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STRUCTURAL BREAKS AND THE LONG-RUN STABILITY OF DEMAND FOR REAL BROAD MONEY FUNCTION IN NIGERIA: A GREGORY-HANSEN APPROACH

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ABSTRACT

This study examines the long-run demand for real broad money function and its stability in Nigeria for the period from 1970 to 2012 inclusive. The study employs the Augmented-Dickey Fuller and Phillips-Perron tests for unit root, the Gregory and Hanson (1996a; 1996b) cointegration test to capture endogenous structural breaks in the cointegrating vectors of Nigerian long-run money demand function, cumulative sum of recursive residuals (CUSUM) and cumulative sum of recursive residuals squares (CUSUMSQ) tests for structural stability proposed by Brown et al. (1975). In estimating the canonical specification models, extended specifications are also presented. The results of the cointegration test suggest that demand for real broad money went through a regime shift in 2005. The results further confirm that there exists a long-run relationship amongst real broad money demand, real income, real domestic interest rate, real exchange rate, rate of inflation and foreign interest rate. However, the result of CUSUMSQ shows that the demand for money function is stable, but has undergone some temporary periods of instability. Hence, the apex bank in Nigeria can target the broad money (M2) aggregate to achieve macroeconomic objectives.

Keywords: Real demand, Money, Cointegration, Stability, Structural, Breaks, Monetary policy.

JEL Classification: C22, C32, E41, E52.

Contribution/ Originality

The paper's primary contribution is finding that the Nigeria's demand for money function has undergone some periods of instability. This finding is in contrast with the findings of previous studies. This explains the inability of the apex bank to match money supply with money demand.

1. INTRODUCTION

As conventionally agreed, a good understanding of the stability and determinants of the demand for real money balances forms the core in the conduct of monetary policy as it enables a

policy-driven change in monetary aggregates to have predictable influences on output, interest rate, and ultimately price (Sriram, 1999; Halicioglu and Ugur, 2005; Nachega, 2011). Hence, a stable money demand function serves as a stabilization policy which depends on the ability of central bank to adjust money supply to its demand in order to prevent monetary disturbances from inhibiting real output. It is argued that the relationship between money supply on one hand and prices, income, and balance of payment on the other is determined by the demand for money, and such relationship plays an important role in macroeconomic theory. Several important factors have influenced and shaped the evolution of empirical research on the demand for money. First, there is evolving nature of theories on the demand for money. Second, the growing arsenal of econometric techniques that has permitted more sophisticated examinations of dynamics, functional forms, and expectations. Third, and most importantly, research has been spared by the apparent breakdown of existing empirical models in the face of newly emerging data (Tahir, 1995).

Thus, in line with maintaining price stability, the Central Bank of Nigeria (CBN) strives to promote and maintain monetary stability through the management of debt and foreign exchange rate. In essence, appropriate demand and supply management policies by the CBN necessary for economic development requires money to be stable and functional (Nwafor *et al*., 2007). The apex bank has over the years sought a predictable and stable money demand function. This is due to the fact that a stable money demand function contributes to broader economic growth and rising standard of living. Thus, the re-examination of the question whether demand for money has remained stable during the financial reforms which started in 2005 in Nigeria is imperative. It is often suggested that financial market reforms could lead to an unstable demand for money and changes in money velocity with attendant consequences for monetary policy implementation. In countries where the central bank targets a money aggregate, for instance using reserve money to implement monetary policy, the effectiveness of monetary policy rests on the stability of the monetary transmission mechanism as well as velocity of money. When this relationship is subjected to unexpected shifts, monetary targets lose their transparency and are less able to accurately signal the appropriate stance of monetary policy. This argument has been used as a reason for moving to inflation targeting, which does not rely on the stability of money demand, but instead uses a broad range of information to assess the monetary policy stance (Dagher and Kovanen, 2011).

The velocity of money has been fluctuating in Nigeria. For instance, it was 5.4 in 1970, 2.5 in 1986, 4.6 in 1989, 4.6 in 2006, 2.6 in 2009, and 3.0 in 2011 respectively. This fluctuation in the velocity of money poses big challenge to the Central Bank of Nigeria in its monetary aggregate targeting in particular and monetary policy formulation in general. Again, it can be seen that the velocity of money in 1986 (2.3) and 2009 (2.6) was remarkable. These figures show that there was structural change during the two periods. During the Structural Adjustment Programme in 1986 and the "bailing out" of commercial banks in 2009, lots of money was injected into the economy. This led to a decreased velocity of money and after then increased to 4.6 and 3.0 in 1989 and 2011, respectively.

