Currency Substitution: Evidence from Nigeria

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This paper examines the existence, causes and effects of currency substitution in Nigeria by estimating conventional money demand equations based on a partial adjustment and an autoregressive distributed lag models using three definitions of monetary aggregates. The behavior of the foreign currency/Naira deposit ratios have been influenced by devaluation expectations, exchange rate risks and political uncertainties during the Yar'adua-Jonathan presidency. Also, the money demand estimations reveal that short-term foreign interest rates significantly affect the demand for the Naira, suggesting strong evidence of currency substitution and the possibility of importing considerable instability in the economy.

Keywords: Currency Substitution, Demand for Money Function; Autoregressive Distributed Lag Approach; Monetary Policy

JEL Classification: E51, E41, C22

1.0 Introduction

The idea of currency substitution dates back to the post World War I era when Europe experienced severe hyperinflations, when there was lack of stable domestic means of payment. Consequently, the use of foreign currencies was desired not only as a store of value, but as a means of payment as well, (Gomis-Porqueras *et al.* 2000). The increasing use of foreign currency appears to mirror the attempts of economic agents to hedge against inflation and/or exchange rate depreciation during periods of large macroeconomic imbalances. In this context, permitting foreign currency deposits may have also served as a vehicle to foster financial intermediation and financial deepening at a time when banking systems were considered fragile, thereby laying the foundation for the expansion of deposit money banks' operations.

The definition of currency substitution in the literature has subsequently been linked to the holding of foreign currency by domestic residents, in relation to

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varying exigencies that derive from the traditional roles that money plays in the economy. At one extreme, Calvo and Vegh (1992) limit the concept to the use of foreign currency by domestic residents as a medium of exchange. On the other hand, others such as Clements and Schwartz (1992) and Agenor and Khan (1992) adopt a more general stance; they define currency substitution as a process whereby foreign currency substitutes for domestic money as a unit of account, medium of exchange and as a store of value.

Boamah, *et al.* (2012) noted that increased currency substitution may have several negative spill-off effects such as weakening the autonomy of monetary policy; increasing vulnerability to economic shocks; the potential for significant deterioration of the balance of payments account and/or exchange rate volatility. Furthermore, currency substitution has the potential to negatively impact overall economic growth, especially for small open economies.

Currency substitution explains the conditions under which foreign money balances will be held and adapted to expected changes in relative risks and returns among the various currencies. The general idea of several representative papers [see Miles (1978) and Girton and Roper (1981)] is that monetary policy will be ineffective in a country where foreign currencies are regarded as good substitutes for domestic currency. An implication of this hypothesis is that the elasticity of substitution between domestic and foreign currencies is likely to increase in periods when the exchange rate is floating. Hence, if the issue of currency substitution is empirically relevant, one of the stronger arguments for floating exchange rates, which is greater national monetary independence, is seriously weakened.

The relevance of the currency substitution problem for Nigeria is not so much related to the choice of fixed versus floating exchange rates, but to the potential problems of short-run monetary instability that currency substitution can create. If the demand for domestic currency is strongly influenced by foreign variables, a substantial degree of instability may be imported from abroad, even if the monetary authorities follow consistent monetary and exchange rate policies. It is therefore important that policy makers in Nigeria have a realistic notion about the extent of currency substitution in the country and its potential impact on policy decision and the wider economy as a whole.

The objective of this paper is to examine the presence and extent of currency substitution in Nigeria and explores discussion on policy implications. For ease of exposition, the paper is structured into six sections, with Section one as the introduction. Section two reviews the literature, while a historical perspective of the trend of currency substitution in Nigeria is provided in Section three. While the theoretical framework is presented in Section four, an attempt is made to explain and quantify the main forces determining the behavior of the foreign currency/Naira deposit ratio and the effects of currency substitution in Section five. Section six concludes the paper.

2.0 Literature Review

Although there are varying approaches to modeling currency substitution, most studies have utilized M2 in a simple money demand function, as M2 is deemed to be more relevant for monetary policy formulation. As Bahmani-Oskooee and Tanku (2006) noted, Mundell was the first to argue that the demand for money could depend on the exchange rate in addition to income and interest rates, but since this was only a conjecture and not supported by any empirical analysis, not much attention was paid to Mundell's idea.

In estimating the demand for money in Nigeria, Doguwa *et. al.* (2014) noted that the demand for money had often ignored the influence of foreign money developments. The authors estimated the demand for real cash balances as a function of real income, real monetary policy rate, exchange rate spread and movements in exchange rate. The results verified the hypothesis that foreign financial aid and monetary influences on the demand for real cash balances are transmitted by changes in exchange rate expectations and concluded that ignoring the effects of exchange rate expectations may lead to misspecification of the demand for money.

A majority of the studies in the literature have utilized the model or variant of Arango and Nadiri (1981) as the basis for estimating currency substitution. In particular, Bordo and Choudhiri (1982) posited that if currency substitution is important, the expected devaluation in the exchange rate should be a significant determinant of the demand for foreign currency. The efficient market hypothesis suggests that the forward rate is a good measure of the expected exchange rate. To account for departure from the simple efficiency hypothesis they used the proportional spread between 90 – day forward and spot exchange rates to measure the expected rate of exchange rate appreciation. They estimated demand for money functions using both M_1 and

M_2 in Canada, but found the influence of the expected return on foreign money on the demand for domestic money to be negligible.

Bahmani-Oskooee and Techaratanachai (2001) found that currency depreciation in Thailand has indeed resulted in currency substitution away from the Thailand Baht. Following Arango and Nadiri (1981), the authors estimated a money demand function with M_2 (real money stocks) as a function of real income, the interest rate on alternative assets and the nominal effective exchange rate. Using the Johansen and Juselius co-integration technique, the results indicated that the nominal exchange rate was positive, indicating that, as the Thai baht depreciates, public holding of M2 declines.

Kaplan *et al.* (2008) investigated whether currency depreciation in Turkey has resulted in currency substitution away from the Turkish dollar. The study estimated a money demand function (real money stocks) as a function of real income, nominal domestic interest rate and the nominal effective exchange rate. Since all of the variables appeared to be integrated of order one, using the Johansen and Juselius co-integration method they found one co-integrating relationship, and estimated the long-run model. All variables were found to be significant and the positive sign on the nominal exchange rate variable implied the existence of currency substitution.

