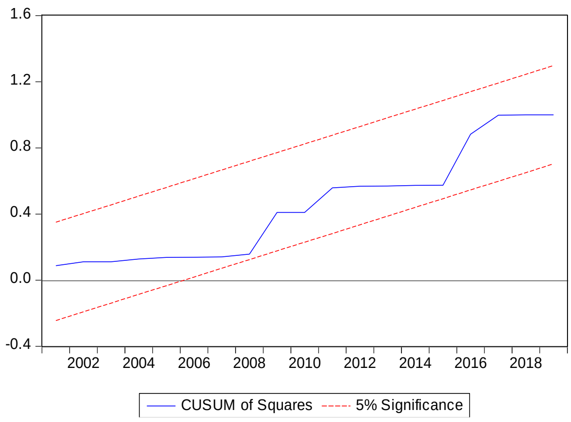


Figure 4: CUSUMSQ test



Conclusion and policy implication

The management of exchange rates using monetary policy instruments is inevitable in a contemporary world of integrated financial markets. However, since in reality, the channel of transmission may not be smooth and linear as empirically documented from reviewed studies, this study also adds to the literature by looking at how the exchange rate of the Naira responds to changes in policy interest rates in the presence of high or low Commercial Banks Debt. The fact being that the banking system is the largest component of the Nigerian financial system, thus, any shock to it translates to the entire financial system and the economy at large.

The key findings from this study are that the relationship between exchange rate and interest rate in Nigeria is, indeed, contingent on the level of Debt of the banking system. Both in the short-run and long-run, monetary tightening (increase in interest rate) has a *depreciating* marginal effect on the exchange rate in the presence of a high Debt level in the banking system. However, in the presence of a low level of Debt in the banking system, the relationship between the exchange rate and the interest rate was found to be conventional, such that monetary tightening exert *appreciating* pressure on the exchange rate. These findings reveal that, although it may be tempting to raise interest rates to induce capital inflows and consequently achieve exchange rate appreciation (and reduce inflation, for a given pass-through), the reverse effect may indeed be the case in the presence of high debt profile in the banking system. This is because investors may be scared away by the fear of bankruptcy in the system. This is similar to the findings of (Goderis & Loannidou, 2008).

This finding underscores the potentially important role of corporate Debt levels in determining the efficacy of monetary policy for exchange rate stabilisation. It is, therefore, recommended that monetary authorities should keep a close watch on the Debt profile of the banking system, making sure it doesn't reach an alarming level.

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Appendix I

Table A1.

Date	EXCH	lnEXCH	MPR	RGDP	lnRGDP	Structural Dummy (D99)	BANKS DEBT LEVEL DUMMY (DT)
1981	0.610	-0.494	6.000	15258.004	9.633	0	0
1982	0.673	-0.396	8.000	14985.078	9.615	0	0
1983	0.724	-0.323	8.000	13849.725	9.536	0	0
1984	0.765	-0.268	10.000	13779.255	9.531	0	0
1985	0.894	-0.112	10.000	14953.913	9.613	0	0
1986	2.021	0.703	10.000	15237.987	9.632	0	1
1987	4.018	1.391	12.750	15263.929	9.633	0	1
1988	4.537	1.512	12.750	16215.371	9.694	0	1
1989	7.392	2.000	18.500	17294.676	9.758	0	1
1990	8.038	2.084	18.500	19305.633	9.868	0	1
1991	9.909	2.293	15.500	19199.060	9.863	0	1
1992	17.298	2.851	17.500	19620.190	9.884	0	1
1993	22.051	3.093	26.000	19927.993	9.900	0	1
1994	21.886	3.086	13.500	19979.123	9.902	0	1
1995	21.886	3.086	13.500	20353.202	9.921	0	1
1996	21.886	3.086	13.500	21177.921	9.961	0	1
1997	21.886	3.086	13.500	21789.098	9.989	0	1
1998	21.886	3.086	13.500	22332.867	10.014	0	1
1999	92.693	4.529	18.000	22449.410	10.019	1	1
2000	102.105	4.626	14.000	23688.280	10.073	0	1
2001	111.943	4.718	20.500	25267.542	10.137	0	1
2002	120.970	4.796	16.500	28957.710	10.274	0	1
2003	129.357	4.863	15.000	31709.447	10.364	0	1
2004	133.500	4.894	15.000	35020.549	10.464	0	1
2005	132.147	4.884	13.000	37474.949	10.531	0	1
2006	128.652	4.857	10.000	39995.505	10.597	0	1
2007	125.833	4.835	9.500	42922.408	10.667	0	1
2008	118.567	4.775	9.750	46012.515	10.737	0	1
2009	148.880	5.003	6.000	49856.099	10.817	0	0
2010	150.298	5.013	6.250	54612.264	10.908	0	0
2011	153.862	5.036	12.000	57511.042	10.960	0	0
2012	157.499	5.059	12.000	59929.893	11.001	0	0
2013	157.311	5.058	12.000	63218.722	11.054	0	0
2014	158.553	5.066	13.000	67152.786	11.115	0	0
2015	193.279	5.264	11.000	69023.930	11.142	0	0
2016	253.492	5.535	14.000	67931.236	11.126	0	0
2017	305.790	5.723	14.000	68490.980	11.134	0	0
2018	306.080	5.724	14.000	69799.942	11.153	0	0
2019	306.921	5.727	13.500	71387.827	11.176	0	0