If the money demand function is unstable and undergoes substantial instability as Keynes thought, then velocity is unpredictable, and the quantity of money may not be directly linked to aggregate spending, as it is in the modern quantity theory. In recent years, the rapid pace of financial innovation, has led to substantial instability of the money demand function and this calls into question whether the theories and empirical analysis are adequate. It also has important implications for the way monetary policy should be conducted, because it casts doubt on the usefulness of the money demand function as a tool to provide guidance to policy makers (Mishkin, 2004). Thus, what is being sought in a stable demand for money function is a set of necessary conditions for money to exert a predictable influence on the economy so that the Central Bank's control of the money supply can be a useful instrument of economic policy (Tahir, 1995).

Therefore, the difference between the actual and targeted broad money (M_2) growth in Nigeria can be illustrated with figure 1 below:

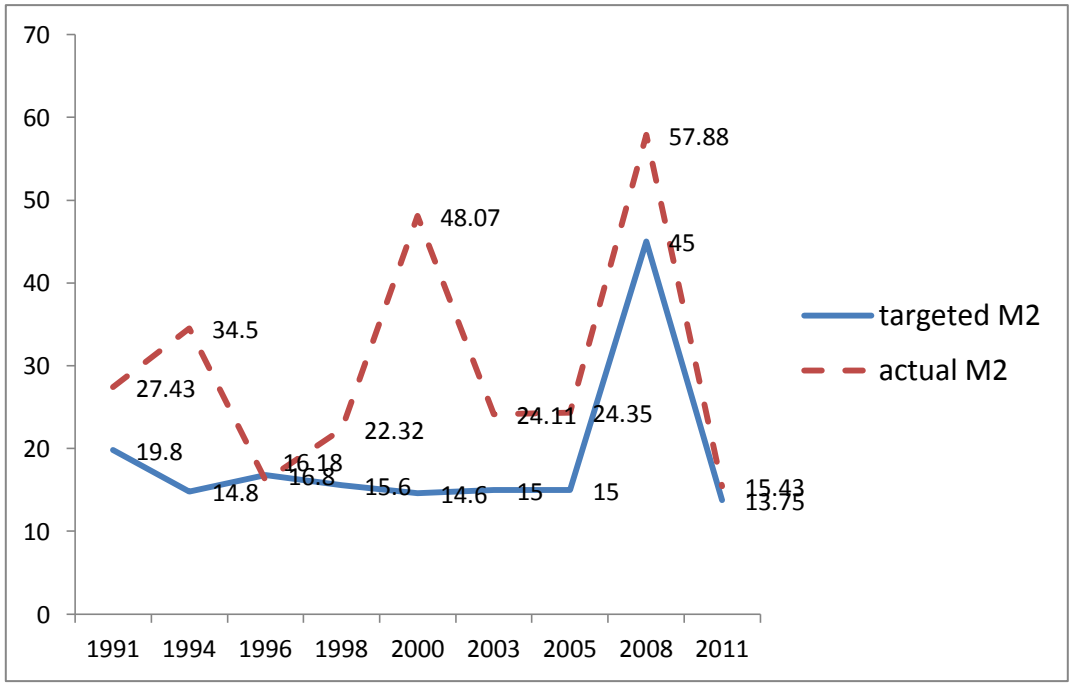

Figure-1. Trending of targeted and actual broad money supply

Source: Author's computation. Note: Data from Central Bank of Nigeria Statistical Bulletn (2011).

From the above figure, the discrepancy between targeted and actual broad money can be clearly seen. For example, in 1991, 1994, 1996, 1998, 2000, 2003, 2005, 2008, and 2011, the targeted and actual broad money growth were 19.8% and 27.43%, 14.8% and 34.5%, 16.8% and 16.18%, 15.6% and 22.32%, 14.6% and 48.07%, 15% and 24.11%, 15% and 24.35%, 45% and 57.88%, 13.75% and 15.43%, respectively. It is likely this mismatch exerts unpredictable influence on the economy and makes it difficult for the Central Bank of Nigeria to control money supply. Thus, the mismatch between targeted broad money (M2) supply and actual demand for

broad money (M2) in Nigeria may be responsible to either partial knowledge of what constitutes the determinants of demand for money or the recent innovations in the financial sector. Yet, recent studies conducted on Nigeria report stable demand for money. The question is, if the demand for money function is truly stable in Nigeria, why is the CBN unable to match money supply with money demand? It is because none of the previous studies conducted on Nigerian demand for money used all the relevant potential determinants and a few do not employ the appropriate methodology.

