Ratchet Effects in Currency Substitution: An Application to Nigeria

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This study examines the persistence of currency substitution in Nigeria by applying the Bounds testing approach to cointegration and including a ratchet variable in the estimated Autoregressive Distributed Lag (ARDL) model. Empirical results show that factors such as exchange rate risks, expected exchange rate depreciation, exchange rate spread, inflation expectations as well as the ratchet variables are significant determinants of currency substitution in Nigeria, with the ratchet variables having overarching influence in the long run. This indicates that currency substitution is persistent in Nigeria and may portend negative implications for the stability of the money demand function as well as the effectiveness of monetary policy. Among others, the study recommends strong and sustained monetary policy intervention towards encouraging deposit holders and other economic agents to switch their currency portfolio back to Naira.

Keywords: Currency Substitution, Ratchet Effect, Cointegration, Monetary Policy, ARDL Model.

JEL Classification: C22, E41, E51

1.0 Introduction

Currency substitution describes a situation in which a more stable foreign currency is being used extensively by residents of an economy alongside or instead of the domestic currency. However, in a more specific term, McKinnon (1985) stated that direct currency substitution occurs when two or more currencies compete as a means of payment within the same commodity domain. Implicit in McKinnon's definition is the fact that the concept of currency substitution relates to the process where by residents of an economy switch their currency portfolio from local to foreign currency with a view to facilitating transactions that are unrelated to international trade or finance. A strand of literature has also described a situation in which economic agents use a foreign currency, largely because of macroeconomic instability in the domestic economy as unofficial currency substitution. This also includes the practice of buying foreign currency for keep with the ultimate aim of selling them in future at a higher price. In whatever form the phenomenon of

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currency substitution takes place, the literature is in agreement as to the fact that it remains a source of worry to policy makers, especially in developing countries.

In Nigeria, the incidence of currency substitution has recently attracted substantial attention with policy makers asking serious policy and empirical questions regarding its severity, persistence and consequences. For instance, during the first quarter of 2000, the ratio of foreign currency deposit to domestic (Naira) demand deposit in the country (a proxy for currency substitution index) was 15.2 per cent. However, this has almost doubled to about 27.4 per cent during 2009:Q1 and has increased steadily since then to about 51.4 per cent in 2013:Q1[2]. As pointed out by Ho (2003), increasing trend of currency substitution is capable of generating exchange rate instability, altering the demand for money function and frustrating the implementation of monetary policy. It is therefore of significant policy and empirical relevance to understand the dynamics of currency substitution in any economy where it is evident.

In economic literature, a major causal variable of currency substitution is inflation (see Tanzi and Blejer, 1982; Elkhafif, 2002). The consensus in this regard is that currency substitution increases during periods of higher inflation (Us, 2003; Mongardini and Mueller, 2000). Given this argument, it naturally follows that a reduction in inflation rate should lead to a decline in currency substitution. However, this is usually not the case as several works have documented contrary findings to the effect that currency substitution often attain an irreversible state such that economic agents fail to respond to the incentives arising from low inflation, due to ratchet effect. Ratchet effect is said to occur when a dependent variable responds in an asymmetric manner to one of the independent variables. In our case, the presence of ratchet effect is established if currency substitution responds asymmetrically to different episodes of inflation. Such asymmetric effect leads to high persistence in currency substitution, requiring concerted policy response.

According to Us (2003), the factor generating asymmetry in currency substitution is the fixed costs of developing, learning, and applying new money management techniques to beat inflation. He argued that once these fixed costs are covered, the incentives to switch back to domestic currency

[2] Source: Central Bank of Nigeria Monetary Survey. See Doguwa (2014) for a trend analysis on currency substitution in Nigeria.

declines substantially, thus leading to ratchet effect on the demand for domestic and foreign currencies.

While the incidence and extent of currency substitution has been duly investigated in most countries (El-Erian, 1988 for Egypt and Yemen; Fasano-Filho, 1986 for Argentina; Rogers, 1992 for Mexico and Canada; Mongardini and Mueller, 2000 for Kyrgyz Republic; etc) only a few of such studies have been conducted on Nigeria. These few studies include Yinusa and Akinlo (2008), Effiom and Samuel (2010), Adeniji (2013), Akinlo (2003) and Doguwa (2014) with most of them focusing on the determinants of currency substitution in Nigeria.