Instead of utilizing the money demand function, some studies have defined a currency substitution variable, for instance, El-khafif (2002). Currency substitution was defined as the share of nominal foreign currency in money supply and was modeled as a function of the nominal exchange rate, and the interest rate differential between the interest rate on local currency and that on the dollar. The author used an error-correction model to examine the dynamic of the currency substitution phenomenon in two of Africa's emerging economies: Egypt and South Africa. The results indicated that currency substitution does exist, but its elasticity with respect to the exchange rate variable is larger in South Africa than in Egypt.

The economic impact of currency substitution on the financial and economic development of a country is generally well documented in the literature. Many studies have alluded to the potential effects on the effectiveness of macroeconomic policy and the ability to formulate and conduct monetary policy. For instance, Cuddington (1983) made reference to Miles (1978) argument that even though some degree of monetary independence is attained with a flexible exchange rate regime as opposed to a fixed exchange rate system, this independence may vanish in the presence of currency substitution.

Ortiz (1983) also agreed that the argument for floating exchange rates, that is, autonomy of monetary policy, is severely weakened in the presence of currency substitution. He noted that a considerable amount of instability may be imported from foreign territories as the demand for domestic currency is significantly influenced by foreign factors. Similarly, Ho (2003) noted that given a fixed amount of money supply, as domestic currency is substituted for foreign currency, the domestic economy becomes susceptible to monetary shocks both at home and abroad, and hinders any attempts of the monetary authorities to pursue policies independent of foreign influences.

Ramirez-Rojas (1985) noted that currency substitution may redirect the effects of macroeconomic policy, as heavy substitution could lead to deficits in the balance of payments accounts and/or exchange rate depreciation. He argued that either way deficit financing through money creation will fall, as well as the inflation tax base. Also, in analyzing the Asian economic crisis, Bahmani-Oskooee and Techaratanachai (2001) suggested that implications of currency substitution for domestic money holdings could impact on economic growth. They argued that depreciation of the domestic currency raises the domestic currency value of foreign assets. Therefore, those expecting further depreciation, substitute more foreign currency for domestic currency, thereby reducing their domestic money holdings. If these effects are strong, the decline in domestic currency holdings could cause economic slowdown and further aggravate economic crisis.

Akinlo (2003) investigated whether the depreciation of the Naira has a significant effect on currency substitution in Nigeria. He found that Naira depreciation in the study period spanning 1980 to 2000 did not cause currency substitution. Rather as Naira depreciates, those holding foreign currencies see it as an increase in wealth. Yinusa and Akinlo (2008) indicated the presence of currency substitution in the domestic banking system in Nigeria during 1986 to 2005, with the parallel market exchange rate volatility being the major driver. The authors indicated that currency substitution was low during the period and classified Nigeria as a moderately dollarized economy.

3.0 Trend of Currency Substitution in Nigeria

This paper uses two definitions to measure the degree of currency substitution in the Nigerian economy. The first measure (CS_1), which is widely used in the empirical currency substitution literature, is based on demand deposits only defined as the ratio of foreign currency deposits (FCD) to Naira demand deposits (DD) in the Nigerian banking system. That is:

$$CS_1 = \frac{FCD}{DD} \tag{1}$$

The second measure (CS_2) incorporates all deposits and is defined as the ratio of FCD to Naira demand deposit, as well as time and savings deposits (TSD) in the banking system. Thus, the CS_2 is expressed as:

$$CS_2 = \frac{FCD}{DD + TSD} \tag{2}$$

These ratios are derived from the monetary survey of the Central Bank of Nigeria (CBN). Note that foreign currency denominated bills and coins circulating within the economy are generally omitted in the CS ratios of most studies ostensibly because the stock of foreign cash in circulation within a particular country is difficult to measure and can only be approximated roughly, based on generally very restrictive assumptions. Figure 1 shows the monthly ratios of foreign to domestic currency demand and total deposits held in Nigeria's banking system from December 1994 to June 2014.

During the last two military administrations (December 1994 to May 1999), the CS_1 ratio fell from a peak of 9.43 per cent in June 1996 to a low of 2.04 per cent in July 1997. Similar trend was exhibited by the CS_2 ratio. In 1994 fixed exchange rate regime was introduced to regulate the economy. However, in 1995, the government operated a dual exchange rate system – the fixed and the autonomous foreign exchange market as a guided deregulation. This policy of guided deregulation and dual exchange rate continued with a merger achieved in January 1999.

Following the transition to civilian democracy in May 1999, the CS_1 ratio averaged 14.2 per cent, with a minimum of 5.9 per cent recorded in Jan 2000 and a maximum of 19.95 per cent achieved in January 2004. The increase in CS_1 ratio from an average of 2.05 per cent during the period Dec 1994 to May

1999 to 14.2 per cent during the period June 1999 to May 2003 was largely explained by the pursuance of the financial sector liberalization policy and the introduction of the inter-bank foreign exchange market (IFEM) in October 1999 to replace the autonomous foreign exchange market. Similar trend was also observed with the CS_2 ratio.