2. EVOLUTION OF THE CURRENT MONETARY POLICY IN NIGERIA

The CBN's focus on price stability objective represents a paradigm shift from past practices in which the promotion of rapid and sustainable economic growth and employment were the overriding objectives of monetary policy. Prior to 1986, in order to achieve its objective of sustainable growth and employment, the CBN relied on the use of direct (non-market) monetary policy instruments such as credit ceilings on the Deposit-Money of Banks (DMBs), administered interest and exchange rates, as well as prescription of cash reserves requirements. The most popular instruments of monetary policy were the setting of targets for aggregate credit to the domestic economy and the prescription of low interest rates. With these instruments, the CBN hoped to direct the flow of loanable funds with a view to promoting rapid development through the provision of finance to preferred sectors of the economy (agriculture, manufacturing, and residential housing) (Onafowora and Owoye, 2007).

Notwithstanding the huge oil revenues since 1970's, government has been reckless in spending. A particular military head of state once exclaimed that the problem of Nigeria is not money, but how to spend it. Thus, the government went into spending spree and invited the whole world for the Festival of Arts and Culture (FESTAC) in 1977. As a result, the economy was plunged into a quackmire of twin deficit. The government resorted to borrowing from the CBN, the International Monetary Fund (IMF), and the World Bank to finance the deficits.

The government also adopted austerity measures in 1982. The austerity measures achieved some success by 1985 as inflation fell to a single digit, the external current account moved from deficit to balanced position, and real GDP grew by 9.5%. However, improvements in the fiscal and external positions in 1985 proved transitory and failed to establish a basis for sustained economic growth (Onafowora and Owoye, 2007). However, as a policy option to put the Nigerian economy back on the path of sustainability, the government adopted the IMF sponsored Comprehensive Structural Adjustment Programme (SAP) in July 1986. The SAP involved both structural and sectoral policy reforms. The main strategies of the SAP were the liberalization of the external trade and payment system, the adoption of a market-based exchange rate in 1985 for the domestic currency (Naira), the elimination of price and interest rate controls, as well as reliance on market forces as the major determinant of economic activity. The adoption of SAP marked the start of a regime of financial sector reforms characterized by the free entry and free exit of banks and the use of indirect (market-based) monetary control instruments for implementing monetary policy in Nigeria (Nnanna, 2001).

The developments in the Nigerian economy since 1986, and most importantly, the adoption of M2 as an intermediate target for monetary policy by the CBN pose two central questions: Is the real M2 money demand function stable as an intermediate target? Is the CBN justified in its choice of M2 as a target? The recent developments in monetary systems and the increased openness may have caused the money demand function to be unstable. The monetary implications inherent in these questions cannot be over-emphasized. If the money demand function is unstable and experiences substantial shifts over time, then the income velocity of money will be unpredictable, and the quantity of money may not be a good predictor of economic activity. In other words, the choice of M2 as an intermediate target portends serious economic problem for Nigerian monetary authority if M2's demand function is found to be unstable (Onafowora and Owoye, 2007).

3. LITERATURE REVIEW

Khan and Ali (1997) examined the existence of a long-run equilibrium relationship between money, income, price, and interest rate in Pakistan. The study employed Engle-Granger cointegration and error correction approach using annual data from 1972 to 1992. The results suggested that the structural changes in the financial sector after 1989 especially interest rate liberalization did not affect the stability of broad monetary aggregate in Pakistan. Meanwhile, in a similar study for Syria, Samara (n.d) reported that real money demand (M2 and M1) and their determinants are weakly cointegrated. Moreover, both the stability tests and Error Correction Model suggest unstable money demand function in Syria. Sterken (1999) investigated a money demand (M_1) equation for the Ethiopian economy with quarterly data from $1996Q_1$ to $1999Q_4$ using unrestricted VAR approach. The study concluded that the true endogeneous variables in the model were real income and the real coffe price, while real money holdings and shortage were weak exogeneous variables. In a similar study, Watson (2001) argued that there exists a stable long-run demand for money function in Jamaica within the period studied, while Nachega (2001) reported a short-run stable demand for money in Cameroon. Employing similar methodology, Adam *et al.* (2011) argued that disaggregating currency and deposits, currency responded more strongly to expected inflation, and deposits to the interest rate spread vis-à-vis T-bills, than does overall M2. The results suggested the existence of a stable cointegrating relationship between real money balances and its determinants in Tanzania.