Doguwa (2014) provided strong empirical evidence on the presence of currency substitution in Nigeria, and attributed this to devaluation expectations, exchange rate risks, increasing spread between official and parallel market exchange rates and some of the policies taken by the political regimes. However, the study did not examine the persistence of currency substitution in the country.

This study aimed to build on Doguwa (2014), by integrating the ratchet in the currency substitution model and bridge this gap. Consequently, the main objective of this study is to model currency substitution in Nigeria and investigate the degree of its persistence. The Autoregressive Distributed Lag (ARDL) model is employed using monthly data spanning 1990 - 2013.

In order to achieve the aforementioned objectives, the paper is structured into five parts. Following this introduction is section two, which presents a review of literature. Section three discusses the estimation techniques while the empirical findings are presented and discussed in section four. Section five concludes with some policy recommendations.

2.0 Literature Review

Many empirical works have been conducted on currency substitution in both country-specific and cross-country studies. For instance, El-Erian (1988) investigated the magnitude and determinants of private sector currency substitution in Egypt and Yemen Arab Republic over the period 1980 – 86. The study indicated that the increased importance of currency substitution in Egypt was associated with higher expectations of exchange rate depreciation of the local currency and greater political uncertainty. That of Yemen was,

however, more responsive to anticipations of increased yields on foreign currency arising from exchange rate depreciations. The study computed the elasticity of currency substitution with respect to exchange rate expectations to be 0.07 for Egypt and 0.7 for Yemen, indicating that a 10 per cent increase in the expected command of foreign currency over local goods and services would result in a 0.7 and 7.0 per cent increase in the share of foreign currency in broad money in Egypt and Yemen, respectively. The author concluded that foreign exchange demand was responsible for the instability of the domestic money demand function in the two countries.

Ramirez-Rojas (1985) examined the empirical similarities of currency substitution in three Latin American countries of Argentina, Mexico and Uruguay. The author argued that currency substitution was an important feature of the three economies. His study found empirical support for the irreversibility of currency substitution in those economies, but with varying degree. The study indicated that all the countries faced the challenge of controlling monetary aggregates in the presence of currency substitution. His statistical analysis lent support to the increase in currency substitution in all the three countries, and stressed the need for appropriate economic policies to deal with the problem. To halt the process of increasing currency substitution and reduce the level of foreign currency holdings as well as prevent further increases in those holdings, the study proposed the need to increase expected returns on domestic financial instruments, ensure a net monetary contraction and implement consistent and credible demand management policies.

Fasano-Filho (1986) indicated that currency substitution was encouraged in Argentina due to the relatively low value of the local currency and the certainty that the nominal exchange rate was to be adjusted for balance of payments considerations. The author examined whether currency substitution was empirically significant in Argentina during the period 1960 – 76. He found that the behaviour of the demand for money function was influenced by the expected rate of devaluation, indicating the presence of currency substitution. The rate of devaluation coefficient was found to be negative and significant for all definitions of money in the high inflation periods except for quasi money.

Arize (1991) examined the effects of currency substitution on the demand for money function in South Korea utilizing quarterly data from 1973 to 1985. The study found that currency substitution had a negative effect on the

demand for money in South Korea during the period. Bordo and Choudhri (1982) indicated that if currency substitution is important, the expected change in the exchange rate should be a significant determinant of the demand for home currency. They estimated demand for money functions using both M1 and M2 but found the influence of the expected return on foreign money on the demand for domestic money in Canada to be negligible. They concluded that even though significant amount of foreign currency were held in Canada, currency substitution was not an important factor in the demand for money function.

Boamah *et al*. (2012) observed that increased currency substitution may have several negative spill-off effects including weakening the autonomy of monetary policy, increasing vulnerability to economic shocks arising from the host country, the potential for significant deterioration of the balance of payments account and/or exchange rate volatility and has the potential to negatively impact on overall economic growth. The study therefore examined the presence and extent of currency substitution in the Caribbean countries of Guyana, Jamaica, Trinidad and Tobago and Barbados. Adopting a money demand function in an ARDL framework, the study found that currency substitution due to exchange rate shocks occurred in three of the four countries investigated.

Ortiz (1983) indicated that a substantial degree of instability may be imported from abroad if the demand for domestic currency is strongly influenced by foreign variables, even if the monetary authorities follow consistent monetary and exchange rate policies. The author's money demand estimations indicated that foreign interest rates do not significantly affect the demand for Pesos, indicating that the instability problem associated with the currency substitution hypothesis has not been empirically meaningful in Mexico.

