Investigating the Relationship between Currency Substitution, Exchange Rate and Inflation in Nigeria: An Autoregressive Distributed Lag (ARDL) Approach.

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Abstract

Currency substitution is a widely spread phenomenon in developing countries with high level vagueness of its concept and causes. Therefore, this paper goes all out to examine the relationship that exists between currency substitution and some macroeconomic variables such as exchange rate, inflation and interest rate in Nigeria using Autoregressive Distributed Lag (ARDL) techniques over a period of 1970 – 2012. The result of the bound test procedure and other tools employed confirm that there is a stable and long-run relationship between currency substitution and the macroeconomic variables under consideration. The CUSUM and CUSUMSQ when also incorporated support these findings for the period. It is therefore suggest that effective and efficient policy control measure should be develop and implement to normalize exchange rate, inflation and interest rate.

Keywords: Currency Substitution, Exchange Rate, Inflation, ARDL, CUSUM and CUMSUMQ.

JEL Classification: C41, C31, F31, C12

I. Introduction

Currencies are issued exclusively by the Central Bank such as the Central Bank of Nigeria (CBN), Federal Reserve System of United States, and Bank of England in United Kingdom. They are backed by law and should be accepted in exchange for goods and services and in discharge of debt obligations. It is a subset of money which performs functions such as a medium of exchange, a unit of value, a store of value and a standard of deferred payment. Besides the above stated attributes, the characteristics of liquidity and convertibility make currency a super-asset that finds a prominent place in agents' portfolio. It then means that currency if transacted freely in an open economy, a country's currency can be readily converted for the purpose of internationally tradable goods and into other currencies as well. Hence, it is important to note that currencies of countries are not equal considering the fact that the regulatory bodies e.g. CBN and the economy of countries differs.

Currency managed by the central bank of a country can either be a hard or soft currency. Reserve/ hard currencies are treated as store of value internationally, and they are held by central banks in their reserves. This asset value quality of a reserve currency is based on reputation, which in the specific case means that there is a credible commitment to stabilizing the reserve-currency prices relative to some other prices that matter. Soft currencies, on the other hand, lack this implicit warrantee of relative price stability. It can then be inferred that there is an ordinal preference-ranking for currencies when used for asset-holding purposes. Moreover, in a free currency market agents can implement that ranking by moving to higher-ranking monetary assets at small transaction cost. In a free currency market where an agent has a choice of holding any currency as an asset, the agent will prefer holding the best currency that Central Banks also hold in their reserves therefore, kick off a systematic process of currency substitution i.e the substitution of the reserve/hard currency for the soft.

Currency substitution is a widely spread phenomenon in developing countries with high level vagueness of its concept. Vast literatures have been scrutinized in other to make sense out of its nebulous concept. Hence, the following are important insights and valuable contributions of authors on the concept of currency substitution.

Mcknnon (1982), states that currency substitution is a treacherous expression because people differ on its proper interpretations. A closer look at the way it has been defined in literatures brings little clarity. This definition has varied from a very narrow to a broad view of the role of money. At one extreme, Calvo and Vegh (1992), following Cuddington (1989), limit currency substitution to the use of different currencies as media of exchange. At the other end of the spectrum, Mckinnon (1982) solves the "semantic problem" by distinguishing between direct and indirect currency substitution. Direct currency substitution means that two or more currencies compete as a means of payment within the same domain. Indirect currency substitution refers to investors switching between non-monetary financial assets. Spinelli (1983), among others was of the opinion that, indirect currency substitution is hardly distinguishable from the concept of capital mobility. Hence, there exist all sort of variation between these two poles. Gross and Thygesen (1992), Clements and Schwartz (1992), Agenor and Khan (1992) define currency

substitution as a situation in which foreign money substitutes for domestic money in its three traditional roles. Others such as Kim (1985) and Elkhafif and Kubursi (1991) limit their interpretation to the store of value role of money. Mckenzie and Thomas (1984) talk about the substitutability between domestic and foreign primary securities.