Halicioglu and Ugur (2005) reported that there exists a stable money demand function in Turkey and argued that it is possible to use the narrow money aggregate as a target for monetary policy. Similarly, Sovannroeum (2008) estimated the demand for money function in Cambodia with monthly data for the period of 1994:12 to 2006:12. The results suggested that the demand for money function was stable in Cambodia. In another study, Dritsakis (2011) examined the demand for money in Hungary using quarterly data for the period of $1995Q_1$ to $2010Q_1$. The results showed that there is unique cointegrated and stable long-run relationship amongst M1, real income, inflation rate, and nominal exchange rate. Dagher and Kovanen (2011) reported a stable long-run money demand function in Ghana. In a similar study, Baba *et al.* (2013) argued

that changes in past and current macroeconomic activity significantly affect money demand in Ghana.

Anoruo (2002) reported that demand for broad money was stable in Nigeria during the SAP period from 1986Q_2 to 2000Q_1. Nwafor *et al.* (2007) argued that there exists a long-run relationship among aggregate demand for money in accordance with the Keynesian liquidity preference theory in Nigeria. Similarly, Onafowora and Owoye (2007) reported that there exists a long-run relationship between real broad money aggregate, real income, inflation rate, domestic nominal interest rate, foreign interest rate and expected exchange rate. Gbadebo (2010) examined whether financial innovations have affected the demand for money, but reported that financial innovations have not significantly affected the demand for money in Nigeria.

Nduka *et al.* (2013) examined the stability of demand for money function in Nigeria for the period of 1986 to 2011. The study employed CUSUM and CUSUMSQ tests for stability and reported that demand for money function was stable during the period reviewed. Kumar *et al.* (2010), Chukwu *et al.* (2010) and Omotor (2011) employed Gregory-Hansen cointegration with structural breaks to investigate the long-run relationship between demand for money and its determinants. The results suggested a long-run relationship between demand for money and its determinants in Nigeria. However, results of the regime shifts suggested different endogeneously determined break dates. For instance, Kumer, Webber and Fargher reported 1986 and 1992, while Chukwu *et al.* (2010) reported 1994, 1996 and 1997. Yet, Omotor (2011) reported 1981, 1992 and 1994.

4. THE MODEL

The model to investigate the demand for money function is specified in the equation below. The study adopted and modified the model originally proposed by Mundell (1963) and employed by Nduka *et al.* (2013) as follows:

$$In\left(\frac{M_2{}^d}{P}\right)_t = \beta_0 + \beta_1 InRY_t + \beta\ RIR_t + \beta_3 R_t^f + \beta_4 RI + \beta_5 REX_t + U_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

where β_0 is the constant term U_t is the error term, $\beta_1 > 0$, $\beta_2 < 0$, $\beta_3 < 0$, $\beta_4 < 0$, $\beta_5 < 0$ or > 0, $\left(\frac{M_2{}^d}{P}\right)_t$ = real money balances, P = Consumer Price Index, RY = scale variable proxied by Real Gross Domestic Product (RGDP), RIR = opportunity cost variable proxied by real interest rate, R^f = foreign interest rate proxied by US interest rate , RI = Rate of inflation, REX = exchange rate depreciation proxied by real exchange rate.

The Gregory and Hanson (1996a; 1996b) technique employed by Chukwu *et al.* (2010); Kumar *et al.* (2010) and Omotor (2011) is the only time series based structural change test that estimates cointegration vectors and considers break dates. This gives it important advantages over other techniques if the purpose is to examine the change in slope parameters that are due to the impact of structural breaks. The null hypothesis of no cointegration with structural breaks is

tested against the alternative of cointegration. Four models are proposed by Gregory and Hansen that are based on alternative assumptions about structural break: (i) level shift (ii) level shift with trend (iii) regime shift where both the intercept and slope coefficients change and (iv) regime shift where intercept trend and slope coefficients change (Kumar *et al*., 2010).