Rogers (1992) estimated models of the demand for US dollars relative to the domestic currencies of both Mexico and Canada to test the currency substitution hypothesis. Applying the vector autoregression (VAR) and error correction (ECM) methodologies to a general equilibrium model whose centerpiece is a relative money demand function, the study found a negative and significant correlation between the ratio of Mexdollars to Pesos and the expected rate of depreciation of the Peso. He attributed this finding to the presence of convertibility risk associated with holdings of Mexdollars. The relationship was found to be positive in the Canadian models, and was

inconsistent with the conventional currency substitution hypothesis. In line with the conclusions of Ortiz (1983), the study could not find evidence of the conventional currency substitution hypothesis in Mexico even after applying the Ramirez-Rojas (1985) datasets.

Rodriguez (1993) observed that in an economy operating under currency substitution, shifts in the denomination of currency holdings or the location of foreign currency holdings can affect economic performance. With this, a shift from dollar deposits abroad to deposits in the local system, in pesos or in dollars, increases the supply of credit to the financial system with no corresponding increase in money demand. Given the initial situation of tight credit, an increase in credit results in current account deficit associated with the temporary real currency appreciation, which can be difficult to reverse. Data from Argentina and Peru indicated that the capital flows that followed their stabilization programmes have been associated with a significant worsening of their current accounts. Vegh (1988) further observed that increases in oil prices could cause current account deficits for oil-dependent economies that have currency substitution.

Using a dynamic currency substitution model that incorporated forward-looking rational expectations estimated for a group of ten developing countries, Agenor and Khan (1996) examine the relative demand for domestic and foreign currency deposits by residents of developing countries. The study found that foreign rate of interest and the expected rate of depreciation of the parallel market exchange rate are important factors in the choice between holding domestic money or foreign currency deposits abroad. The ten countries involved in the study were Bangladesh, Brazil, Ecuador, Indonesia, Malaysia, Mexico, Morocco, Nigeria, Pakistan and the Philippines.

By applying the Hansen-Singleton GMM procedure, Imrohoroglu (1994) found that the US dollar deposits in Canada was not a good substitute for the domestic Canadian currency, as the estimates of the elasticity of currency substitution was below unity for all the information sets considered in the study. The study indicated that currency substitution was of second-order importance in a low-inflation economy of Canada.

Komarec and Melecky (2003) examined the relevance of currency substitution phenomenon in the Czech Republic. Utilizing a modified Branson and Henderson portfolio balance model in a demand for money framework, the study detected the presence of currency substitution in the domestic banking

system and capital mobility. They identified the factors determining currency substitution in the Czech Republic to include lack of restrictions on capital inflow, early adoption of necessary financial techniques and a sharp increase in trade openness.

Elkhafif (2002) examined the dynamics of the currency substitution phenomenon in Egypt and South Africa utilizing an error-correction modeling technique. Using the Pool's framework, the study modeled currency substitution as a function of nominal exchange rate and interest rate differential. Results from the ECM showed that Egypt had an elasticity of currency substitution of 0.14, indicating that 10 per cent depreciation in the Egyptian Pound will lead to a 1.4 per cent increase in currency substitution. South Africa, however, has an elasticity of 0.32, indicating that the elasticity of currency substitution with respect to exchange rate of South Africa is 2.3 times that of Egypt. The author also found a unidirectional causality from exchange rate to currency substitution during the period. The study indicated that exchange rate anchoring was more suitable to a high currency substitution environment, and more effective in reducing the rate of substitution.

In terms of currency substitution studies which accommodated ratchet effects, only two were found in the literature, namely Mongardini and Mueller (2000) and Us (2003). Mongardini and Mueller (2000) analyzed the currency substitution process in the Kyrgyz Republic by applying an ARDL framework and including a ratchet variable in their specification. The study measured the degree of currency substitution in the economy in two ways: CS1 being the ratio of foreign currency deposits to total deposits and CS2 being the ratio of foreign currency deposits and cash to broad money plus foreign cash. Their econometric analysis indicated that the interest rate differential and the depreciation of the exchange rate were the significant currency substitution determinants in the economy. The authors concluded that the extent of currency substitution in the economy has not reached an irreversible threshold, implying that monetary policy could still impact on the portfolio decisions of the private sector. Us (2003) also analyzed the persistence of currency substitution in Turkey using the ratchet variable technique, to see whether the economy has reached a point where currency substitution is irreversible. Results from the study utilizing the ARDL modeling approach suggested that currency substitution was not persistent enough to be irreversible during the 1990 – 93 period. It was, however, persistent in the

narrow sense during 1995 – 99 period, but was not irreversible in the broader sense.

