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Monetary Uncertainty and Demand for Money Stability in Nigeria: An Autoregressive Distributed Lag Approach

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ABSTRACT

This paper investigates the effect of monetary uncertainty (MUC) on the stability of money demand function in Nigeria using the Autoregressive Distributed Lag approach for the period of 1980-2014. The demand for money in Nigeria is specified as a function of income, domestic interest rate, inflation, nominal exchange rate and MUC. The effect of MUC on money demand function has not been previously studied in the demand for money literature in Nigeria. The results from the bound testing indicate that MUC, income, domestic interest rate, inflation, exchange rate and broad money (M2) are co-integrated. The finding shows that MUC has a significant influence on the demand for money function in Nigeria. Evidence has shown a unidirectional causality running from MUC to money demand without feedback. The CUSSUM and CUSSUMSQ stability test established that the broad money demand function in Nigeria is stable over the period under study. By implication the monetary policies aimed at monetary targeting could be very effective even when there is the presence of significant MUC.

Keywords: Autoregressive Distributed Lag, Co-integration, Money Demand, Uncertainty, Nigeria
JEL Classifications: E41, E6

1. INTRODUCTION

The stability in money demand function is important in the design and implementation of monetary policy. A money demand function that is devoid of instability has long been considered as a requirement for effective use of monetary aggregates in the conduct of monetary policy (Friedman and Scwartz, 1982; 1992; Goldfeld and Sichel, 1990). It has been established that money demand function help in establishing the link between monetary aggregates and the national income (Laidler, 2013). This is particularly true in the presence of a significant volatilities in the various components of monetary aggregates. The theory on money demand provides scale and opportunity cost variables that influence demand for cash balances. The scale variables often considered in the money demand function are the income, interest rate, and inflation. Mundell (1963) added nominal exchange rate (NER) to the model. Exchange rate captures the substitution effect between foreign and local currency due to exchange rate variations.

However, economic uncertainty are omitted from the money demand analysis. Friedman (1984) first introduced the effects of monetary uncertainty (MUC) into the money demand analysis in his popular hypothesis. Friedman postulated that a continuous fluctuations in money supply tends to lower the money velocity thereby increasing the money demand. Since a fall in velocity signifies a rise in the holding of money by economic agents, then Friedman`s hypothesis that an increase in volatility in money growth translate into an increase in the money demand can easily be tested. Friedman (1984) further asserts that exceptional volatility in monetary growth raises the degree of anticipated uncertainty thereby raises the demand for money. Following this approach, scholars have tried to re-specify the money demand function to include a measure of monetary growth volatility into the function in addition to the identified determinants of the money demand function. A positive and conventionally significant coefficient of uncertainty measure from the money demand model estimate will support the Friedman`s hypothesis.

In line with the Friedman`s hypothesis, Choi and Oh (2003) derived a money demand function using the general equilibrium model integrating the money in utility function method and for the first time added the output uncertainty and MUC variables in money demand function model. They provided the theoretical justification to the addition of the two uncertainty variables into the money demand function and further provide for the signs of the coefficients to be positive or negative. Other researchers identify variable omission in the model specification as a cause for money demand function instability (Bahmani-Oskooee, 2012). Several studies have shown that by including these omitted variables, the function will be stable. Studies like McNown and Wallace (1992) using US data found that for the narrow money measure (M1) function stability, the exchange rate has to be included in the specification. The NER take care of currency substitution between the domestic economy and the rest of the world. Abdullah et al. (2010) conclude that a broad definition of money M2 is a better measure than a narrow definition of money M1 in considering the long-run economic impacts of changes in monetary policy in the ASEAN-5 countries.