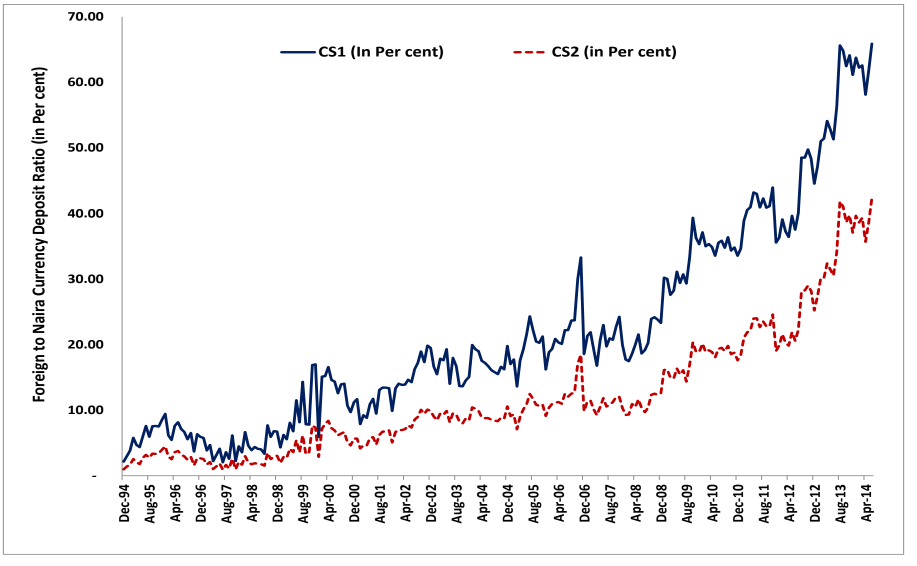

Fig. 1: Currency Substitution Ratio in the Nigerian Banking System

The period June 2003 to June 2009 witnessed further increases in the CS_1 and CS_2 ratios. These two ratios averaged 21.1 per cent and 11.3 per cent in the period up from 14.2 per cent and 7.2 per cent attained during the first term of President Obasanjo, respectively. The CS_1 and CS_2 ratios peaked at 33.3 per cent and 18.5 per cent in November 2006, respectively. This coincided with the period of further liberalization of the Foreign exchange market and unification of the exchange rate between official and inter-bank. Before 2006, the CBN maintained a narrow band policy of +\- 3 per cent of the moving central rate intended to anchor expectations.

The first term of President Yar'adua-Jonathan administration witnessed substantial increases in both CS_1 and CS_2 ratios. The CS_1 ratio rose from 29.3 per cent in August 2009 to a peak of 65.6 per cent in August 2013. Similar trend is observed for the CS_2 ratio. In 2009 the CBN decided to return to a regime of fully liberalized foreign exchange market over a three months period and reverted to the wholesale Dutch auction system.

The period February 2014 to June 2014 indicated an uptrend in the CS_1 and CS_2 ratios. These two ratios averaged 62.1 per cent and 38.9 per cent in the period, up from 42.7 per cent and 24.2 per cent attained during the preceding period, respectively. The CS_1 and CS_2 ratios peaked at 65.9 per cent and 49.4 per cent in June 2014, respectively. This reflected the uncertainties associated with the macroeconomic policy direction of the CBN in the months leading to June 2014 when Governor Emefiele assumed office.

4.0 Theoretical Framework

Following Ortiz (1983), we consider these two simple money demand functions:

$$\left(\frac{DD}{P}\right)_t^* = f\left(r_t^d, r_t^f, r_t, \theta_t, \gamma_t, \omega_t\right) \tag{3}$$

and

$$\left(\frac{FCD}{P}\right)_t^* = h\left(r_t^d, r_t^f, r_t, \theta_t, \gamma_t, \omega_t\right) \tag{4}$$

where the left hand sides of equations (3) and (4) are the real domestic and foreign desired demand money balances in period t, P is the price index, r_t^d, r_t^f and $r_t$are the real returns on domestic currency, foreign currency and an alternative asset; $\theta_t$is a measure of foreign exchange risk, $\gamma_t$is a proxy for political risk factors, and $\omega_t$is the real wealth. Assuming that $f(.)$ and $h(.)$ are exponential functions, the desired money demand functions can be written as:

$$\left(\frac{DD}{P}\right)_t^* = \alpha_0 \omega_t exp\left\{\alpha_1\left(r_t^d - r_t^f\right) + \alpha_2\left(r_t^d - r_t\right) - \alpha_3\theta_t - \alpha_4\gamma_t\right\} \tag{5}$$

and

$$\left(\frac{FCD}{P}\right)_t^* = \beta_0 \omega_t exp\left\{\beta_1\left(r_t^f - r_t^d\right) + \beta_2\left(r_t^f - r_t\right) + \beta_3\theta_t + \beta_4\gamma_t\right\} \tag{6}$$

Taking the natural logarithm of equations (5) and (6) and subtracting the natural log of (5) from (6) gives:

$$ln\left(\frac{FCD}{DD}\right)_t^* = ln\left(\frac{\beta_0\omega_t}{\alpha_0\omega_t}\right) + \{\beta_1(r_t^f - r_t^d) + \beta_2(r_t^f - r_t) + \beta_3\theta_t + \beta_4\gamma_t\} - \{\alpha_1(r_t^d - r_t^f) + \alpha_2(r_t^d - r_t) - \alpha_3\theta_t - \alpha_4\gamma_t\} \quad (7)$$

Imposing the following symmetry conditions $\alpha_i = \beta_i$ for i=1, 2,...4 in equation (7) and adding the stochastic term μ_t gives equation (8):

$$ln\left(\frac{FCD}{DD}\right)_t^* = \rho_1(r_t^f - r_t^d) + \rho_2\theta_t + \rho_3\gamma_t + \mu_t \quad (8)$$

where $\rho_1 = 2\alpha_1 + \alpha_2$, $\rho_2 = 2\alpha_3$ and $\rho_3 = 2\alpha_4$. The desired level of the left hand side of equation (8), that is, the natural log of currency substitution is not directly observable. We then use the partial adjustment hypothesis of Nerlove (1958) expressed as:

$$ln\left(\frac{FCD}{DD}\right)_t - ln\left(\frac{FCD}{DD}\right)_{t-1} = \lambda\left\{ln\left(\frac{FCD}{DD}\right)_t^* - ln\left(\frac{FCD}{DD}\right)_{t-1}\right\} \quad (9)$$

where λ is the coefficient of adjustment and is expected to fall in the interval (0,1], and the left hand side and the right hand side of equation (9) are the actual change and desired change, respectively. The equation postulates that actual change in currency substitution in any given time period, is a function λ of the desired change for the period. Now substituting (8) in (9) yields the partial adjustment model:

$$ln\left(\frac{FCD}{DD}\right)_t = \lambda\{\rho_1(r_t^f - r_t^d) + \rho_2\theta_t + \rho_3\gamma_t\} + (1 - \lambda)ln\left(\frac{FCD}{DD}\right)_{t-1} + \epsilon_t \quad (10)$$

where $\epsilon_t = \lambda\mu_t$. Equation (8) represents the long-run, or equilibrium demand for currency substitution, while equation (10) is the short-run demand function for currency substitution. Once the short-run function is estimated to obtain the estimate of the adjustment coefficient λ, we can then derive the long-run function by dividing the parameter estimates in equation (10) by the adjustment coefficient and ignore the lag term to get equation (8).