Akinlo (2003) investigated whether the depreciation of the Naira has resulted in currency substitution in Nigeria. Utilizing the cointegration technique in a demand for money framework and quarterly data for the period 1980 – 2000, the study found that Naira depreciation has not led to currency substitution in Nigeria. The author indicated that as Naira depreciates, those holding foreign currencies see this as increase in wealth and thus demand for more domestic currency. Yinusa and Akinlo (2008), however, indicated the presence of currency substitution in the domestic banking system in Nigeria during 1986 – 2005. The authors showed that currency substitution was low during the period and classified Nigeria as a moderately dollarized economy. The study indicated that real parallel market exchange rate volatility was the major factor driving the process.

Doguwa (2014) examined the presence and extent of currency substitution in Nigeria using the partial adjustment model and the reduced form of an ARDL model. The study indicated that devaluation expectations, exchange rate risks and some of the political uncertainties during the Obasanjo and Yar'adua-Jonathan presidency were the factors influencing the behaviour of the foreign currency/naira demand deposit ratio. The author added that short-term foreign money market interest rates, expected inflation and three month Naira deposit rate significantly affect the demand for money in Nigeria, indicating the presence of currency substitution, and the possibility of importing considerable instability in the economy.

3.0 Methodology

The currency substitution equation estimated in this study derives from the standard money demand function as used by Mongardini and Mueller (2000). Within this framework, the currency substitution index is modelled as a function of its own lags, interest rate differential, exchange rate depreciation and the ratchet effect variable that captures the persistence effect in the currency substitution model. The currency substitution models for CS1 and CS2, which are modified versions of the ones specified by Doguwa (2014), are as follows:

$$\ln(CS1_t) = \delta_0 + \delta_1 ED_t + \delta_2 ER_t + \delta_3 SPRD_t + \delta_4 EINF_t + \delta_5 RCS1_t + \varepsilon_t \quad (1)$$

and

$$\ln(CS2_t) = \alpha_0 + \alpha_1 ED_t + \alpha_2 ER_t + \alpha_3 SPRD_t + \alpha_4 EINF_t + \alpha_5 RCS2_t + \epsilon_t \quad (2)$$

where CS denotes currency substitution index measured in terms of narrow – defined as the ratio of foreign currency deposits to Naira demand deposits in the Nigerian banking system (CS1), and broad - defined as the ratio of foreign currency deposits to the total of Naira demand, time and savings deposits in the banking system (CS2); ED is the difference between official exchange rate and real exchange rate and represents the expected depreciation in exchange rate; ER is the exchange rate risk defined as the difference between the real exchange rate and its trend line; SPRD is the spread between the exchange rates in the official and BDC segments of the market; EINF is expected inflation defined as the weighted average of the past three periods inflation (Doguwa, 2014). Narrow – RCS_1 and broad – RCS_2 capture persistence in currency substitution. The ratchet variables are calculated as in Mongardini and Mueller (2000) as:

$$RCS1_t = \begin{cases} \ln(CS1_t), & t = 1 \\ \max(RCS1_{t-1}, \ln(CS1_t)), & t \geq 2 \end{cases} \quad (3)$$

and

$$RCS2_t = \begin{cases} \ln(CS2_t), & t = 1 \\ \max(RCS2_{t-1}, \ln(CS2_t)), & t \geq 2 \end{cases} \quad (4)$$

respectively; ε_t and ϵ_t are the random error terms and ln(.) is the natural log operator. The optimal lag length for the right hand side variables are established via Akaike Information Criterion (AIC). Data on the variables are sourced from the statistics database of the Central Bank of Nigeria at *http://statistics.cbn.gov.ng/cbn-onlinestats/.*

Having tested for unit root in the included variables, equations (1) and (2) are estimated within the framework of the theory of cointegration and error correction modelling. We adopt the bounds testing approach to cointegration and Autoregressive Distributed Lag procedure (ARDL) to error correction model proposed by Pesaran and Shin (1999); with further extension by Pesaran, *et al.* (2001). In the ARDL model proposed by Pesaran *et al.* (2001), it is not necessary to ensure that all the included variables are I(1) as in the