Global financial crisis of 2008 has seriously affected Nigerian economy leading to a slowdown in the growth of the economy, a rise in unemployment rate and a decline in trade volume (Doguwa et al., 2014). These developments made it necessary to re-specify the demand for money function in Nigeria by including the measure of MUC in the function. Added to these developments, there was monetary tightening in the face of inflationary conditions and loosening during the periods of recessionary conditions. Increased MUC would make rational economic agent to move away their assets from cash holding to a less volatile assets such as real assets. More so, a rise in MUC would make people more careful about the future thereby keeping more cash today.

The objective of this paper is to provide empirical evidence on the stability of money demand function in Nigeria by investigating the effect of money uncertainty on the Nigeria`s money demand function in both short and long-run using the Autoregressive Distributed Lag (ARDL) approach. This paper differs from the existing literature by re-specifying the money demand function model for Nigeria to include the impact of MUC. The MUC is particularly important to the money demand function in Nigeria because there has been a lot of significant changes in the monetary and financial sector of the economy which made the economy to experience volatility in the sector. Volatility in the economy affects economic agent’s decision towards holding money. The effect of MUC on money demand function in Nigeria has not been previously studied in the demand for money literature in Nigeria.

The rest of the paper is structured as follows. Section 2 is the literature review, Section 3; data and methodology, Section 4 presents the model of the study. Section 5 discusses the results and findings while Section 6 concludes the paper.

2. LITERATURE REVIEW

The current literature on money demand function focus mainly on the conventional variables such as income or wealth, rate of interest, inflation and exchange rates and their impact on the demand for money function. The studies rarely focus attention on the effects of economic uncertainty on the function. Choi and Oh (2003) were the first authors to establish that MUC has an influence on the money demand function. They investigated the impact of monetary and output uncertainty on the United States (US) money demand function and established that output uncertainty affects money demand function negatively. While uncertainty in money holding has a positively significant influence on the US demand for money function. Brugeman et al. (2003) study the Euro area and found that economic uncertainty has no impact on the selected Euro Area countries money demand. Atta-Mensah (2004) using Johansen and Juselius co-integration approach found evidence of a significant and positive effect of output uncertainty on the narrow money (M1) and a negative influence on the broad money (M2) for Canada. Greiber and Lemke (2005) employing the Euro Area and US data found a positive impact of MUC on the money demand function for both countries. Bahmani-Oskooee et al. (2013) investigated the impact of money uncertainty on money demand for Australia using bound testing approach. They established that MUC has both short and long run impact on Australian money demand. Saygili and Ozdemir (2013) study the economic impact of uncertainty on money demand function for Turkey. Using Nymblon type test in the context of the co-integrated vector autoregressive (VAR) methodology, they found that including economic uncertainty measure in the model is necessary to achieve a stable demand for money in Turkey. Bahmani-Oskooee et al. (2013) investigated the effect of output, measured by the GDP and money uncertainty on the Chinese money demand function. They found that both the output and money uncertainty affect Chinese money demand in the short-run.

The empirical literature on the effects of MUC on the money demand function presented an inconclusive results. While others found that MUC affect demand for money stability in the short-run (Greiber and Lenke, 2005; Bahmani-Oskooee et al., 2013), some studies conclude that MUC has both short and long run impact on the money demand function (Bahmani-Oskooee et al., 2013; Attah Mensah, 2004; Saygili and Ozdemir, 2013). Brugeman et al., 2013 concludes that neither output nor money uncertainty has any impact on the money demand function for the Euro Area.

Since our paper focus on the stability of money demand in Nigeria, a cursory review of recent literature on demand for money in Nigeria will help in highlighting the contribution of this study. The pioneering works of Tomori (1972), Ajayi (1974), Teriba (1974), Ojo (1974) and Odama (1974) collectively named the TATOO debate marks the beginning of study on the demand for money in Nigeria. Using simple ordinary least squares (OLS) technique, they established a stable demand for money function in Nigeria. Subsequently, other scholars tried to establish the relationship between money demand and its determining factors in Nigeria focusing on the conventional determinants of money demand function. For example, Teriba (1974) using annual data covering 1958-1972 employed currency outside banks as a scale variable and long-term bond, treasury bill, time deposit and savings rates as opportunity cost variables. Using OLS, the study established a high significant income elasticity of demand deposits in Nigeria. Ojo

(1974) utilizing annual data for the period 1960-1970 focuses his study on only the opportunity cost variables identified as interest rate and expected inflation. Using OLS and partial adjustment model the study found that demand for money is inelastic with respect to income and price changes expectation.