One method of estimating the potential monetary instability problems of currency substitution is to examine the properties of alternative definitions of monetary aggregates. If foreign currency deposits are effectively regarded by the public as money, they should be included as part of the money stock for policy making purposes. In fact the FCD are included as part of quasi money in Nigeria. Alternatively, if the currency substitution problem is important, domestic money demand estimations that fail to account for the foreign currency component should be unstable. To explore the relevance of this question for the case of Nigeria, a conventional money demand equation will be estimated based on the three definitions of the monetary aggregates:

$$M^j = COB + DD \tag{11}$$

$$M^k = M^j + FCD \tag{12}$$

$$M^h = M^k + TSD \tag{13}$$

The money demand equations are given in equation (14) as:

$$ln\left(\frac{M^{j,k,h}}{P}\right)_t = \alpha_0 + \alpha_1 ln\, Y_t + \alpha_2 RD_t + \alpha_3 FR_t + \alpha_4 IR_t + \alpha_5 SP_t + \alpha_6 ln\left(\frac{M^{j,k,h}}{P}\right)_{t-1} + \in_t \tag{14}$$

where $(M^{j,k,h}/P)$ is the real monetary aggregates with $(M^j$ and $(M^h$ representing the Nigeria's narrow and broad money supply, respectively; Y_t is current real income; RD_t is the period average interest rate payable on 3 months Nigerian naira deposits; FR_t is the short-term US money market rate; the weighted average inflation rates of the past three periods is taken as proxy for expected inflation, IR_t and $\in_t$, is a random error term; SP_t is the spread between the official and parallel market exchange rate. COB is domestic currency outside banks; TSD, DD, FCD are as defined in equations (1) to (2).

5.0 Causes and Effects of Currency Substitution

5.1 Causes of Currency Substitution

For a local resident, the real return of the holdings of desired domestic currency r^d, can be approximated by the rate of inflation. The real return on desired foreign money is simply r^f which is equal to r^d plus the expected percentage rise in the domestic currency price for foreign currency. Thus, the differential $(r^f - r^d)$ is just the expected depreciation (ED) of the exchange rate. However, foreign exchange futures market for most developing countries' currencies did not exist and exchange rate forwards started most recently in Nigeria.

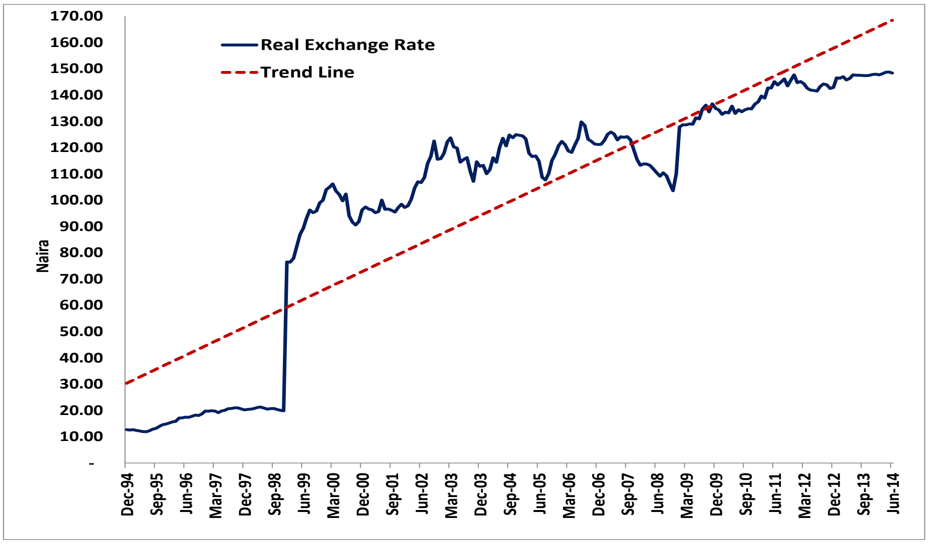

Fig. 2: Real Naira/Dollar Exchange Rate and its Long-run Trend

Therefore, to account for the departure from the simple efficiency hypothesis, an obvious proxy for the expected rate of depreciation of the exchange rate is the spread (SP) between the official and parallel market exchange rate. Given the length of the period in which the exchange rate was fixed, the deviations of the real exchange rate from trend were used as a proxy measure of foreign exchange risks (ER) (see Fig. 2). Finally, dummy variables $(PR^k, k = 1\ 2, 3)$ were included to reflect the various tenures of the three heads of Government to take account of the political risk factors in the study period.

Equation (8) and (10) can be expressed as

$$\ln(CS)_t = \rho_1 SP_t + \rho_2 ER_t + \sum_{k=1}^{3} \rho_{k+2} PR_t^k + \mu_t \quad (15)$$

$$\ln(CS)_t = \lambda\rho_1 SP_t + \lambda\rho_2 ER_t + \sum_{k=1}^{3} \lambda\rho_{k+2} PR_t^k + (1-\lambda)\ln(CS)_{t-1} + \epsilon_t \quad (16)$$

where the adjustment coefficient λ and ρ_1, ρ_2, ρ_3, ρ_4, and ρ_5 are parameter values to be determined. The variables CS, SP, ER are as earlier defined. The political risk variable PR_t^k is defined as:

$$PR_t^k == \begin{cases} 1, & t \in President\ \ k\ tenor \\ 0, & Otherwise \end{cases}$$

Thus, PR_t^1, PR_t^2 and PR_t^3 represent the "political risks" associated with the regime of the three heads of Government covered in the study period - starting with General Abacha-Abdulsalam (up to May, 1999), President Obasanjo (June, 1999 to May 2007) and Presidents Yar'adua-Jonathan (June 2007 to date), respectively. The error term $\epsilon_t = \lambda\mu_t$ and μ_t is normally distributed with a constant mean and variance.

Empirical results from the Augmented Dickey Fuller (ADF) test showed that the null hypothesis of a unit root test cannot be rejected at the 10 per cent level for all the variables used in this paper, except for three month average deposit rate (RD) and expected inflation (IR) that are level stationary, I(0). All the other variables in Table 1 are I(1), which suggest short run disequilibrium. Thus, estimates of equations (15) and (16) would only be valid if all the variables are level stationary. Therefore, there is need to correct for the short-run disequilibrium.