Johansen cointegration framework. Thus, the procedure can be applied even when there is a mix of I(0) and I(1) variables in the model. The bound testing approach to cointegration is known to possess some important econometric merits over other methods, some of which were discussed in Pesaran *et al.* (2001), Harris and Sollis (2003) and Inder (1993). The ARDL bound test representation of equations (1) and (2) are specified as:

$$\begin{aligned}\Delta\ln(CS1_t) = {} & \sum_{i=1}^{p}\beta_i\Delta\ln(CS1_{t-i}) + \sum_{i=1}^{q}\varphi_i\Delta ED_{t-i} + \sum_{i=1}^{r}\omega_i\Delta ER_{t-i} \\ & + \sum_{i=1}^{c}\rho_i\Delta SPRD_{t-i} + \sum_{i=1}^{d}\pi_i\Delta EINF_{t-i} + \sum_{i=1}^{s}\gamma_i\Delta RCS1_{t-i} \\ & + \delta_1\ln(CS1_{t-1}) + \delta_2 ED_{t-1} + \delta_3 ER_{t-1} + \delta_4 SPRD_{t-1} \\ & + \delta_5 EINF_{t-1} + \delta_6 RCS1_{t-1} + \alpha + \epsilon_t \end{aligned} \quad (5)$$

and

$$\begin{aligned}\Delta\ln(CS2_t) = {} & \sum_{i=1}^{p}\beta_i\Delta\ln(CS2_{t-i}) + \sum_{i=1}^{q}\varphi_i\Delta ED_{t-i} + \sum_{i=1}^{r}\omega_i\Delta ER_{t-i} \\ & + \sum_{i=1}^{c}\rho_i\Delta SPRD_{t-i} + \sum_{i=1}^{d}\pi_i\Delta EINF_{t-i} + \sum_{i=1}^{s}\gamma_i\Delta RCS2_{t-i} \\ & + \delta_1\ln(CS2_{t-1}) + \delta_2 ED_{t-1} + \delta_3 ER_{t-1} + \delta_4 SPRD_{t-1} \\ & + \delta_5 EINF_{t-1} + \delta_6 RCS2_{t-1} + \alpha + \epsilon_t \end{aligned} \quad (6)$$

where the $\beta,\varphi,\omega,\rho,\pi,$ and γ are short run coefficients and the δs represent the long run parameters of the model. Δ represents a first difference operator and p, q, r, s, c and d are the respective optimal lag lengths selected for the right hand side variables. The ARDL bound testing approach of Pesaran *et al.* (2001) for testing the null hypothesis of no cointegration among the variables against the presence of cointegration involves testing for the joint significance of the coefficients of the lagged level variables in equation (5) and (6) using an F-test as follows:

$$H_0: \delta_i = 0 \; vs \; H_1: \delta_i \neq 0 \; \forall \; i = 1, 2, \ldots, 6$$

The ARDL bound test is based on Wald test F statistic and the asymptotic distribution of the Wald-test is non-standard under the null hypothesis of no cointegration. Thus, Pesaran *et al.* (2001) provides two (2) critical values for

the cointegration test. The lower critical bound assumes all the variables are I(0) while the upper critical bound assumes that all variables are I(1). If the computed F-statistic falls below the lower bound critical value, the null hypothesis of no cointegration cannot be rejected. Conversely, if the computed F-statistic lies above the upper bound critical value; the null hypothesis of no cointegration is rejected, implying the existence of cointegration amongst the variables in the model. If, however, the computed F-statistic lies between the lower and upper bounds, then the result is inconclusive. Once the presence of cointegration is established, an appropriate autoregressive distributed lag error correction model is specified as follows:

$$\Delta\ln(CS1_t) = \alpha + \sum_{i=1}^{p} \beta_i \Delta\ln(CS1_{t-i}) + \sum_{i=0}^{q} \varphi_i \Delta ED_{t-i} + \sum_{i=0}^{r} \omega_i \Delta ER_{t-i} + \sum_{i=0}^{c} \rho_i \Delta SPRD_{t-i} + \sum_{i=0}^{d} \pi_i \Delta EINF_{t-i} + \sum_{i=0}^{s} \gamma_i \Delta RCS1_{t-i} + \lambda\varepsilon_{t-1} + \mu_t \quad (7)$$