Oresotu and Mordi (1992) specifies money demand function in Nigeria using real GDP as a scale variable. Inflation, domestic and foreign interest rates and exchange rates as the opportunity cost variables. The study found that income (GDP), foreign interest rate, domestic interest rate, inflationary expectations and domestic currency exchange rate as the factors influencing money demand function in Nigeria during the period under review. The demand function was found to be stable over the period. Anoruo (2002) investigated the demand for money stability in Nigeria under the IMF prescribed structural adjustment programme (SAP) period. Using quarterly data the study employ real industrial production index as the scale variable and only real discount rate as the opportunity cost variable. The study utilized the Johansen Co-integration test and concluded that the demand for money function in Nigeria was stable under the SAP period.

Nwafor (2007) uses price deflated GDP, rate of interest and consumer price index variables in specifying the money demand function. They established a stable demand for money function. In a similar study, Kumar et al. (2013) found a stable demand for money function in Nigeria over the period of study. Bitrus (2011) using annual data spanning from 1985 to 2007 on both narrow and broad money examined the stability of money demand in Nigeria. The results provides that money demand function is stable over the period. Doguwa et al. (2014) employed the Gregory and Hansen residual based test co-integration method using quarterly data for 1991:1 to 2013:4. Focusing on the impact of financial crisis on the money demand function, they provide evidence of a stable money demand function before and after the recent global financial crisis.

Iyoboyi and Pedro (2013) utilized the bound testing approach to study the stability in the narrow demand for money in Nigeria focusing on the effect of Naira exchange rate and foreign interest on Nigeria`s money demand stability. The study used real GDP as a scale variable, domestic interest rate, and anticipated exchange rate, expected rate of inflation and foreign rate of interest as foregone cost factors. The paper established that the specified factors in the demand for money in Nigeria are co-integrated during the period of study and that the function was stable. It is important to note here that no clear consensus has been arrived at on the effect of MUC on money demand stability (Bahmani-Oskooee et al., 2013).

From above review, this paper extends the literature in two important ways. First, the main contribution of this study is to establish if MUC variable has influence on the demand for money in Nigeria, a variable that other similar studies have not considered. Secondly, as it is common to most time series variables, series such as inflation happens to be stationary while some others like income, NER or domestic interest rate may have a unit root. A combination of such variables that are at level; I(0) and some at first difference; I(1), the most appropriate approach to be employed will be Pesaran et al. (2001) or Narayan (2005) bound testing co-integration technique rather than using other co-integration methods.

3. METHODOLOGY: THE MONEY DEMAND MODEL

Following Abdullah et al. (2010) and Choi and Oh (2003) the long-run demand for money model can be specified thus;

$$\ln M_t=\alpha+\beta_1 \ln GDP_t+\beta_2 \ln DIR_t+\beta_3 \ln CPI_t+\beta_4 \ln NEX_t+\varepsilon_t \quad (1)$$

Where, M is monetary aggregate measure (broad money), GDP measures income, DIR measures domestic rate of interest, CPI is the measure of inflation, NEX is the NER, the subscript t is the time period, ε_t is the stochastic error term. Apriori expectation for the parameters in equation 1 is that; β_1 is positive, β_2, β_3 bears a negative sign and β_4 can be negative or positive.