Many authors conclude and define currency substitution as a situation in which domestic money demand is influenced by foreign economic variables. Miles (1978) stresses the importance of the responsiveness of the demand for both currencies to other economic variables, cautioning that "the mere ownership of foreign currency- denominated balances by domestic residents is not a sufficient condition for currency substitution to occur". Ramirez-Rojas (1985) defines currency substitution as the demand for foreign fiat currency by domestic residents. Khan and Ramirez-Rojas (1986), alternatively, define currency substitution as "the ability of domestic residents to switch between domestic and foreign fiat money". In the end note they mention that in actual fact, the definition of currency substitution covers a wide variety of possibilities, such as foreign currency deposits in the domestic financial system, deposits held abroad by domestic residents, and foreign currency notes circulating within the boundaries of the country.

Komarek and Melecky (2001, p. 5-7) make the distinction between the terms substitution and substitutability (i.e. the ability to be substituted). These two terms lead to different research streams. The study of currency substitutability explores its potential effect on domestic and foreign variables, which is mainly of interest to economists and policymakers. On the other hand, the analysis of substitution explores the dimension of, and the potential for, partial displacement (substitution) of one currency with another currency. Substitutability does not necessarily imply substitution, and vice versa. Substitution is initiated by the right combination of shocks. "When studying the determinants of currency substitutability, it is quite useful to distinguish the three traditional functions of money in the economy, namely as: (i) a unit of account, (ii) a provider of transaction services, and (iii) a provider of store-of-value services. The habit of using a particular currency is considered a very important factor. This determines the ability of the currency to be substituted as a unit of account. The more prevalent the use of non-domestic currencies in transactions, the greater is their potential to substitute for the domestic currency in the context of this function of money. Similarly, the longer people use different currencies in account transactions, the more these currencies will potentially be substituted in this context. Most economists understand currency substitutability in terms of money as a provider of transaction services (because they have experience of currencies being mainly substituted by other assets in accordance with the provider of store-of-value services function of money). The concept of store of value is closely related to the concept of international capital mobility (McKinnon 1985).

Currency substitution is the use of a foreign currency for transactions in place of the domestic currency. The foreign currency thus serves as a medium of exchange. It is the outcome of disproportionate reputation between, e.g., the dollar and the Naira in the position continuum of currencies. It results in an unbalance demand from Nigerians to hold dollars as a store of value, a

demand that is not reciprocated by Americans holding Naira as a hedge against the devaluation of the dollar. This can lead to the systematic devaluation of the soft currency.

.Countries using flexible exchange rates can experience problems if there is a high rate of currency substitution because they can no longer control all currency types through monetary policy. The higher the rate of currency substitution, the greater the likelihood of monetary disturbances caused by changes in the foreign currency. Girton and Roper (1981), for example, emphasized that currency substitution can magnify small swings in expected money growth differentials into large changes in exchange rates. Kareken and Wallace (1981) also showed that the free-market international economy generates the multiplicity of equilibrium exchange rates which highlight the potential instabilities caused by currency substitution. The concern with inflation relates to increased uncertainty for economic agents that can result in a decline in trust of the domestic currency and lead to substitution to foreign currencies for daily transaction or as a store of value. As a result the economy will become more vulnerable to external shocks since it induces a capital outflow that leads to an increase of foreign debt and, in addition, policy options of monetary authorities are reduced because it becomes difficult to control money supply.

Hence, this study seeks to empirically examine the extent of currency substitution in Nigeria and the relationship between currency substitution, inflation and exchange rate in Nigeria.

The paper is structured into five sections. Section II presents the literature review. Section III presents the model specification and techniques of analysis; Section IV poses the estimated result and analysis, while section V concludes the paper.

II. Literature Review

Harrison and Vymyatnina (2007) examined the determinants of currency substitution in Russia for the period from 1999 to 2005. Based on the portfolio balance model and distinguishing foreign currency held for transaction and assets, they found a long-run relationship between variables including inflation and output. As for currency substitution, its positive relation to inflation was confirmed based on the regressions for transaction and assets.