and

$$\Delta\ln(CS2_t) = \alpha + \sum_{i=1}^{p} \beta_i \Delta\ln(CS2_{t-i}) + \sum_{i=0}^{q} \varphi_i \Delta ED_{t-i} + \sum_{i=0}^{r} \omega_i \Delta ER_{t-i} + \sum_{i=0}^{c} \rho_i \Delta SPRD_{t-i} + \sum_{i=0}^{d} \pi_i \Delta EINF_{t-i} + \sum_{i=0}^{s} \gamma_i \Delta RCS2_{t-i} + \lambda\epsilon_{t-1} + \mu_t \quad (8)$$

where λ is the adjustment parameter, which measures the speed at which equilibrium is restored following disequilibrium errors arising from shocks. Both $\varepsilon_t, \epsilon_t$ are the residuals from the long run equations (1) and (2) respectively. The μ_t is the residuals from the estimated cointegrating equations (7) and (8).

4.0 Empirical Results

This section presents the results of the analysis including unit root tests, ARDL bound tests for cointegration and the long run and short run model results.

4.1 Unit Root Tests

We begin by testing for the presence of unit root in all the variables, using both the Augmented Dickey Fuller (ADF) and Phillips – Perron (PP) tests. Empirical results from the ADF tests showed that the null hypothesis of a unit root cannot be rejected at the 5 per cent level for CS1, CS2, ED, ER and SPRD. However, the hypothesis was rejected for RCS1, RCS2 and EINF, indicating that the variables were stationary at level. Further ADF tests on the first difference of the variables resulted in a strong rejection of the null hypothesis for all the series at the 1 per cent levels.

Table 1: Unit Root Tests

	Level		First Difference	
Variable	ADF	PP	ADF	PP
CS1	-2.7142	-8.6339*	-13.9634*	-28.1383*
CS2	-2.5369	-7.7476*	-13.7436*	-29.8629*
ED	-3.3034	-3.2344	-13.1743*	-13.1731*
ER	-1.4314	-1.5619	-14.5303*	-14.5431*
SPRD	-1.8711	-1.9011	-15.0553*	-15.0550*
RCS1	-7.6882*	-7.1423*	-12.6703*	-12.5995*
RCS2	-6.4529*	-6.2071*	-12.6164*	-12.5441*
EINF	-4.6743*	-4.0712*	-12.4431*	-12.4768*

* and ** indicate significance at 1 and 5 per cent levels.

The MacKinnon critical values were -3.9986 and -3.4297 at 1 and 5 per cent levels for both ADF and PP Tests

The Phillips – Perron (PP) test on the other hand reports ED, ER and SPRD as I(1) series significant at the 1 per cent levels while the other series were found to be stationary at level. Thus, the series exhibited different levels of stationarity as some of the variables were stationary at level, while the others were differenced stationary, lending support to the use of bounds testing approach to cointegration.

4.2 Bounds Test for Cointegration

In order to investigate if there is a long run relationship amongst the included variables in the ln(CS1) and ln(CS2) models, we conducted the ARDL bounds test proposed by Pesaran et al. (2001). The test is based on the joint F-statistic and its asymptotic distribution is non-standard under the null hypothesis of no cointegration. Thus, we estimated an ARDL model for our dependent variables via ordinary least squares (OLS) and conducted an F-test for the joint significance of the coefficients of the lagged levels of the included

variables. If the coefficients of the lagged levels of the included variables are jointly zero, we conclude that the variables are not cointegrated.

The critical values for the bounds test are documented in Pesaran *et al.* (2001) and are based on assumptions regarding whether the variables in the model are I(0) or I(1). The lower bound critical values are calculated on the assumption that all the variables included in the ARDL model are integrated of order zero, while the upper bound are calculated on the assumption that the variables are first difference stationary. If the F-test statistic exceeds the upper critical bounds, the null hypothesis of no cointegration is rejected. On the other hand, the null hypothesis cannot be rejected if the test statistic is lower than the lower bounds value. The results of the ARDL bounds test for the different combination of variables included in our models are presented in table 2.