Equation 1 can be extended to include a measure of MUC. Choi and Oh (2003) first provided the theoretical derivation of a money demand function incorporating the MUC measure in the model. They defined MUC as the volatility of nominal money supply. We therefore re-specify Equation (1) as;

$$\ln M_t=\alpha+\beta_1 \ln GDP_t+\beta_2 \ln DIR_t+\beta_3 \ln CPI_t+\beta_4 \ln NEX_t+\beta_5 \ln MUC_t+\varepsilon_t \quad (2)$$

Earlier on, Friedman (1984) ascribed a fall in velocity of circulation of US monetary aggregates to volatility in money supply. Friedman (1983) reported that increased volatility in money supply increases uncertainty and therefore results to a rise in money demand. However, an estimate of MUC could be positive or negative (Choi and Oh, 2003).

Equation 2 specified a long-run money demand model. Estimation of the equation by whichever econometric approach provides the long-run parametric estimates of the parameters coefficients (Bahamani and Bahamani-Oskoee, 2012). MUC might have both short-run and long-run effects. To incorporate the short-run effects in the model, and also distinguish short-run from long-run effects, equation 2 needs to be re specified into an error-correction form. That can be done in the subsequent paragraphs.

The ARDL technique, otherwise known as the bound test co-integration approach can differentiate between the dependent and independent variables. We can derive the bound testing co-integration model as follows;

$$\begin{aligned}\Delta \ln MSS_t =& \varphi_0+\sum_{i=1}^{\rho} b_i \Delta MSS_{t-i}+\sum_{i=0}^{\rho} c_i \Delta GDP_{t-i}+\sum_{i=0}^{\rho} d_i \Delta DIR_{t-i}\\ &+\sum_{i=0}^{\rho} e_i \Delta CPI_{t-i}+\sum_{i=0}^{\rho} f_i \Delta NEX_{t-i}+\sum_{i=0}^{\rho} g_i MUC_{t-i}\\ &+\alpha_1 MSS_{t-i}+\alpha_2 GDP_{t-i}+\alpha_3 DIR_{t-i}+\alpha_4 CPI_{t-i}\\ &+\alpha_5 NEX_{t-i}+\alpha_5 MUC_{t-i}+\varepsilon_t \end{aligned} \quad (3)$$

Where Δ denotes the first difference operator, φ_0 is the drift component and ε_t is the white noise residuals. Equation 3 is an error-correction model (ECM) where lagged error terms form equation 2 are replaced by combination of lagged level variables. To fulfil this, we adopted the Pesaran et al. (2001) and Narayan (2005) bound testing approach and use the following specification to estimate our model in equation 3. Equation 3 represents a conventional VAR model where a combination of the lagged series in the model are incorporated as a proxy for lagged error terms that captures departure of the dependent variable from the independent variables in the model. Considering the small size of our sample data and the number of our variables, we estimate our model in equation 3 and establish the appropriate lag p, using the Scwartz Bayesian Criteria (SBC). Also the Beusch-Godfrey langrange multiplier (LM) test is used to check for the model adequacy.

Once equation 3 is estimated, F-test is performed to judge the combine significance of the lagged level variables as a sign of co-integration. This is based on new F critical values as provided by Narayan (2005) in their F-tests table. For co-integration, the computed F-statistic has to be more than the table`s upper bound critical value (Narayan, 2005; Pesaran et al., 2001). Equation 3 has another advantage in that both the short-run and the long-run effects of all the variables are computed using a single step through estimation of equation 3. Explicitly, the impact for the short run period is ascertained using the output from the estimates of the respective coefficients assigned to the first order variables. On the other angle, a long run impacts are inferred from the parameter estimates of β_1-β_5 which are normalized on β_0. The F-test statistic is built on a hypothesis of no co-integration among the variables in the model against the existence of co-integration and is denoted as; H_0: $\beta_1=\beta_2=\beta_3=\beta_4=\beta_5=0$ null hypothesis of no co-integration against H_1: $\beta_1\neq\beta_2\neq\beta_3\neq\beta_4\neq\beta_5\neq 0$ the alternative hypothesis of existence of co-integration among the variables.