Considering the deepening economic relation with Europe, Dorbec (2005) examined the period from 1999 to 2004 to identify the determinants of currency substitution with particular emphasis on the euro by considering different market participants. One of the important implications of his study is that there is a difference in the behaviour of economic agents in relation to their reactions to exchange rate appreciations. While households respond to the change in exchange rate movements, enterprises do not change their behaviour. It suggests that it is more appropriate to distinguish between households and enterprises in studying currency substitution.

Concerning currency substitution and inflation in Russia, Oomes and Ohnsorge (2005) estimated the monetary model for the period 1996 to 2004 by using various monetary aggregates. Estimating the short-run dynamics including two cointegrating vectors obtained from the money demand and the mark-up models, they confirmed that monetary aggregates including foreign currency holdings provided a stable long-run relationship for the money demand function and

thus confirmed the importance of adding foreign cash holdings to monetary aggregate in the money demand function for Russia

In their analysis of the Argentine economy, Kamin and Ericsson (2003) augment the available data on multiple currencies from the financial system with data on the amount of dollars (in cash) circulating in Argentina. The data are obtained from the Currency and Monetary Instruments Reports of the U.S. Treasury Department that document the flow of U.S. currency between the U.S. and foreign countries. Similarly, Feige et al. (2002), Feige et al (2003), and Feige and Dean (2004) use these and additional sources (including survey data, a denomination displacement method, and a money demand method) to generate estimates of dollarization for Latin American and transition economies.

Research that shot to investigate the causes of currency substitution are mostly found in developed countries, emerging market and transitional economies with diverse and highly controversial conclusion. Such literatures are from Latin America and Asia (see for example, Rogers, 1996; Sahay and Vegh, (1996); Savastano, (1996), Reinhart, Rogoff and Savastano, (2003), Yeyati, 2006, e.t.c.). The volume of studies reflects the fact that currency substitution is a subject with global effects, which merits the attention of academics and policy-makers (Mizen and Pentecost, 1996; and Corrado, 2008). However in the African, literature on the cause of currency substitution is very negligible as the records we can lay hand on only show the contribution of Oresotu and Mordi (1992) who test the existence of currency substitution by including exchange rate as one of the explanatory variables in the aggregate money demand functions. Their result points to the existence of currency substitution in Nigeria. Specific studies addressed to the issue of currency substitution were Olomola (1999) and Akinlo (2003). Hence, the above is the gusto towards delving into the relationship between currency substitution, exchange rate, and inflation

III. Model Specification and Estimation Techniques

3.1 Currency substitution model in Nigeria

Adopted from Adebiyi M.A (2013), currency substitution if defined narrowly, occurs when the foreign currency displaces the domestic money as a medium of exchange, accounting for a significant portion of the narrow money M_1. Therefore, in the case of Nigeria, M_1 can be defined as: $M_1 = CC + DD_k + DD_{fc}$ 3.1

Where CC is the currency in circulation; DD_k is the demand deposits denominated in the local currency, the naira; DD_{fc} is the demand deposits denominated in foreign currencies, which include the US dollar and other foreign currencies.

Since no data is ever collected on the foreign cash circulating in the Nigerian economy, currency in circulation (CC) is virtually denominated in naira only, while the ratio of demand deposits (DD) denominated in foreign currencies (fc) to M_1 is therefore, used as a proxy for the degree of currency substitution in narrow money. Hence, the currency substitution index in relation to the medium of exchange function (CSI_m) can be defined as,

$CSI_m = DD_{fc} / M_1$ 3.2

Also, currency substitution can be evidenced in broad money supply, M_2 in the case of Nigeria as foreign monetary assets play a key role in store of value. Consequently, currency substitution index (CSI_s), which considers foreign currency deposits excluding demand deposits (DEP_{fc}), can be expressed as:

$CSI_s = DEP_{fc} / QM$ 3.3

Where QM stands for quasi monetary liabilities. Conceptually, the overall currency substitution index is formulated by adding equation 2 and 3 together:

$CSI = CSI_m + CSI_s$ 3.4

3.2 Model Specification

The model applied here follows Pool's (1970) framework, which was the base for a number of Currency Substitution studies in several countries (see, for example, Calvo and Rodriguez (1977), Miles (1978), Bilson (1979), and El-Erian (1988), Rogers (1992) and Berg and Borensztein (2000a)). There is general agreement that this model provides an adequate representation of the Currency Substitution process, however it does not explain the direction of relationship between Currency Substitution, exchange rate and inflation which is the subject of this paper. Hence, the model is modify and we add interest rate as thus:

$CS = \beta_0 EXR + \beta_1 INF + \beta_2 INT + \mu$ 3.5

Where, CS is currency substitution proxy by CSI explained in the previous section, EXR is the nominal effective exchange rate (Naira per US dollar) and it is expected to be positive as increase in EXR induces an expectation of further depreciation of the domestic currency, public may hold less of domestic currency and more of foreign currency. Inflation rate also is expected to be positive as many economic literatures were of the view that currency substitution is a product of high inflation. Evidence suggests that in a country with high inflation, foreign currencies are first used as a store of value, then as a unit of account and finally as a medium of exchange. As domestic inflation rate rises, people do not swiftly abandon the domestic medium of exchange for foreign substitutes. Rather, the substitution is gradual, with the extent of substitution growing with the domestic inflation rate.

3.3 Techniques of Analysis

This paper employs ARDL method of analysis. "ARDL" stands for Autoregressive-Distributed Lag and it is a model that deals with single cointegration and is introduced originally by Pesaran and Shin (1999) and further extended by Pesaran et al. (2001). It can be used to test for cointegration, and estimate long-run and short-run dynamics, even when the variables in question may include a mixture of stationary and non-stationary time-series. The term "autoregressive", means the dependent variable is explained (in part) by lagged values of itself. It also has a distributed lag component, in the form of successive lags of the explanatory variable. Sometimes, the current value of the explanatory variable itself is excluded from the distributed lag part of the model's structure. The basic form of an ARDL regression model is given as

follows:

$$Y_t = \beta_0 + \beta_1 Y_{t-1} + ...+ \beta_k Y_{t-p} + \alpha_0 X_t + \alpha_1 X_{t-1} + \alpha_2 X_{t-2} + ... + \alpha_q X_{t-q} + \varepsilon_t, \quad 3.6$$

where ε_t is a random "disturbance" term, which we'll assume is "well-behaved" in the usual sense.

Therefore, the above model can be modified to suit our analysis as thus:

$$\Delta CS_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta CS_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta EXR_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta INF_{t-i} + \sum_{i=1}^{n} \alpha_{4i} \Delta INT_{t-i} + \beta_1 CS_{t-i} + \beta_2 EXR_{t-i} \beta_3 INF_{t-i} + \beta_4 INT_{t-i} + \mu_t \quad 3.7$$

Where,

D denotes the first difference operator,

α_0 is the drift component,

ε_t is the usual white noise residuals.

The left-hand side is the currency substitution and the first until fourth expressions ($\beta 1 - \beta 4$) on the right-hand side correspond to the long-run relationship. The remaining expressions with the summation sign ($\alpha 1 - \alpha 4$) represent the short-run dynamics of the model.

To investigate the presence of long-run relationships among the CS, EXR, INF and INT bound testing under Pesaran, et al. (2001) procedure is used. The bound testing procedure is based on the F-test. The F-test is actually a test of the hypothesis of no coinetegration among the variables against the existence or presence of cointegration among the variables, denoted as:

Ho: $\beta 1 = \beta 2 = \beta 3 = \beta 4 = 0$ i.e., there is no cointegration among the variables.

H_1: $\beta 1 \neq \beta 2 \neq \beta 3 \neq \beta 4 \neq 0$ i.e., there is cointegration among the variables.

The exact critical values for the F-test aren't available for an arbitrary mix of I(0) and I(1) variables. However, Pesaran *et al*. (2001) supply *bounds* on the critical values for the *asymptotic* distribution of the F-statistic. For various situations (*e.g*., different numbers of variables, (k + 1)), they give lower and upper bounds on the critical values. In each case, the lower bound is based on the assumption that all of the variables are I(0), and the upper bound is based on the assumption that all of the variables are I(1). In fact, the truth may be somewhere in between these two polar extremes. If the computed F-statistic falls below the lower bound we would conclude that the variables are I(0), so no cointegration is possible, by definition. If the F-statistic exceeds the upper bound, we conclude that we have cointegration. Finally, if the F-statistic falls between the bounds, the test is inconclusive.