GH-1: Level shift

$$InRDM_t = a_1 + a_2\sigma_{tk} + b_1In(RY_t) + b_2RIR_t + b_3 R_t^f + b_4RI_t + b_5REX_t + \varepsilon_t \text{ .....(9)}$$

GH-2: Level shift (includes trend)

$$InRDM_t = a_1 + a_2\sigma_{tk} + \alpha_1 t + b_1In(RY_t) + b_2RIR_t + b_3R_t^f + b_4RI_t + b_5REX_t + \varepsilon_t \text{.....(10)}$$

GH-3 Regime shit (Intercept and slope coefficients change

$$\ln RDM_t = a_1 + a_2\sigma_{tk} + \alpha_1 t + b_1In(RY_t) + b_{11}In(RY_t)\sigma_{tk} + b_2RIR_t + b_{22}RIR_t\sigma_{tk} + b_3R_t^f + b_{33}R_t^f\sigma_{tk} + b_4RI_t + b_{44}RI_t + b_5REX_t + b_{55}REX_t\sigma_{tk} + \varepsilon_t \text{.....(11)}$$

GH-4: Regime shift (intercept, trend and slope coefficients change)

$$\text{InRDM}_t = a_1 + a_2\sigma_{tk} + \alpha_1 t + \alpha_{2t}\sigma_{tk} + b_1\ln(RY_t) + b_{11}\ln(RY_t)\sigma_{tk} + b_2RIR_t + b_{22}RIR\,\sigma_{tk} + b_3R_t^f + b_{33}R_t^f\sigma_{tk} + b_4RI_t + b_{44}RI_t\sigma_{tk} + b_5REX_t + b_{55}REX_t\sigma_{tk} + \varepsilon_t \text{.....(12)}$$

where σ is the shift in the slope, intercept or trend coefficient. The break dates are attained by estimating the cointegration equations for all possible break dates and break date is selected where the absolute value of the ADF test statistic is at its maximum (Kumar *et al*., 2010).

5. EMPIRICAL RESULTS

5.1. Unit Root Test

To examine the time series properties of the model variables, the Augumented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests were conducted. With the exception of RIR and RI, model variables exhibited mean reversion after first difference. Table 1 below presents the unit root test results.

Table-1. ADF and PP Unit Root Tests, 1970-2012

Variable	Lag	ADF	PP	Order of integration
RDM	[9,6]	0.977(-2.933)	1.147(-2.933)	
ΔRDM	[9,5]	-4.486*(-2.935)	-4.328*(-2.935)	I(1)
RY	[9,2]	2.461(-2.937)	-5.545*(-2.933)	
ΔRY	[9, -]	-8.12*(-2.937)		I(1)
RIR	[9,4]	-3.402*(-2.933)	-3.315*(-2.933)	I(0)
REX	[9,3]	-2.647(-2.933)	-2.583(-2.933)	
ΔREX	[9,14]	-7.536*(-2.935)	-11.347*(-2.935)	I(1)
RI	[9,4]	-3.279*(-2.933)	-3.171*(-2.933)	I(0)
RF	[9,4]	-1.944 (-2.933)	-1.947 (-2.933)	
ΔRF	[9,8]	-5.512*(-2.935)	-5.683*(-2.935)	I(1)

Source: Author's computation. **Note**: Lag is the lag lengths for ADF and PP tests respectively. For both ADF and PP, the 5% critical values are given below the test statistics in parentheses. Asterisk (*) shows no unit root at 5% critical value.

The null hypothesis of non-stationarity of each variable was tested against the alternative hypothesis of stationarity. The ADF and PP results suggest that the null hypothesis cannot be rejected for most variables in their level form at the 5% significance level with the exception of real interest rate and rate of inflation. Also, the nulls that their first differences have unit roots are also rejected. Similar result for rate of inflation was reported by Kumar *et al.* (2010). However, it is worth to note that the PP test suggests that the real income is stationary at level, while the ADF test indicates that it is stationary after first difference.

5.2. Cointegration Test with Structural Breaks

The Gregory and Hanson (1996a; 1996b) cointegration test was employed on the demand for money function in Nigeria. The results of the GH test are reported in table 2 below. The model is specified in its canonical and extended version respectively, following Kumar *et al.* (2010).