4. DATA

The specification in Equation 3 is estimated using annual data that covers the period 1980 to 2014. All data are collected from the International Financial Statistics of the IMF except MUC variable which was constructed following Choi and Oh (2003) and Bahamani-Oskooee et al. (2013). All data are transformed into natural logarithms.

5. RESULTS AND DISCUSSION

5.1. Unit Root Test

In modelling the money demand function with MUC variable, we first investigate each variable in the model to find out whether they are stationary. To test for the stationarity, this study uses the Augmented Dickey Fuller (ADF) and Zivot and Andrews (1992) unit root tests. Table 1 presents the results for the ADF test.

Table 1: ADF unit root test

Series	Intercept		Intercept and trend	
	Level	First difference	Level	First difference
MUC	−3.088	−4.301***	−2.878	−4.601***
DIR	−3.051	−3.393**	−3.086	−3.654**
LCPI	−1.799	−2.727	−0.689	−3.806**
LGDP	0.084	−5.450***	−2.544	−5.341***
LNEX	−1.870	−4.917***	−0.758	−5.315***

***,**stand for significance level at the 1%, 5% and 10% respectively. The figures denote t-statistics for testing the null hypotheses. The lag length is determined as 4 based on Schwartz (1987). The critical values for intercept and intercept and trend at 1%, 5% and 10% are −3.479, −2.883, −2.578 and −4.028, −3.443 and −3.146 respectively, MUC: Monetary uncertainty, ADF: Augmented Dickey Fuller

The results show that all the variables are not stationary at their levels, therefore stationarity is achieved after taking their first difference.

The variables under study seems to have a structural break, we use the Zivot and Andrews (1992) unit root test where the break date is considered as endogenous. We test the null hypothesis $\alpha=1$ for the existence of a unit root, against an alternative hypothesis that the variables are trend stationary having a structural break. The results is presented in Table 2. The result show an evidence that a breakpoint occurs in 1992 for the money supply. The 1992 breakpoint in money supply can be explained within the policy shift in the government monetary policy. A policy shift in 1992 saw the abolishing of the direct control monetary policy framework following the amendment of the CBN Act in 1991. The year 1992 marked the end of the Ibrahim Babangida military regime, a period of high and reckless government spending leading to high volatility in the financial system. financing of huge deficit through the central Bank`s ways and means facilities resulted in rapid expansion of the domestic liquidity. The huge deficit had been largely financed by the central leading to a growth in the monetary aggregates.

The first stage in co-integration technique is to establish the degree of integration of each variable in the model. Table 3 presents the computed F-values for long-run co-integration between the dependent variable (money demand) and the explanatory variables; MUC, domestic interest rate, inflation and exchange rate from a null hypothesis that there is no longrun relationship among the variables in the model. We then compare the F-statistic in the table with the Narayan (2005) critical values. The F-statistic is largely influenced by the number of lags ascribed to variable first difference (Bahamani-Oskooee, 2013). In accordance with this notion we estimate the model in equation 3 by imposing two lags using the SBC in selecting the optimum desired number of lags. Result in Table 3 showed that the F-statistic of 6.226 is greater than the critical values provided by Pesaran et al. (2001) and Narayan (2005) at 1% level of significance, signifying that there is co-integration between the demand for money and MUC, domestic interest rate, income, NER and inflation. Therefore, the null hypothesis of no co-integration is rejected.