Table 2: ARDL Bounds Test for Cointegration

Variable	F-statistic	Critical Values		Decision
		Lower Bound	Upper Bound	
CS1, SPRD, ED, ER, RCS1, EINF	10.82	2.45	3.61	Co-integration
CS2, SPRD, ED, ER, RCS2, EINF	10.84	2.45	3.61	Co-integration

Critical values are obtained from Pesaran et al. (2001). Table CI(iii), Case III

The results showed that the variables included in the ln(CS1) model are cointegrated. The F-statistic was 10.82, which is higher than the upper bound of the critical values (3.61) and implies the presence of a long run relationship amongst the variables.

In the case of the ln(CS2) model, the null hypothesis of no cointegration amongst the included variables is rejected at the 5 per cent significance level, as the associated F-statistic was higher than the upper bound of the critical values. This implies that the variables included in the model are co-integrated.

4.3 Regression Results

The regression results for ln(CS1) and ln(CS2) models estimated using the ARDL procedure are presented in table 3. The upper panel shows the short run model results while the long run estimates are presented at the lower panel.

The selected ARDL representation for the ln(CS_1) model was ARDL (1, 2, 2, 1, 1, 2) for variables ln(CS1), ED, EINF, ER, SPRD and RCS1, respectively.

However, the ARDL specification selected via AIC for ln(CS2) model was ARDL (1, 2, 2, 1, 2, 1) for variables ln(CS2), ED, EINF, ER, SPRD and RCS2, respectively.

Table 3: Regression Results Using the ARDL Procedure

Variable	CS1		Variable	CS2	
	Coefficient	P-value		Coefficient	P-value
Short-Run Coefficients: Error Correction Representation					
C	0.0087	0.5458	*C*	0.0140	0.3142
D(CS1(-1))	-0.3613	0.0000	*D(CS2(-1))*	-0.4186	0.0000
D(ED)	-0.0034	0.5799	*D(ED)*	-0.0042	0.4790
D(ED(-1))	0.0268	0.0392	*D(ED(-1))*	0.0296	0.0196
D(ED(-2))	-0.0287	0.0189	*D(ED(-2))*	-0.0400	0.0017
D(EINF)	-0.0407	0.0298	*D(EINF)*	-0.0459	0.0123
D(EINF(-1))	0.0653	0.0019	*D(EINF(-1))*	0.0826	0.0001
D(EINF(-2))	-0.0258	0.0143	*D(EINF(-2))*	-0.0330	0.0017
D(ER)	0.0083	0.2517	*D(ER)*	0.0108	0.1271
D(ER(-1))	0.0093	0.1987	*D(ER(-1))*	0.0094	0.1848
D(SPRD)	0.2763	0.0820	*D(SPRD)*	0.3259	0.0352
D(SPRD(-1))	0.2192	0.1703	*D(SPRD(-1))*	0.2336	0.1367
D(RCS1)	0.5294	0.1497	*D(SPRD(-2))*	-0.1260	0.0474
D(RCS1(-1))	-0.9931	0.0048	*D(RCS2)*	0.9509	0.0061
D(RCS1(-2))	0.4947	0.1384	*D(RCS2(-1))*	-1.1769	0.0004
ECMCS1(-1)	-0.3931	0.0000	*ECMCS2(-1)*	-0.3422	0.0001
R-squared	0.4622	-	R-squared	0.4779	-
AIC	-0.4695	-	AIC	-0.5262	-
DW-statistics	1.9427	-	DW-statistics	1.9542	-
F-statistics	12.0899	0.0000	F-statistics	12.8734	0.0000
Estimated Long-Run Coefficients					
C	-0.9934	0.0000	*C*	-1.3785	0.0000
ER	0.0153	0.0000	*ER*	0.0174	0.0000
ED	-0.0199	0.0000	*ED*	-0.0216	0.0000
EINF	0.0156	0.0000	*EINF*	0.0166	0.0000
SPRD	0.2043	0.0000	*SPRD*	0.2244	0.0000
RCS1	0.6415	0.0000	*RCS2*	0.6009	0.0000

The ln(CS1) model investigated the long run effects of the ratchet variable as well as other right hand side (RHS) variables on currency substitution (narrowly defined). It shows that all the included variables are statistically significant determinants of currency substitution in Nigeria. For instance, the sentiments expressed by economic agents concerning future inflation matter for currency substitution in Nigeria as the inflation expectation coefficient is positive and statistically significant. This reflects the desire of economic

agents to hedge against inflation risk by increasing their foreign currency holding whenever they expected inflation to rise. Also, a widening gap between the official exchange rate and the BDC rate was associated with increased currency substitution. This suggests that inefficiencies in the foreign exchange market increased the desire of economic agents to hold more foreign currencies.