Table A2. Computation of the Debt level (₦' Billion)

Date	(A) Total liabilities	(B) Capital	(C) Total Deposits	(D) Total Debt =A-B-C	(E) Total Assets	(F) Total Debt /Total Assets	(G) AVERAGE of T.debt to T.assets ratio (Average of (F))	DUMMY VALUES
1981	19.4775	0.4974	10.6769	8.3032	19.4775	0.43	0.46	0
1982	22.6619	0.6677	12.0189	9.9753	22.6619	0.44	0.46	0
1983	26.7015	0.8451	13.9385	11.9179	26.7015	0.45	0.46	0
1984	30.0667	0.9667	15.7348	13.3652	30.0667	0.44	0.46	0
1985	31.9979	1.1287	17.5971	13.2721	31.9979	0.41	0.46	0
1986	39.6788	1.2987	18.1376	20.2425	39.6788	0.51	0.46	1
1987	49.8284	1.5451	23.0867	25.1966	49.8284	0.51	0.46	1
1988	58.0272	1.9324	29.0651	27.0297	58.0272	0.47	0.46	1
1989	64.874	2.6923	27.1649	35.0168	64.874	0.54	0.46	1
1990	82.9578	3.7127	38.7773	40.4678	82.9578	0.49	0.46	1
1991	117.5119	4.3008	52.4087	60.8024	117.5119	0.52	0.46	1
1992	159.1908	3.7693	76.0735	79.348	159.1908	0.50	0.46	1
1993	226.1628	4.4202	112.4074	109.3352	226.1628	0.48	0.46	1
1994	295.0332	5.4477	144.0974	145.4881	295.0332	0.49	0.46	1
1995	385.1418	6.5306	182.3856	196.2256	385.1418	0.51	0.46	1
1996	458.7775	8.7305	220.3322	229.7148	458.7775	0.50	0.46	1
1997	584.375	17.6665	280.0289	286.6796	584.375	0.49	0.46	1
1998	694.6151	25.6348	326.9648	342.0155	694.6151	0.49	0.46	1
1999	1070.0198	31.4533	516.7728	521.7937	1070.0198	0.49	0.46	1
2000	1568.8387	44.2057	775.9323	748.7007	1568.8387	0.48	0.46	1
2001	2247.0399	75.1706	975.5253	1196.344	2247.0399	0.53	0.46	1
2002	2766.8803	101.2765	1209.7473	1455.8565	2766.8803	0.53	0.46	1
2003	3047.8563	122.7359	1417.06	1508.0604	3047.8563	0.49	0.46	1
2004	3753.277803	142.3245	1778.713	1832.240303	3753.277803	0.49	0.46	1
2005	4515.11757	172.32152	2155.159834	2187.636216	4515.11757	0.48	0.46	1
2006	7172.932139	170.4948549	3379.275706	3623.161578	7172.932139	0.51	0.46	1
2007	10981.69358	152.9541381	5255.939839	5572.799603	10981.69358	0.51	0.46	1
2008	15919.55982	210.9363277	8252.891781	7455.731716	15919.55982	0.47	0.46	1
2009	17522.85825	219.5099605	9601.809648	7701.53864	17522.85825	0.44	0.46	0
2010	17331.55902	249.7145775	10610.17191	6471.672535	17331.55902	0.37	0.46	0
2011	19396.63376	220.2082421	12131.47043	7044.955083	19396.63376	0.36	0.46	0
2012	21288.14439	188.3876661	14245.08268	6854.674037	21288.14439	0.32	0.46	0
2013	24301.21388	209.621104	16699.05616	7392.536617	24301.21388	0.30	0.46	0
2014	27526.41629	283.3875188	17950.38156	9292.647218	27526.41629	0.34	0.46	0
2015	28173.26094	236.423843	17330.4785	10606.3586	28173.26094	0.38	0.46	0
2016	31682.82367	257.1191975	18394.78676	13030.91771	31682.82367	0.41	0.46	0
2017	34593.8887	275.1145791	19207.14973	15111.6244	34593.8887	0.44	0.46	0
2018	36445.61	277.9	20525.80238	15641.90762	36445.61	0.43	0.46	0
2019	39904.55458	302.1512497	22713.80354	16888.5998	39904.55458	0.42	0.46	0

Appendix II

In a regression equation of $y = \phi_0 + \phi_1 D + \phi_2 \beta + \phi_3 \Omega + \varepsilon$ where D is a dummy variable, β is a continuous variable, Ω is defined as $\Omega = D\beta$ and $\boldsymbol{\varepsilon}$ is the random error term. In interpreting the results of the regression, Ω is *0* for observations with *D=0* and β for observations with *D=1*

Therefore, if *D=1* the estimated regression line will be $\hat{y} = \widehat{\phi_0} + \widehat{\phi_1} + \left(\widehat{\phi_2} + \widehat{\phi_3}\right)\beta$ and if *D=0* the estimated regression line will be $\hat{y} = \widehat{\phi_0} + \hat{\phi}_2 \beta$

This implies that the marginal effect of $\boldsymbol{\beta}$ on $\boldsymbol{y}$ is different for *D=0* and *D=1* because the regression lines corresponding to *D=0* and *D=1* exist with different slopes and intercept.