This same process is repeated again for each of the variables in the model by taking each of the explanatory variable to be a dependent variable and estimate the respective models. The results is also presented in Table 3. The second model for MUC, the F-statistic is 2.494, and it falls below the Narayan (2005) and Pesaran et al. (2001) lower bound critical values. The null hypothesis of no co-integration is rejected. All the other models for the rest of the variables showed an F-statistic value lower than the lower bound

Table 2: Zivot and Andrews unit root test

Series	Model A			Model B			Model C			
	$\hat{T}_B$	$t_{\hat{\alpha}}$	t-statistics	$\hat{T}_B$	$t_{\hat{\alpha}}$	t-statistics	$\hat{T}_B$	$t_{\hat{\alpha}c}$	$t_{\hat{\alpha}c}$	t-statistics
LMSS	1992	2.545***	−3.156***	2009	3.076***	3.390	2007	2.346**	3.730***	3.485***
MUC	1990	2.732**	−3.040	1993	−2.219**	−2.768	1990	2.241**	0.118	−2.879
LGDP	1995	3.518***	−4.151	1997	−3.791***	−4.175	1995	3.551	−3.295***	−5.401
LNEX	2006	−1.339	−1.556	2002	−2.670**	−2.851	1999	3.463	−2.680**	−3.116
LCPI	1992	3.730***	−3.118	1996	−4.736	−4.361	1995	3.223	−5.902	−4.790
DIR	2010	−1.759	−2.823	1991	−2.239**	−3.127	1989	1.274	−1.219	−3.086

$\hat{k}$ is the optimal number of lagged first-difference terms included in the unit root test to correct for serial correlation. $\hat{T}_B$ denotes the estimated break points. $\hat{t}_\alpha$ is the t value of DT_{jt}. Zivot and Andrews (1992) Table for the critical values. a, b and c indicate significance of the test statistics at 1%, 5% and 10% critical level, respectively. While *** and ** indicate the two-tailed significance level of the break date at 1% and 5% respectively, (Zivot and Andrews; 1992) MUC: Monetary uncertainty

Table 3: Bound co-integration test result

Model	F-statistic	Level of significance	Critical bound			
			F-statistic[A]		F-statistic[B]	
			I(0)	I(1)	I(0)	I(1)
LMSS	6.266***	1%	4.257	6.040	3.41	4.68
MUC	2.494	5%	3.037	4.443	2.62	3.79
		10%	2.508	3.763	2.26	3.35

***represent 1% level of significance, F-statistic A and F-statistic B indicate critical bound F-statistic for Narayan (2005) and Pesaran et al. (2001), respectively

critical values indicating the absence of co-integration among the variables in the respective models.

We can draw a useful conclusion from the analysis above, that there exist a long-run association between the money demand and other factors specified in the over the study period.

Table 4 presented the long-run coefficients in two models; Model A (without a structural break) and Model B (with structural break). In both models, the long-run elasticity of MUC is significant and greater than unity with a coefficients of 8.741 and 8.795 respectively. This suggests that a 10% rise in MUC results to an increase in the domestic demand for money by 87 percent in both models A and B. and that structural shocks has little or no influence on the two models. It also bears the a priori expected sign based on the established theory. This is the major findings of this paper and it confirms the Friedman's (1983) hypothesis that MUC has an influence on money demand in an economy. Uncertainty in money supply has a greater influence on the demand for money function in Nigeria and therefore cannot be ignored in the monetary policy planning and design. Significantly also, our empirical analysis provides a greater support for including the MUC variable in the model rather than excluding it. Results in Table 4 show that in both model A and B, income commands a significant influence in explaining the long run demand for money function in Nigeria.

Most of the coefficients in the estimated models in Table 4 are more than one signifying that a 1% economic growth will require more than 1% rise in the supply of money to go in line with increase in money demand. Exchange rate bears no any significant long run impact in the model. The positive estimated coefficient implies that depreciation leads to a fall in the demand for domestic currency in Nigeria which could be due to expectation of further depreciation. The inflation carries a significant negative coefficient highlighting the opportunity cost feature of the rate of inflation on money demand function. As price level increases by say 1% people reduce their normal money holding by <1% leading to a reduction in demand for money.