The positive coefficient for exchange rate risk indicates that exchange rate risk increases the desire of economic agents to hold more foreign currency. The negative coefficient of the expected depreciation variable may be reflective of economic agents' desire to reduce their holdings of foreign currencies in order to take advantage of the associated naira margin. These results are in line with apriori expectations. It is revealing to note that the results for both ln(CS1) and ln(CS2) models are quite similar.

The ratchet variable, which captures the extent of persistence in currency substitution, was significant and positive in both models [ln(CS1) and ln(CS2)] in the long run. This shows that currency substitution has been quite persistent in Nigeria. In order to allow for comparability in terms of the contributions of the right hand side variables to currency substitution, we computed their respective scaled coefficients and the results are presented in table 4. For the ln(CS1) model, the ratchet variable contributed 52.6 per cent to variations in currency substitution, followed by exchange rate risk (46.8 per cent). The other variables accounted for the remaining influence. In the broad money definition of currency substitution, the ratchet variable accounted for about 92.4 per cent with the exchange rate risk accounting for only 9.4 per cent. In summary, ratchet effect seems to be responsible for nothing less than 50 per cent of the variations in currency substitution in Nigeria, irrespective of its definition.

Table 4: Relative Contributions of RHS Variables to Currency Substitution

Variable	CS1		CS2	
	Long-Run Elasticity	Contribution *(In per cent)*	Long-Run Elasticity	Contribution *(In per cent)*
ER	0.7057	46.76	0.0983	9.43
ED	-0.1207	-5.03	-0.0355	-2.14
EINF	0.1509	5.37	0.1462	7.52
SPRD	0.0499	0.76	-0.2907	-6.42
RCS1	0.3721	52.61	-	-
RCS2	-	-	0.6491	92.43

Empirical results from the short run models are similar to those obtained from the long run model. For instance, the coefficients of exchange rate risk (ER) in the ln(CS1) and ln(CS2) models remained positive in the short run at least at its first lag. Also, the spread variable (SPRD) impacts positively on currency substitution in the short run, as observed in the long run. In the short run, the ratchet variables were found to be significant in both ln(CS1) and ln(CS2) models.

The adjustment parameters for the two models are negative and statistically significant, providing further evidence in favour of long run relationship amongst the included variables. However, the speed of adjustment in the ln(CS1) model seems to be faster 0.39 compared with 0.34 for ln(CS2) model. This implies that about 39.0 and 34.0 per cent of disequilibrium errors in ln(CS1) and ln(CS2) are corrected within a month, respectively.

Overall, empirical results from both the long-run and short-run models from the two definitions of currency substitution indicated that a ratchet effect has been detected in Nigeria, indicating that currency substitution in the country is persistent and may require deliberate, sustained and strong policy response to reverse. The presence of ratchet effect in the currency substitution model may portend negative implications for the stability of the money demand function as well as the effectiveness of monetary policy.

5.0 Concluding Remarks

Motivated by the possible adverse implication of currency substitution for monetary policy design and implementation, this study examined the dynamics of currency substitution in Nigeria and the degree of its persistence using the autoregressive distributed lag (ARDL) model. The degree of persistence in currency substitution was proxied by the ratchet variable.

Empirical results indicated that the ratchet variables were significant, indicating the presence of ratchet effects in currency substitution in Nigeria. This implies that currency substitution is quite persistent. In terms of their relative contributions to the degree of currency substitution in Nigeria, the ratchet and exchange rate risk variables dominated as they accounted for nothing less than 95.0 per cent while the other variables accounted for the balance. In addition, exchange rate risks, exchange rate spread, expected depreciation, and inflation expectations were responsible for currency substitution in the long run. However, while exchange rate risk, inflation

expectation and exchange rate spread impact positively on currency substitution, agents' sentiments regarding expected depreciation provide some dampening effects.

The results underpin the need for strong and sustained monetary policy intervention towards encouraging deposit holders and other economic agents to switch their currency portfolio back to Naira. There is also the need to engender exchange rate stability and foreign exchange (FOREX) market efficiency in the country. The current efforts by the CBN towards engendering discipline and orderliness in the FOREX market should be sustained so as to reduce the arbitrage premium and ensure exchange rate stability.

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