Table 1: Testing The Null Hypothesis of a Unit Root using ADF Test

Variable	ADF	Prob	Difference	ADF	Prob
SP	-1.8889	0.3372	d(SP)	-15.0891	0.0000
ER	-1.6403	0.4604	d(ER)	-14.7147	0.0000
CS_1	0.9959	0.9965	d(CS_1)	-15.4192	0.0000
CS_2	1.6329	0.9996	d(CS_2)	-14.6609	0.0000
Y	4.4861	1.0000	d(Y)	-2.5935	0.0990
RD	-2.9352	0.0460	d(RD)	-5.6422	0.0000
IR	-9.0659	0.0000			
FR	-2.0074	0.2832	d(FR)	-4.0999	0.0017
M^i/P	-0.8445	0.8004	d(M^i/P)	-10.9117	0.0001
M^j/P	0.0031	0.9555	d(M^j/P)	-11.0077	0.0001
M^k/P	-0.2094	0.9319	d(M^k/P)	-9.8522	0.0000

ADF meand Augmented Dickey Fuller

Pesaran *et al*. (2001) proposed a new approach to testing for the existence of a relationship between variables in levels which is applicable irrespective of whether the underlying variables are either I(0), purely I(1) or mutually co-integrated. The statistic underlying the new approach is the familiar F Wald test in a generalized Dickey-Fuller type regression used to test the significance of lagged levels of the variables under consideration in a conditional unrestricted equilibrium correction model. The ARDL (p, q, r) bound test representation of equation (15) is specified as:

$$\Delta\ln(\mathrm{CS}_t) = c + \rho_1 \ln(CS_{t-1}) + \rho_2 SP_{t-1} + \rho_3 ER_{t-1} + \sum_{i=1}^{p} \beta_{1i} \Delta\ln(CS_{t-i}) + \sum_{j=1}^{q} \beta_{2j} \Delta SP_{t-j} + \sum_{k=1}^{r} \beta_{3k} \Delta ER_{t-k} + \epsilon_t \qquad (17)$$

where

$$c = \sum_{h=1}^{3} \partial_h PR_t^h$$

With PR^h_t defined earlier. The β parameters are the short-run coefficients and the ρ parameters represent the long-run coefficients of the model. Δ represents a first difference operator and p, q, r are the optimal lag lengths selected for the right hand variables. This bound testing approach for testing the null hypothesis of no co-integration amongst the variables against the presence of co-integration involves testing for the joint significance of the coefficients of the lagged level variables in equation (17) using the F Wald test as follows:

$$H_o: \rho_1 = \rho_2 = \rho_3 = 0 \ \ Vs \ \ H_1: \rho_1 \neq \rho_2 \neq \rho_3 \neq 0$$

The ARDL bound test is based on F Wald statistic and the asymptotic distribution of the statistic is non-standard under the null hypothesis of no co-integration. If the computed F Wald statistic lies above the upper bound critical value (or P-value of less than 10 per cent) the null hypothesis is rejected, implying the existence of co-integration amongst the variables in the model. Once the presence of co-integration is established, an appropriate distributed lag error correction model of equation (15) is specified as follows:

$$\Delta\ln(CS)_t = \sum_{h=1}^{3} \partial_h PR_t^h + \sum_{i=1}^{p} \lambda_{1i} \Delta\ln(CS_{t-i}) + \sum_{j=0}^{q} \lambda_{2j} \Delta SP_{t-j} + \sum_{k=0}^{r} \lambda_{3k} \Delta ER_{t-k} + \gamma\mu_{t-1} + \varepsilon_t \qquad (18)$$

Using monthly data from December 1994 to June 2014, the (estimated) orders of an ARDL(p, q, r) model in the three variables $ln(CS)_t$, SP_t and ER_t in equation (17) were selected by searching across the 6^3 =216 ARDL models, spanned by p = 1, 2, ….., 6, q = 1, 2,….,6 and r = 1, 2, ….,6, using the AIC criterion. This resulted in the choice of ARDL (3,1,3) specification for $ln(CS_1)$ and $ln(CS_2)$ with estimates of the levels relationships given by

$$\ln(CS_1)_t = 2.107\,PR_t^1 + 3.070\,PR_t^2 + 3.467\,PR_t^3 - 0.305\,SP_t - 0.014\,ER_t + \hat{\pi}_t \quad (19)$$

and

$$\ln(CS_2)_t = 1.457\,PR_t^1 + 2.485\,PR_t^2 + 2.850\,PR_t^3 - 0.389\,SP_t - 0.017\,ER_t + \hat{\mu} \quad (20)$$

where $\hat{\pi}_t$ and $\hat{\mu}_t$ are the equilibrium correction terms. All the levels estimates are highly significant.

In order to investigate if there is a long run relationship amongst the regressors in the $ln(CS_1)$ and $ln(CS_2)$ models, we conducted the ARDL bounds test of Pesaran *et al*. (2001). We estimated an ARDL(3,1,3) model of equation (17) and conducted the Wald F test for the joint significance of the coefficients of the lagged levels of the included variables H_o. If the coefficients of the lagged levels are jointly zero, we conclude that the variables are not co-integrated. The ARDL (3,1,3) bound test regressions are presented in Table 2, with the associated F Wald statistic and its P-value. The computed F Wald statistic P-value for both models is less than 10 per cent suggesting that the null hypothesis of no co-integration should be rejected, implying the existence of co-integration amongst the variables in the two models.