For affirmation purpose, we will also perform a Bounds t-test of $H_0 : \beta_0 = 0$, against $H_1 : \beta_0 < 0$. If the t-statistic for CS_{t-1} in equation (3.6) is less than the "I(1) bound" tabulated by Pesaran *et al.* (2001; pp.303-304), this would support the conclusion that there is a long-run relationship between the variables. If the t-statistic is greater than the "I(0) bound", we'd conclude that the data are all stationary.

Bounds test of cointegration has econometrics advantage over other techniques of cointegration test in that; it assumes all the variables to be endogenous, it can be applied irrespective of the order of integration and the short run and long run coefficient in the model can be estimated simultaneously.

As suggested by Pesaran et al.(2001), equation (3.6) can be reproduce to ARDL version of the error correction model relating to the variables equation (3.6) as thus:

$$\Delta CS_t = \alpha_0 + \sum_{i=1}^{n} \alpha_{1i} \Delta CS_{t-i} + \sum_{i=1}^{n} \alpha_{2i} \Delta EXR_{t-i} + \sum_{i=1}^{n} \alpha_{3i} \Delta INF_{t-i} + \sum_{i=1}^{n} \alpha_{4i} \Delta INT_{t-i} + ECM_{t-i} + \Phi \mu_t \quad 3.8$$

Where Φ is the speed of adjustment parameter and ECM is the residuals that are obtained from the estimated cointegration model of equation (3.8). The data used were collected from the Central Bank of Nigeria statistical Bulletin (2010) and international financial statistics (2012).

IV. Estimated Result and Interpretation

4.1 Unit Root /Stationarity Test Results

Prior to the testing of cointegration, we conducted a test of order of integration for each variable to convince us whether or not the ARDL model should be used. The Augmented Dickey-Fuller and the Phillip-Perron unit root tests are used. The results are presented in the Table 4.1 below:

Table 4.1: Summary of Unit Root Test Results

VARIABLE	Augmented Dickey-Fuller (ADF) Test			Phillip-Perron (PP) Test		
	CONSTANT	CONSTANT &TREND	STATUS	CONSTANT	CONSTANT &TREND	STATUS
CSI	-1.646436	-2.054423		-1.696727	-2.095655	
D(CSI)	-4.955993*	-4.966249*	I(1)	-5.998928*	-5.946411*	I(1)
EXR	-0.187596	-1.801704		-0.310458	-1.733632	
D(EXR)	-4.273106*	-4.483503*	I(1)	-5.645013*	-5.795234*	I(1)
INF	-3.757004*	-3.715945*	I(0)	-3.194499**	-3.554133**	I(0)
INT	-1.569682	-1.052853		-1.640772	-1.282762	
D(INT)	-5.287767*	-5.476465*	I(1)	-6.810418*	-6.934801*	I(1)

SOURCE: Author's Computation (2003)

Notes: * indicates *stronger* significant at one percent or a rejection of the null of no unit root at the one percent level

** indicates significant at five percent or a rejection of the null of no unit root at the five percent level. Number of lags was selected using the AIC criterion

- In the model without trend: Level form: -3.6019 (1%), -2.9358 (5%) and -2.6059 (10%)
- In the model with trend: Level form: -4.2023 (1%), -3.5247 (5%) and -3.1931 (10%).

From the result presented in table 4.1 above, the CSI, EXR and INT were not stationary at level with both the ADF and PP unit root test, while the INF is stationary at level therefore it is integrated of order (0). For the other variables after the first difference, it was observed that the null hypothesis of non-stationarity were rejected for them at 10%, 5% and 1% critical value for ADF and PP with trend and without trend respectively . This means that the variables are stationary at first difference and are integrated of order (1). Therefore, it is evident that the result obtained from the test above show a mixture of I(0) and I(1) of the variables making the ARDL testing the appropriate model to be use Pesaran, *et al.* (2001).