Table-2. Cointegration test with structural breaks (1970-2012)

Specification / GH Model	Break Date	GH Test Statistics	5% Critical Value	Existence of Cointegration
$LnRDM_t=\Psi_0+\Psi_1 lnRY_t+\Psi_2 RIR_t+\varepsilon_t$ (1)				
GH-1	2006	-7.736	-5.280	Yes
GH-2	2006	-7.558	-5.570	Yes
GH-3	2005	-8.627	-6.000	Yes
GH-4	2006	-8.718	-6.320	Yes
$LnRDM_t=\Psi_0+\Psi_1 lnRY_t+\Psi_2 RIR_t+\Psi_3 REX+\varepsilon_t$ (2)				
GH-1	2006	-7.766	-5.560	Yes
GH-2	2006	-7.903	-5.830	Yes
GH-3	2005	-9.945	-6.410	Yes
GH-4	2005	-8.298	-6.840	Yes
$LnRDM_t=\Psi_0+\Psi_1 lnRY_t+\Psi_2 RIR_t+\Psi_3 REX+\Psi_4 RI_t+\varepsilon_t$ (3)				
GH-1	2006	-7.907	-5.23	Yes
GH-2	2006	-7.774	-5.29	Yes
GH-3	2005	-9.897	-4.92	Yes
GH-4	2005	-8.673	-4.50	Yes
$LnRDM_t=\Psi_0+\Psi_1 lnRY_t+\Psi_2 RIR_t+\Psi_3 REX+\Psi_4 RI+\Psi_4 Rf_t+\varepsilon_t$ (4)				
GH-1	2006	-7.745	-5.29	Yes
GH-2	2006	-7.796	-5.73	Yes
GH-3	2003	-9.807	4.69	Yes
GH-4	1999	-6.005	-5.03	Yes

Source: Author's computation. **Note**: Models were specified in canonical and extended forms due to Kumar *et al.* (2010).

The null hypothesis of no cointegration is rejected for all the four canonical specifications. The endogenously determined break dates are 2005 and 2006 for specifications 1, 2 and 3 corresponding to G-H models 1 to 4, while the break dates for specification (4) are 1999, 2003 and 2006. In all, the endogenously determined break dates resulting from all the GH models estimated are 1999, 2003, 2005 and 2006. The empirical results suggest that there exists a long-

run relationship amongst real demand for money, real income, real interest rate, real exchange rate, rate of inflation and foreign interest rate in Nigeria.

5.3. Cointegrating Equation

Table-3. Cointegrating Equations

	Specification (1) [2005 & 2006]	**Specification (2) [2005]**	**Specification (3) [2005]**	**Specification (4) [2003]**
Intercept	111.066 (0.666)	-557.589 (-1.122)	-401.745 (-0.734)	498.368 (0.399)
Dum x intercept	886005.918 (19.3004)*	-3691613.748 (-10.914)*	-254539.14 (-5.85)*	2001466.26 (1.371)
Trend	6.436 (0.869)	54.248 (1.902)**	71.266 (1.899)**	123.169 (2.291)*
Dum x Trend	51339.764 (25.189)*	359160.263 (18.505)*	451530.81 (15.134)*	494650.660 (7.882)*
RY_t	0.000024 (0.329)	0.000184 (1.0019)	0.000184 (0.995)	0.000369 (1.429)
Dum x RY_t	0.1915 (9.545)*	1.218 (9.743)*	1.166 (7.93)*	1.482 (4.917)*
RIR_t	-1.285 (-0.257)	-26.434 (-1.617)*	-60.262 (-1.188)	-129.844 (-1.773)*
Dum x RIR_t	-10250.468 (-7.432)*	-175010.028 (-15.732)*	381809.76 (-9.465)*	-521460.61 (-6.098)*
REX_t	-	-10.389 (-2.147)*	-10.267 (-2.106)*	-15.804 (-2.183)*
Dum x REX_t	-	-68780.148 (-20.88)*	-65050.267 (-16.77)	-63470.38.38 (-7.507)*
RI_t	-	-	-33.069 (-0.705)	-91.577 (-1.32)
Dum x RI_t	-	-	-209519.600 (-5.617)*	-367779.04 (-4.546)*
Rf_t	-	-	-	-102.453 (-1.069)
Dum x Rf_t	-	-	-	-411454.38 (-3.679)*

Source: Author's computation. **Note:** Absolute t-ratios are in parentheses. 5% and 10% significance levels are indicated with * and ** respectively. The years relevant for the dummy variable are indicated in the column header in parentheses [ ]. For instance, Dum 2005 means that the dummy is unity after that year.