The associated ECM regression associated with the level relationships in equation (19) and (20) are given in Table 3. The conditional ECM regression also passes the test against residual serial correlation as the hypothesis of no serial correlation in the residuals is accepted in both models. The regression results are satisfactory in spite of the crude measures of expected depreciation or devaluation of the official exchange rate and the foreign exchange risks. All the regressors have the correct sign. The coefficient of the monthly change in

Table 2: Regression Results of ARDL(3,1,3) Bound Testing Approach

Dependent Variable: $\Delta ln(CS_1)_t$

Variable	Coefficient	Std Error	P-Value
C	0.3931	0.1351	0.0040
$ln(CS_1)_{t-1}$	-0.1087	0.0404	0.0077
SP_{t-1}	-0.0951	0.0361	0.0089
ER_{t-1}	-0.0028	0.0013	0.0308
$\Delta ln(CS_1)_{t-1}$	-0.6085	0.0690	0.0000
ΔSP_{t-1}	0.1679	0.1141	0.1425
ΔER_{t-1}	0.0080	0.0051	0.1179
$\Delta ln(CS_1)_{t-2}$	-0.3063	0.0743	0.0001
ΔER_{t-2}	-0.0005	0.0029	0.8651
$\Delta ln(CS_1)_{t-3}$	-0.1884	0.0626	0.0029
ΔER_{t-3}	0.0052	0.0029	0.0783
Adjusted R^2		0.3581	
AIC		-0.3854	
F Wald Test		**2.4869**	**0.0614**

Dependent Variable: $\Delta ln(CS_2)_t$

Variable	Coefficient	Std Error	P-Value
C	0.2892	0.1012	0.0047
$ln(CS_2)_{t-1}$	-0.0932	0.0368	0.0121
SP_{t-1}	-0.0933	0.0364	0.0112
ER_{t-1}	-0.0028	0.0013	0.0337
$\Delta ln(CS_2)_{t-1}$	-0.6041	0.0681	0.0000
ΔSP_{t-1}	0.1441	0.1139	0.2071
ΔER_{t-1}	0.0076	0.0051	0.1364
$\Delta ln(CS_2)_{t-2}$	-0.3028	0.0738	0.0001
ΔER_{t-2}	0.0001	0.0029	0.9809
$\Delta ln(CS_2)_{t-3}$	-0.1933	0.0625	0.0022
ΔER_{t-3}	0.0061	0.0029	0.0367
Adjusted R^2		0.3487	
AIC		-0.392	
F Wald Test		**2.2604**	**0.0823**

Table 3: Equilibrium Correction Form of the ARDL(3,1,3) Currency Substitution Equation

Dependent Variable: $\Delta ln(CS_1)_t$

Regressor	Coefficient	Std Error	P-Value
PR^1_t	0.0273	0.0281	0.3331
PR^2_t	0.0252	0.0199	0.2061
PR^3_t	0.0336	0.0213	0.1155
ΔSP_t	0.1906	0.1125	0.0917
ΔER_t	0.0021	0.0051	0.6805
$\Delta ln(CS_1)_{t-1}$	-0.6053	0.0690	0.0000
ΔSP_{t-1}	0.1106	0.1130	0.3291
ΔER_{t-1}	0.0080	0.0051	0.1652
$\Delta ln(CS_1)_{t-2}$	-0.3061	0.0742	0.0001
ΔER_{t-2}	0.0005	0.0029	0.8556
$\Delta ln(CS_1)_{t-3}$	-0.2016	0.0624	0.0014
ΔER_{t-3}	0.0061	0.0029	0.0369
$\hat{u}_{t-1}$	-0.1039	0.0446	0.0208
Adjusted R^2		0.3665	
AIC		-0.3905	
BG-SC Test	**0.0685**		**0.9338**

Dependent Variable: $\Delta ln(CS_2)_t$

Regressor	Coefficient	Std Error	P-Value
PR^1_t	0.0307	0.0281	0.2751
PR^2_t	0.0264	0.0199	0.1854
PR^3_t	0.0390	0.0212	0.0674
ΔSP_t	0.2273	0.1122	0.0440
ΔER_t	0.0043	0.0051	0.4000
$\Delta ln(CS_2)_{t-1}$	-0.3032	0.0739	0.0001
ΔSP_{t-1}	0.0816	0.1129	0.4704
ΔER_{t-1}	0.0063	0.0051	0.2157
$\Delta ln(CS_2)_{t-2}$	-0.3032	0.0739	0.0001
ΔER_{t-2}	0.0010	0.0029	0.7382
$\Delta ln(CS_2)_{t-3}$	-0.2104	0.0625	0.0009
ΔER_{t-3}	0.0068	0.0029	0.0184
$\hat{u}_{t-1}$	-0.0804	0.0403	0.0470
Adjusted R^2		0.3563	
AIC		-0.3956	
BG-SC Test	**0.0760**		**0.9268**

expected depreciation/devaluation estimated for the short-run equation of the $ln(CS_1)$ and $ln(CS_2)$ variables are significantly different from zero at the 10 and 5 per cent levels, respectively. Thus, any expectation of devaluation/depreciation would have immediate impact on the degree of currency substitution. The third period lag of the changes in exchange rate risk variable for the two models are also statistically significant. While all the dummy variables are not significant in terms of $ln(CS_1)$, the dummy variable representing Yar'adua-Jonathan presisency was statistically significant in explaining $ln(CS_2)$. We can, therefore, infer that the policies implemented since the beginning of the Yar'adua-Jonathan presidency have led to increased currency substitution.

It is revealing to note that persistent rise in exchange rate spread would raise economic agents' suspicion for possible devaluation of the local currency and therefore, may increase his desire for currency substitution. The implication of this is that the monetary authority should ensure that the spread between the official exchange rate and the parallel market rate is contained at any point in time. In addition elevation of the foreign exchange risks resulting from exogenous shocks may facilitate currency substitution. Based on the two definitions of the degree of currency substitution, the empirical results in this paper suggest that exchange rate risks and expected depreciation/devaluation of the exchange rate as well as some of the political uncertainties during the Yar'adua-Jonathan presidency were the main causal factors of currency substitution in Nigeria.

5.2 Effects of Currency Substitution

The monetary and real effects of currency substitution on economic activity will depend on the degree to which domestic currency is being displaced by foreign currency. Ortiz (1983) observes that "*If the substitution process goes to the extreme of eliminating or substantially reducing the circulation of domestic coin and currency, the monetary habitat of the country will be changed*". This implies giving up to the country issuing the substitute currency the seniorage of money creation and eroding the base of the inflation tax. Even in less drastic situations, it has been pointed out in the currency substitution literature that substantial monetary instability might arise as a result of diversified currency holdings by domestic residents. The relevance of this substitution problem for monetary policy can only be evaluated empirically.