4.2 Test of Lag Length Selection

The Schwarz Information Criterion (SC) is used to select the optimal lag length. Based on the SIC, it is found that one lag is optimal. SC is used for model selection such as determining the lag length of a model, with smaller values of the information criterion being preferred.

Table 4.2: VAR Lag Order Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-516.0425	NA	4490086.	26.66885	26.83947	26.73006
1	-501.7028	25.00247*	4916753*	26.75399*	27.60710*	27.06008*
2	-487.9907	21.09559	5686871.	26.87132	28.40691	27.42228
3	-481.0838	9.209216	9742852.	27.33763	29.55571	28.13346

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

4.3 Result of the estimated of Long Run Relationship

Equation 3.7 is estimated to test the null hypothesis of no cointegration against the alternative hypothesis. The result obtain is presented in the table below.

Table 4.3: ARDL **Long Run Relationship Result**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(CSI(-1))	0.008897	0.155133	0.057350	0.9546
D(EXR(-1))	0.055417	0.038775	1.429204	0.1629
D(INF(-1))	0.028159	0.037630	0.748307	0.4599
D(INT(-1))	0.009365	0.189862	0.049325	0.9610
CSI(-1)	-0.350377	0.113155	-3.096447	0.0041
EXR(-1)	0.033288	0.020247	1.644080	0.1103
INF(-1)	0.084054	0.042530	1.976341	0.0571
INT(-1)	-0.299519	0.144220	-2.076819	0.0462
C	14.70881	4.519900	3.254235	0.0027
@TREND	0.360351	0.133404	2.701193	0.0111

R-squared	0.454353	Mean dependent var	0.399503
Adjusted R-squared	0.295940	S.D. dependent var	3.334620
S.E. of regression	2.798023	Akaike info criterion	5.103923
Sum squared resid	242.6969	Schwarz criterion	5.521868
Log likelihood	-94.63042	F-statistic	2.868146
Durbin-Watson stat	2.050624	Prob(F-statistic)	0.013873

The above result show a long run relationship among the variable given a negative and significant coefficient of the lag value of the currency substitution index (CSI). This can be further affirmed by conducting a bound test below as thus:

4.4 Bound test

Here, we want to test if the coefficient of β's equal to zero in our estimated model or not. The F-Statistic value from the bound test will be compare with the critical value from the bound table provided from Table C1 (iii) on page 300 of Pesaran et al. (2001).

Table 4.4 F-statistic of Cointegration Relationship

Test Statistic	Value	Lag	Significance Level	Bound Critical Value (restricted intercept and trend)	
F-statistic	4.50982	1		I(0)	I(1)
			1%	3.484	4.458
			5%	4.066	5.119
			10%	5.315	6.414

From the table above, it is evidence that F-statistic exceeds the upper bound at the 1% significance level, therefore we can conclude that there is evidence of a long-run relationship among the variables under consideration.

Also, we also test the model using Henry General to specific Approach to get the parsimonious specification. This involve removing the variables that are nor significant except the level variables and the intercept. The F-statistic obtains form the Wald test is depicted in the table below:

Table 4.5 F-statistic of Cointegration Relationship (in parsimonious Relationship)

Test Statistic	Value	Lag	Significance Level	Bound Critical Value (restricted intercept and trend)	
F-statistic	5.663293	1		I(0)	I(1)
			1%	3.484	4.458
			5%	4.066	5.119
			10%	5.315	6.414

It can be deduce that, the above result confirmed the previous one as the F-Statistic value is greater than the upper bound at 5% level of significance.

Hence, the parsimonious result of the long run relationship estimated using ARDL general tools specific method is presented in the below table:

Table 4.6: ARDL using General Tools Specific Method

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXR(-1))	0.053260	0.036734	1.449885	0.0563
CSI(-1)	-0.318635	0.090425	-3.523765	0.0012
EXR(-1)	0.028275	0.018088	1.563224	0.0273
INF(-1)	0.065976	0.031183	2.115781	0.0418
INT(-1)	-0.303532	0.119945	-2.530602	0.0162
C	13.48611	3.682206	3.662510	0.0008
@TREND	0.333084	0.112952	2.948907	0.0057

R-squared	0.444352	Mean dependent var	0.399503
Adjusted R-squared	0.346296	S.D. dependent var	3.334620
S.E. of regression	2.696106	Akaike info criterion	4.975746
Sum squared resid	247.1455	Schwarz criterion	5.268307
Log likelihood	-95.00279	F-statistic	4.531628
Durbin-Watson stat	2.118671	Prob(F-statistic)	0.001778

The result shows that all the explanatory variables are significant meaning that they can explain or contribute to the value of dependent variable. Hence, the extents of their contribution need to be ascertained.