After estimating the long run model for money demand, we move on to estimate the short run dynamic model. This is presented in Table 5 showing the result for the short run error correction estimation. The result is presented in two models A (a model without a structural break) and model B (with structural breaks). From the table, the lagged error correction term (ECT (−1)) is significant and bears a negative sign. According to Kremers et al. (1992), a negative and statistically significant ECT is ultimately a better and more efficient approach to proof the existence of co-integration. The value of −0.70 for the coefficient in model A with breaks show that 70 percent of the previous year`s difference between realized and the actual equilibrium figure for money demand is adjusted to the equilibrium level every year. In model B with structural break, the ECT coefficient of -0.13 indicates that approximately 13% of the previous year`s discrepancy is adjusted back to equilibrium position every year. The speed of adjustment is faster in the model A showing the effects of structural shocks on the money demand function.

Series of diagnostic tests were conducted on the estimated model to measure how adequate the model is specified. The result is presented in Table 6. From the table, the calculated Breusch-Godfrey LM test of 2.415 is statistically not significant at all conventional levels of significance.

This suggested that the disturbances are not serially correlated, and therefore there is no serial correlation in the money demand function as specified in the model. More so, the model adequacy is shown by the Ramsey RESET t-test estimate results, and that of the heteroscedasticity test which shows that the residual bears constant variance in the model. Table 6 also contain the Jarque-

Table 4: Long-run coefficients

Variables	Models	
	Model A without Break	Model B with Break
MUC	8.741*** (2.246)	8.795*** (2.454)
DIR	−0.052** (0.224)	−0.051* (0.247)
LCPI	−0.542** (0.229)	−0.506** (0.331)
LGDP	1.031*** (0.140)	1.019*** (0.164)
LNEX	0.332** (0.185)	0.323** (0.203)
BREAK	-	−0.047 (0.296)
CONST	−1.049 (3.636)	−0.747 (4.238)

***,** and * represent 1%, 5% and 10% level of significance, MUC: Monetary uncertainty

Table 5: Short-run coefficient

Variables	Models	
	Model A without break	Model B with structural break
∂MUC	0.850** (0.890)	0.854** (0.960)
∂DIR	−0.009** (0.004)	−0.009 ** (0.004)
∂LCPI	−0.919** (0.363)	−0.086** (0.053)
∂LGDP	0.175** (0.523)	0.173** (0.057)
∂LNEX	−0.016** (0.290)	−0.017** (0.031)
BREAK	-	−0.008 (0.050)
ECT(-1)	−0.70** (0.431)	−0.127** (0.727)
CONST	−0.127 (0.727)	−0.127 (0.727)

***represent 1%, level of significance, F-statistic A and F-statistic B indicate critical bound F-statistic for Narayan (2005) and Pesaran et al. (2001), respectively MUC: Monetary uncertainty

Table 6: Diagnostic test

Test	LM X^2 test	P
A: Serial correlation	2.415	0.120
B: Functional formulation	0.682	0.409
C: Normality of residual	27.870	0.000
D: Heteroscedasticity	2.248	0.134

(A) is the Breusch-Godfrey LM test for autocorrelation, (B) is the Ramsey test for omitted variables, (C) is Jacque-Bera normality test, (D) is the white test for heteroscedasticity

Bera (J-B) test for normality. The J-B test statistic show residuals that are statistically not significant at all levels of significance.

The results of diagnostic tests show that the Nigeria`s money demand function as depicted in the model is adequately and well specified.

Investigating the stability for the long run association among the money demand and the influencing factors, we use the CUSSUM and CUSSUMQ squared test as proposed in Brown et al. (1975) to carry out test for constancy of the model parameters. CUSSUM test is built on the basis of the cumulative sum for the recursive residuals based on the first set of n observations. When plots for the CUSSUM test statistics remain inside the 5% significance level region, the estimates are considered to be stable. Similar analysis also applies to the CUSSUM squared test statistic. The CUSSUM and CUSSUM squared tests are presented in Figures 1 and 2, respectively. From the plot of both tests in Figures 1 and 2 both CUSSUM and CUSSUM-squared statistics lies within the critical bounds showing the stability in the money demand function. This finding justifies the incorporation of the MUC into the demand for money model.