To explore the relevance of this question for the case of Nigeria, a conventional money demand equation was estimated using quarterly data from Q4 1994 to Q2 2014., based on the three definitions of the monetary aggregates and the money demand function defined in equations (11) to (14), respectively. Fig 3 presents the plot of the three definitions of real money balances $RM_1 = M^j/P$, $RM_{21} = M^k/P$, and $RM_2 = M^h/P$, with P being the price level over the study period.

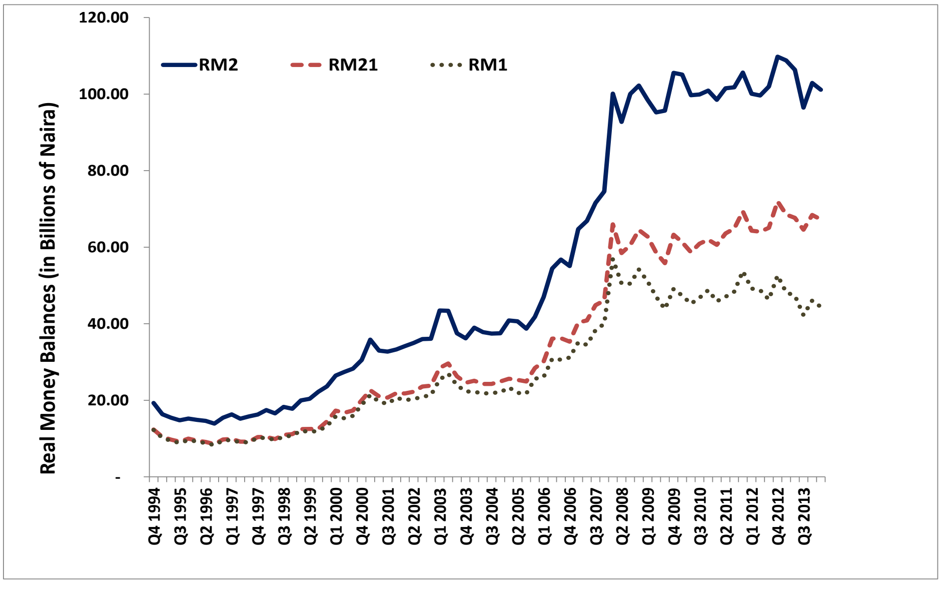

Fig 3: Real Money Balances

The unit root test conducted on the variables in equation (14) suggests the use of the ARDL approach to estimate the parameters of the model. Using quarterly data covering the period Q4 1994 to Q1 2014, the (estimated) orders of an ARDL(p,q,r,s,v,w) model in the six variables $ln(M^{j,k,h}/P)_t$, $ln(Y_t)$, RD_t, FR_t, IR_t and SP_t in equation (14) were selected by searching across the 4^6 =4096 ARDL models, spanned by $p = 1,2,\dots,4$, $q = 1,2,\dots,4$, $r = 1,2,\dots,4$, $s = 1,2,\dots,4$, $v = 1,2,\dots,4$ and $w = 1,2,\dots,4$, using the AIC criterion. This resulted in the choice of ARDL (4,1,1,2,1,1) specification for the models with estimates of the levels relationships given by

$$\ln(RM_1)_t = -12.879 + 1.432\ln(Y_t) + 0.007\,RD_t + 0.001\,IR_t - 0.019\ FR_t - 0.148\,SP_t \quad + \hat{\pi}_t \tag{21}$$

$$\ln(RM_{21})_t = -16.628 + 1.678\ln(Y_t) + 0.003\,RD_t + 0.002\,IR_t - 0.028\ FR_t - 0.149\,SP_t \quad + \hat{\tau}_t \tag{22}$$

and

$$\ln(RM_2)_t = -16.351 + 1.689\ln(Y_t) + 0.002\,RD_t + 0.001\,IR_t - 0.025\;FR_t - 0.138\,SP_t \quad + \hat{\mu}_t \qquad (23)$$

where $\hat{\pi}_t$, $\hat{\tau}_t$ and $\hat{\mu}_t$ are the equilibrium correction terms. The levels estimates for $ln(Y_t)$, SP_t and the constant are significant for all the three equations. The foreign interest rate coefficient (FR_t)is significant for the RM_{21} equation only, while all the other variables coefficients are not statistically significant. The ARDL (4,1,1,2,1,1) bound test regressions results using Eviews software are presented in Table 4, with the associated F Wald statistics and their P-values. The P values for the computed F Wald statistic of the three models are less than 10 per cent implying that the null hypothesis of no co-integration should be rejected. This suggests the existence of co-integration amongst the variables.

Table 4: Regression Results of ARDL(4,1,1,2,1,1) Bound Testing Approach

Dependent Variable:	$\Delta\ln(M^j/P)_t$		$\Delta\ln(M^k/P)_t$		$\Delta\ln(M^h/P)_t$	
Variable	Coefficient	P-Value	Coefficient	P-Value	Coefficient	P-Value
C	2.6112	0.1540	2.1418	0.2602	1.5235	0.3312
$\ln(M^{j,k,h}/P)_{t-1}$	0.0872	0.2471	0.0808	0.2605	0.1154	0.0608
$\ln(Y)_{t-1}$	-0.2102	0.1536	-0.1785	0.2442	-0.1707	0.1821
RD_{t-1}	-0.0076	0.1296	-0.0047	0.3129	0.0008	0.8411
IR_{t-1}	-0.0033	0.0233	-0.0041	0.0049	-0.0036	0.0084
FR_{t-1}	0.0294	0.0016	0.0280	0.0018	0.0334	0.0002
SP_{t-1}	-0.0386	0.0396	-0.0340	0.0607	-0.0184	0.2228
$\Delta\ln(M^{j,k,h}/P)_{t-1}$	-0.5521	0.0009	-0.5508	0.0007	-0.6019	0.0004
$\Delta\ln(Y)_{t-1}$	0.0663	0.5768	0.0366	0.7562	0.0374	0.7182
ΔRD_{t-1}	-0.0043	0.5633	-0.0049	0.4819	-0.0021	0.7457
ΔIR_{t-1}	0.0025	0.2804	0.0018	0.4133	-0.0001	0.9598
ΔFR_{t-1}	-0.0165	0.5924	-0.0187	0.5265	0.0060	0.8250
ΔSP_{t-1}	0.0072	0.7874	-0.0073	0.7759	-0.0175	0.4389
$\Delta\ln(M^{j,k,h}/P)_{t-2}$	-0.5081	0.0013	-0.5220	0.0010	-0.4578	0.0048
ΔIR_{t-2}	-0.0041	0.0711	-0.0042	0.0497	-0.0014	0.4330
$\Delta\ln(M^{j,k,h}/P)_{t-3}$	-0.3340	0.0200	-0.2897	0.0400	-0.4375	0.0036
$\Delta\ln(M^{j,k,h}/P)_{t-4}$	0.0487	0.7269	0.0328	0.8110	0.0371	0.8003
Adjusted R^2	0.2857		0.2711		0.2817	
AIC	-2.1977		-2.3019		-2.5738	
F Wald Test	**3.6745**	**0.0038**	**3.6918**	**0.0037**	**3.6661**	**0.0039**