Specification (2) suggests that models GH-1 and GH-2 are the most appropriate models since their estimated coefficients excluding real income are statistically significant. In sum, the canonical specification (2) is robust. Hence, Nigeria's real money demand function has undergone some regime shifts in the intercept, trend and slope coefficients within the period under review.

5.4. General linear Regression Model

Table-4. The Model (Dependent Variable – (lnRDM))

Variable	**Coefficient**	**S.E**	**t-statistic**	**Prob.**
C	2.590	0.702	3.690	0.0007
Ln(RY)	0.389	0.064	6.064	0.0000
RIR	-0.044	0.015	-2.985	0.0051
REX	0.0063	0.0014	4.393	0.0001
RI	-0.069	0.014	-4.885	0.0000
Rf	-0.067	0.024	-2.836	0.0074

$R^2 = 0.909$ F = 60.141DW = 1.397

The signs of all the variables in table 4 are in line with economic theory postulates. The results show a positive and statistically significant relationship between demand for real money and income. This suggests that as real income increases, people would have the tendency to hold more money. The coefficient (0.389) of the real income variable indicates that the long-run income elasticity for real broad money is less than unity. All else held constant, if real income increases by one per cent, real demand for money will increase by about 0.39 per cent. This is in line with Keynes' transaction and precautionary theories of money demand. Moreover, this result is consistent with previous Nigerian studies like Nduka *et al.* (2013); Bitrus (2011) and Nwafor *et al.* (2007).

The domestic interest rate (opportunity cost variable), real exchange rate (currency substitution variable), rate of inflation (assets substitution variable) and foreign interest rate (capital mobility variable) regressors entered the long-run money demand model in equation (1) with different signs. The coefficient of the domestic real interest rate is negatively related to real demand for money but is statistically significant. This suggests that, if real interest rate increases by one per cent, the real demand for money will decrease by about 0.04 per cent. This further suggests that the higher the rate of return on the alternative assets, the lower the demand for money. The coefficient of real exchange rate positively related to real demand for money and it is statistically significant. This suggests that as real exchange rate increases by one unit, real demand for money increases by about 0.006 per cent. This implies that as real exchange rate increases returns from holding foreign money increases.

There is a negative but statistically significant relationship between rate of inflation and real money demand. If rate of inflation increases by one per cent, all else held constant, the real demand for money decreases by about 0.07 per cent. This is because it is more likely that agents would prefer to hold real assets as hedges during periods of high prices. The coefficients of domestic real interest rate and expected rate of inflation follow Friedman's quantity theory of money. Similar findings were reported by previous Nigerian studies likeNduka *et al.* (2013) and Bassey *et al.* (2012). The coefficient of foreign interest rate is negative but significantly related to real demand for money. This suggests that as foreign interest rate increases by one per cent, the real demand for money decreases by about 0.07 per cent. This result supports the portfolio balance theory of capital mobility for Nigeria.