Figure 1: Plot of cumulative sum of recursive residuals

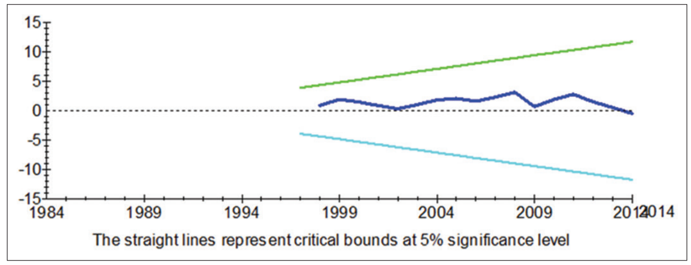
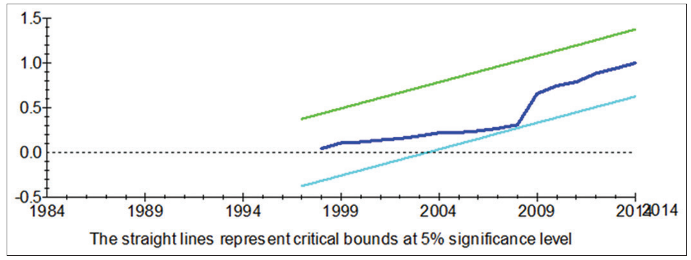


Figure 2: Plot of cumulative sum of squares recursive residuals



The findings therefore justify our inclusion of the MUC variable into the money demand function model. The demand for money function in Nigeria may be stable if the MUC is taken into consideration. More so this concur with the view that excluding an important variable from the money demand model may lead the demand for money function to be unstable (Choi and Oh, 2003).

The vector ECM bound test granger causality result in Table 7 examined the causal relationship between demands for money variable with other explanatory variables affecting the money demand model in Nigeria. The result showed a bidirectional causality between money demand and MUC, income, and domestic interest rate. A one way directional causality exists from money demand to inflation and exchange rate with no feedback effect. Demand for money function in Nigeria is being influenced by the MUC variable.

6. SUMMARY AND CONCLUSION

The study investigated the demand for money in Nigeria using the ARDL cointegration technique. The findings reveals the presence of a long-run stable association between the broad money (M2) and income, interest rate, inflation and MUC. Significantly, our results confirm the Friedman hypothesis that MUC has an impact on both the short and long-run money demand function in Nigeria. Therefore omitting the MUC variable in the money demand model will result into a serious mis-specification of the money demand function. With the inclusion of MUC variable in the money demand function for Nigeria, the function turns out to be well specified and also exhibits a fairly high level of stability performance. The results reveals a long run co-integration between MUC and broad demand for money in Nigeria. This findings supports Bahmaini-Oskooee et al. (2013) and Choi and Oh (2003). More so, by using the CUSUM and CUSSUMQ stability test, we found that the long run demand for money function in Nigeria is stable when the MUC variable is incorporated in the model.

Table 7: Granger causality based on ARDL ECM

Variables	ΔMSS	ΔMUC	ΔDIR	ΔLGDP	ΔLCPI	ΔLNEX	ΔECT(−1)
ΔLMSS	-	85.479***	5.680**	10.069***	6.077**	0.290	13.914***
ΔDUM	162.767***	-	4.681**	1.257	0.717	0.471	-
ΔDIR	9.429***	3.452*	-	0.402	8.717***	19.913***	-
ΔLGDP	31.641***	0.261	9.021***	-	32.633***	1.729	35.541***
ΔLCPI	3.067	2.870	1.247	5.492**	-	6.657**	-
ΔLNEX	1.514	0.196	6.823**	0.872	2.453	-	7.677**

***,** and * represent 1%, 5% and 10% level of significance, ARDL: Autoregressive Distributed Lag, ECM: Error-correction model, MUC: Monetary uncertainty

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