4.5 Testing for Long Run Effect

We can ascertain the effect of the explanatory variables on the dependent variable by normalizing the entire coefficient depicted in the general tools specific method to ARDL estimation using the lag value of the dependent variable in the explanatory variable i.e (CSI). This is done by dividing the value of the variables D(EXR(-1)), EXR(-1), INF(-1), INT(-1), C and TREND by negative value of the lag of dependent variable i.e (-CSI(-1)) to get the elasticity of the variables. The result obtain is shown below:

Table 4.4 Result of Long Run Effect

Explanatory Variables	**Elasticity**
D(EXR(-1)	0.16715
EXR(-1)	0.08874
INF(-1)	0.20706
INT(-1)	-0.9526
C	42.32463
TREND	1.045347

The result in the table above shows that, a positive long run relationship between currency substitution, exchange rate and inflation. It shows that a unit log run increase in the first difference lag of the exchange rate lag of exchange rate and lag of inflation will lead to 0.16, 0.08 and 0.2 increase in the rate at which foreign money is substituted for domestic money.

4.6 Error Correction Representation of ARDL Model

Equation 3.8 above is estimated and the result is given in the below table.

Table 4.6: Error Correction Result of ARDL Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	0.057839	0.124495	0.464585	0.6428
D(EXR)	0.046943	0.019630	2.391359	0.0179
D(INF)	0.027561	0.016492	1.671106	0.0366
D(INT)	-0.077520	0.086704	-0.894082	0.3726

ECM(-1)	-0.231336	0.077851	-0.017156	0.0063

R-squared	0.056247	Mean dependent var	0.103809
Adjusted R-squared	0.033368	S.D. dependent var	1.633790
S.E. of regression	1.606301	Akaike info criterion	3.814716
Sum squared resid	425.7335	Schwarz criterion	3.906945
Log likelihood	-319.2508	Hannan-Quinn criter.	3.852141
F-statistic	2.458459	Durbin-Watson stat	2.000004
Prob(F-statistic)	0.047548		

From the above table, ECM (–1) is one period lag value of error terms that are obtained from the long-run relationship. The coefficient of ECM (–1) indicates how much of the disequilibrium in the short-run will be fixed (eliminated) in the long-run. As expected, the error correction variable ECM (–1) has been found negative and also statistically significant. The Coefficient of the ECM term suggests that adjustment process is quite fast and 23 percent of the previous year's disequilibrium in explanatory variables from its equilibrium path will be corrected in the current year.

4.7. CUSUM and CUSUMSQ Stability Test

Finally, CUSUM and CUSUMSQ plots are drawn to check the stability of short run and long run coefficients in the ARDL error correction model. Figure 4.1 shows the cumulative sum of recursive residuals whereas Figure 4.2 displays the cumulative sum of squares of recursive residuals.