5.5. Stability Test

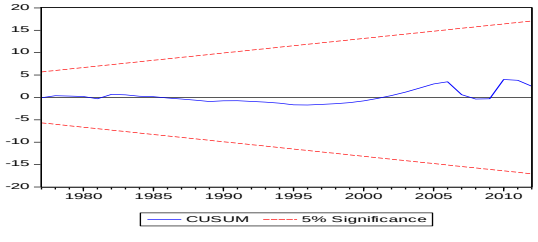

Figure-2. Plot of Cumulative Sum of Recursive Residuals

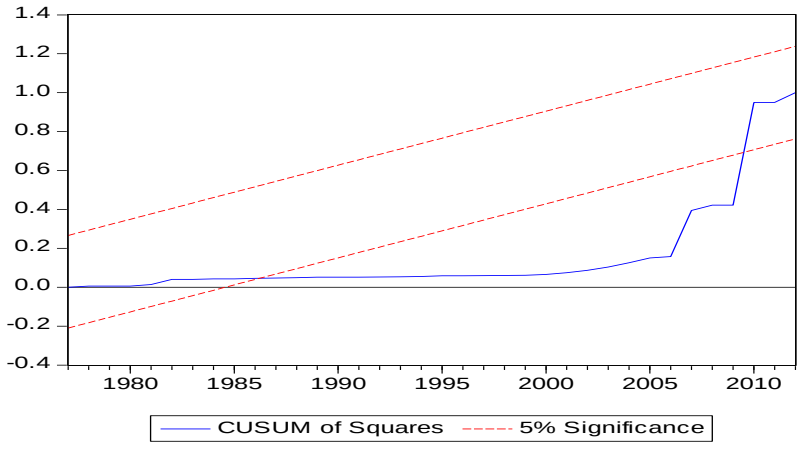

Figure-3. Plot of Cumulative Sum of Recursive Residuals Squares

Figures 2 and 3 are the graphs of CUSUM and CUSUMSQ respectively. Econometric theory suggests it is important that the CUSUM and CUSUMSQ statistics lie within the 5% critical bound. As depicted by figure 2, the estimated long-run parameters of the real broad money demand function are stable. This is due to the fact that the plots of CUSUM lie completely within the 5% critical lines. However, in figure 3, real broad money demand function deviated from the 5% critical lines between 1986 and 2008 and returned to the line for CUSUMSQ. These findings revealed the superiority of CUSUMSQ over CUSUM. This is due to the fact that the CUSUM test suggests that the money demand has always been stable in Nigeria, whereas the CUSUMSQ suggests that it has undergone instability. Almost all the previous studies conducted on Nigerian economy employed only CUSUM test and therefore concluded that money demand function has always been stable. Thus, this necessitated the application of the CUSUMSQ test in this study. The result of the CUSUMSQ test corresponds with the periods of structural changes in the economy. For example, during the Structural Adjustment Programme (SAP) in 1986, all the sectors of the Nigerian economy witnessed structural changes as a result of huge injection of money. Additionally, in 2005, the apex bank came up with the policy of recapitalization that compelled banks to have a capital base of at least twenty five billion naira. These structural changes overlapped with the periods of global financial debt crisis that hit the Nigerian economy in 2008. Following the global debt financial crisis, the CBN bailed banks out by injecting huge money into them.

6. CONCLUSION

The study was carried out to empirically address three research questions on the demand for money function in Nigeria for the period from 1970 to 2012 inclusive. The motivation and justification behind the study were driven by recent changes in the financial sector of the economy due to global financial debt crisis and economic meltdown which led to massive bail-out of deposit money banks (DMBs) by the apex bank as well as the timely establishment of the Asset

Management Corporation of Nigeria (AMCON) in July, 2010 to efficiently resolve the non-performing loan assets of banks including related matters. This is in addition to the shift to a medium term perspective monetary policy that targets inflation. Hence, the study broadly aims to further test for the stability of money demand function in Nigeria.

After testing for the time series properties of model variables, two specifications for cointegration with structural breaks were investigated namely, the canonical and extended forms through augmentation of real exchange rate and rate of inflation to capture the cost of holding money. The empirical findings suggest that the canonical specification performed better. This finding validates Kumar *et al.* (2010). Furthermore, the results suggest that there is cointegrating relationship amongst real demand for broad money, real income, domestic real interest rate, real exchange rate, inflation rate and foreign interest rate after accounting for structural breaks in the underlying relationship. Also, the study finds that models GH-1 and GH-2 in specification (2) with regime shift (intercept, slope coefficients and trend changes) corresponding to break date 2005 are preferred models. The endogenously determined break dates are 1999, 2003, 2005 and 2006.

The signs of all the variables are theory consistent. The empirical results show a positive and statistically significant relationship between demand for real money and real income. The domestic real interest rate, the inflation rate and foreign interest rate are negative, but statistically related to real money demand respectively. The real exchange rate is positive, but significantly related to real money demand.The results of the CUSUM and CUSUMSQ tests suggest that Nigerian money demand function is stable within the period under review, but experienced instability between 1986 and 2008. It is likely that this explains why the Central Bank of Nigeria has been unable to match money supply with money demand.

7. POLICY IMPLICATIONS

It is worth noting that the periods of the endogenously determined structural breaks namely 1999, 2003, 2005 and 2006 are within the periods of deviation from stable demand for money function (1986 through 2008). These periods correspond to the era of injection of huge currency into the economy by the apex bank especially in 2008. The policy implication of the findings is that the Central Bank of Nigeria should target broad money aggregates for effective monetary policy.

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