The associated ECM regression associated with the level relationships in equations (21) to (23) are given in Table 5. The conditional ECM regression also passes the test against residual serial correlation as the hypothesis of no serial correlation in the residuals is accepted in the three models. The regression results are also satisfactory. The results for the two definitions of money RM_1 and RM_{21} are very similar. However, the results for the RM_2 model appear to conform to the priori expectations. All the ECM terms have the correct signs, but not statistically significant.

Table 5: Equilibrium Correction Form of the ARDL(4,1,1,2,1,1) - Effects of Currency Substitution in Real Money Balances

Dependent Variable:	$\Delta\ln(M^j/P)_t$		$\Delta\ln(M^k/P)_t$		$\Delta\ln(M^h/P)_t$	
Variable	**Coefficient**	**P-Value**	**Coefficient**	**P-Value**	**Coefficient**	**P-Value**
C	0.0017	0.8931	0.0020	0.8851	0.0052	0.6587
$\Delta\ln(Y)_t$	0.2324	0.0414	0.2709	0.0243	0.2074	0.0403
ΔRD_t	-0.0003	0.9739	-0.0016	0.8327	0.0012	0.8601
ΔIR_t	-0.0032	0.2315	-0.0025	0.3200	-0.0042	0.0600
ΔFR_t	-0.0933	0.0073	-0.0766	0.0292	-0.0424	0.1831
ΔSP_t	-0.0503	0.0571	-0.0455	0.0749	-0.0312	0.1564
$\Delta\ln(M^{j,k,h}/P)_{t-1}$	0.0034	0.9781	-0.0116	0.9308	0.0010	0.9944
$\Delta\ln(Y)_{t-1}$	-0.0695	0.5309	-0.1018	0.3767	-0.0511	0.6139
ΔRD_{t-1}	-0.0068	0.3748	-0.0042	0.5695	0.0024	0.7221
ΔIR_{t-1}	0.0013	0.5664	0.0007	0.7729	-0.0009	0.6694
ΔFR_{t-1}	0.0926	0.0068	0.0728	0.0287	0.0740	0.0196
ΔSP_{t-1}	0.0151	0.5868	0.0059	0.8310	-0.0064	0.7895
$\Delta\ln(M^{j,k,h}/P)_{t-2}$	0.1275	0.2969	0.1053	0.4089	0.1488	0.2248
ΔIR_{t-2}	-0.0020	0.3510	-0.0019	0.3637	0.0001	0.9520
$\Delta\ln(M^{j,k,h}/P)_{t-3}$	0.0566	0.6676	0.1375	0.3156	0.0527	0.7032
$\Delta\ln(M^{j,k,h}/P)_{t-4}$	0.4515	0.0006	0.4493	0.0008	0.4917	0.0002
$\hat{\pi}_{t-1}$	-0.1479	0.1027				
$\hat{\tau}_{t-1}$			-0.1601	0.1013		
$\hat{\mu}_{t-1}$					-0.0593	0.4537
Adjusted R^2	0.2346		0.1886		0.2023	
AIC	-2.1285		-2.1945		-2.4689	
BG-SC Test	**0.4930**	**0.6135**	**0.2452**	**0.7834**	**1.6678**	**0.1982**

Perhaps the most striking difference is the change in real income elasticity term, which turns out to be positive and significant on the real demand for money functions. The coefficient of the change in the domestic short-term (3 months) deposit rate current and lag one quarter has the expected sign though not significant. The change in short-term foreign deposit interest rate lag one quarter is positive and significantly different from zero for all the short-run equations.

The coefficient of the foreign interest rate variable on the aggregate is positive and significant for the broad definition of money (RM_2), indicating strong empirical evidence of currency substitution in Nigeria. Thus, on the short-run an increase in the short-term money markets foreign interest rate in the current quarter will put an upward pressure on the demand for money in Nigeria in the next quarter. This will imply that a considerable amount of instability may be imported from foreign territories as the demand for domestic currency is significantly influenced by foreign factors.

Also, high inflation expectation is expected to erode the current value of the domestic currency and would tend to increase currency substitution as the inflation expectation coefficients in the current period for all the short-run equations were negative and significant for real broad money balances. While there may be a ratchet effect in the currency allocation of deposits, such an effect can be detected for the deposit – only CS ratio (CS_1 or CS_2). The presence of the ratchet effect, which captures the extent of persistence in currency substitution, if confirmed, will suggests that the Nigerian economy has reached a degree of currency substitution that would make the process asymmetric and difficult to reverse, implying that monetary policy may not have an impact on the portfolio decisions of the private sector.

6.0 Conclusion

The econometric results indicate that the behavior of the foreign currency/naira demand deposit ratio in Nigeria has been influenced by devaluation expectations and exchange rate risk as well as some of the policies being pursued since the advent of the democratic governance.

The money demand estimations show that short-term foreign money market interest rates do significantly affect the demand for Naira, so there is strong evidence of currency substitution. Moreover, while there may be a ratchet effect in the currency allocation of deposits, such an effect can be detected for the deposit – only CS ratio (CS_1 or CS_2).

The presence of the ratchet effect, if established, may suggest that the Nigerian economy has reached a degree of currency substitution that would make the process asymmetric and difficult to reverse. This may imply that monetary policy may not have the expected impact on the portfolio decisions of the private sector.

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