Fig. 4.1 Plot of Cumulative Sum of Recursive Residuals

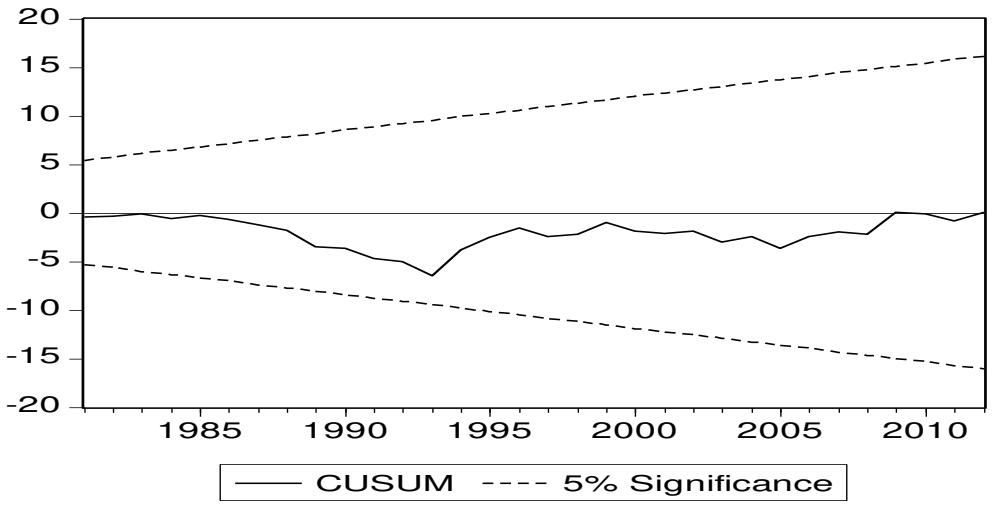
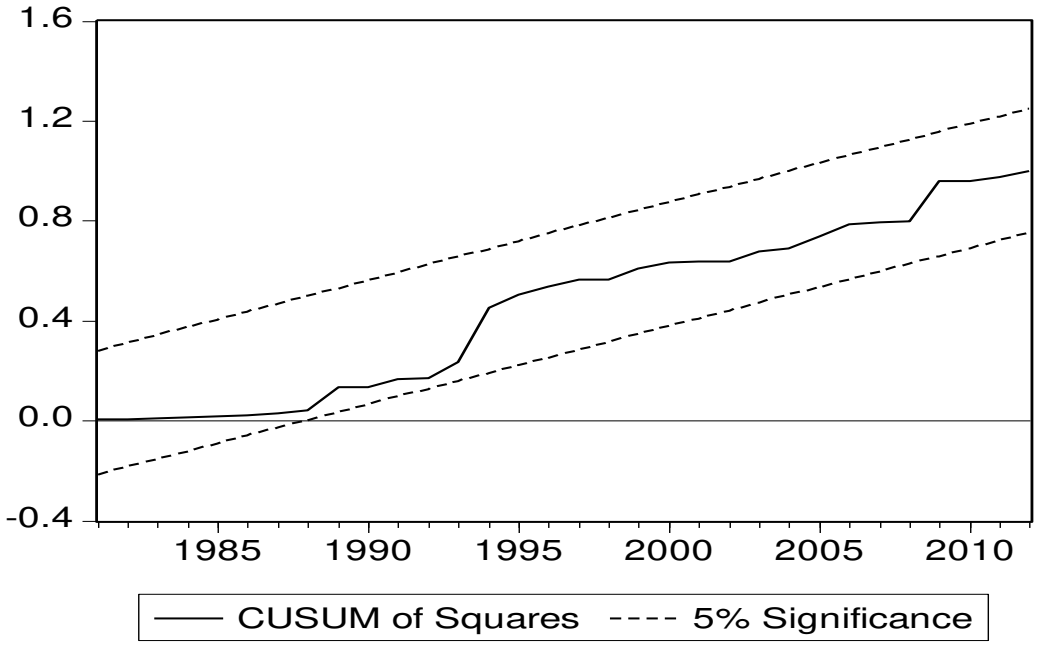


Fig.4.2. Plot of Cumulative Sum of Squares of Recursive Residuals



Figures 1 and 2 show that both CUSUM and CUSUMSQ are within the critical bounds of 5 percent so it indicates that the model is structurally stable

V. Conclusion

The motive behind this paper was to investigate the relations between currency substitution, exchange rate, inflation and interest rate. This was done using the autoregressive distributed lag model (ARDL) estimation techniques approach considering the period between 1970 – 2012. ARDL approach to cointegration test was conducted using bound test, stability test and others. It is interesting to say that, all the techniques confirm and reaffirm the existence of long run relationship between the variables. Therefore we recommend that currency substitution can be reduced if it cannot be totally avoided by effective and efficient policy control on exchange rate, inflation and interest rate.

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