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Financial liberalization and long-run stability of money demand in Nigeria

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Abstract

A stable money demand function is essential when using monetary aggregate as a monetary policy. Thus, there is need to examine the stability of the money demand function in Nigeria after the deregulation of the financial sector. To achieve this, the study employed CUSUM (cumulative sum) and CUSUMSQ (CUSUM squared) tests after using autoregressive distributive lag bounds test to determine the existence of a long run relationship between monetary aggregate and its determinant. Results of the study show that a long-run relationship holds and that the demand for money is stable in Nigeria. In addition, the inflation rate is found to be a better proxy for an opportunity variable when compared to interest rate. The main implication of the study is that interest rate is ineffective as a monetary policy instrument in Nigeria.

Keywords: Stable; demand for money; bounds test
JEL classification: E41; C22

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Introduction

There has been continuous debate on the nature of money demand in the literature. The debate was anchored on the premise that appropriate monetary policy is designed in line with the nature of the money demand. Poole (1970) argued that money supply serves as the most appropriate monetary policy instrument for the Central Bank when the demand for money is stable. This is based on the premise that the use of money supply as a monetary instrument will result in relative low instability in the economy when the demand for money is stable, compared to the use interest rate. On the contrary, money supply becomes ineffective when money demand is unstable. Given this situation, the use of interest rate serves as the most appropriate monetary policy.

Rao and Kumar (2009, pp 1012) claimed that the use of interest rate by central banks in developing countries is inappropriate as the demand for money in their economy is stable. The authors observed that developing countries, Nigeria inclusive, adopted the use of interest rate since it is commonly used in advanced countries, without given due recognition to the nature of the demand for money in their economies. According to them, the use of interest rate would have been appropriate if the demand for money function is unstable. Unstable demand function implies that it is difficult to predict money demand function. By implication, the scale variable and the opportunity variable, which are the determinants of money demand could not convey much information about money demand. A possible cause of this is the sensitivity of money demand to the opportunity variables. Opportunity variables convey information on the opportunity cost of holding money. Interest rate, which is the return forgone by an economic agent for holding money, is an example of an opportunity variable. Hence, as the money demand function becomes more sensitive to interest rate changes, prediction of money demand becomes difficult. The difficulty in predicting money demand promotes the use of interest rate as monetary instrument.

There are a growing number of empirical studies on developing countries that have established that money demand in stable. Their results do not support the claim that financial innovation has led to an unstable money demand function in developing countries. Examples of studies within this strand include: Nachega et al. (2001) for Uganda, James (2015) for Indonesia, Kumar (2011) for 20 developing countries and Ndirangu and Nyamongo (2015) for Kenya. Building on these empirical findings, Kumar (2011) have argued that the use of interest rate as a monetary anchor is inappropriate in a country with stable demand function.

Hence, it is imperative to ask if the use of interest rate is an optimal monetary policy in Nigeria given the nature of stability of money demand function in the country. To answer this question, there is need for an empirical study that will provide information on whether or not the demand for money has been unstable as a result of the series of financial reforms implemented in the country since 1986.

This study empirically tests for the stability of money demand in Nigeria using both narrow and broad money. The study uses of quarterly data spanning the period of 1992:Q1 to 2015:Q4[1]. Autoregressive distributed lag (ARDL) bounds test approach to cointegration developed by Pesaran *et al.* (2001) is used in the study to test whether or not there exist long-run relationship between monetary aggregates (M1 and M2) and their determinants. From the findings of the study, we conclude that long-run relationships hold. Afterward, we test for the stability of the money demand function in Nigeria using CUSUM (cumulative sum) and CUSUM of square tests developed by Brown et al. (1975). Our results show that both M1 and M2 are stable. This is in line with existing studies carried out in Nigeria, such as Anoruo (2002), Akinlo (2006) and Kumar et al. (2013), which focused on periods before and after implementation of financial reforms.

It is important to devote space to articulating how the present inquiry steers clear of the highlighted prior exposition. The data point in the studies by Anoruo (2002) and Akinlo (2006) ends prior to the increase in bank capitalisation in 2005, a major reform within the financial sector in Nigeria. The study by Kumar et al. (2013), which accounts for this increase in capitalisation only focuses on a narrow definition of money while the other two studies have used M2. In the light of these insights, it is difficult to directly compare the findings of the two underlying studies with those of Kumar et al. (2013) because different monetary aggregate measurements are employed. This study therefore accounts for this weakness by: (i) using both M1 and M2 as measures of monetary aggregate and (ii) focusing on period after the liberalization of the financial sector in 1987[2].

Brief literature review

The study of stability of money demand is an area that is well researched in the field of economics. Despite this, researchers are still interested in knowing whether a country's demand function is stable or not. The observed interest in this area among researchers and

[1] The period considered in this study falls on what the study by Batuo and Asongu (2015) and Asongu (2015) regard as second generation of liberalization.
[2] See Fowowe (2013) for a comprehensive review on financial liberalization in Africa.

policy makers can be attributed to the key role stable money demand plays in the formulation of monetary policy. In addition, advancement in the area of econometrics also explains why the area is well researched. This is because as new estimation techniques are developed, they are usually implemented to test for the stability of money demand. Moreover, researchers are curious to know if through new estimation techniques they could have a different and deeper understanding as regards the nature of stability of money demand in an economy. The study's literature review centers on developing countries. Nigeria is a developing country. Hence, the review of the literature provides us with background information on how stable money demand is in developing countries, thereby providing clue on the stability of money demand in Nigeria.

The first set of studies on the stability of demand for money focused on determining whether the coefficient of income is significant and positive while the coefficient of interest rate is insignificant. When this is established, the author concludes that the demand for money is relatively stable. On the other hand, when the coefficient of interest rate is negative and significant, the author presumes that the demand for money is unstable. An example of studies under this category is Ajayi (1977). Using data from 1960 to 1970 for Nigeria, the author observed the effect of interest rate on monetary aggregate to be insignificant while the effect of income is positive and significant. Hence, the author concluded that the demand for money is stable in Nigeria.

Due to development in the econometrics analysis, it was observed in the literature that studies emanating from early the 1990's used cointegration tests to ascertain whether or not the demand for money is stable. Hence, researchers set-out to examine whether cointegration holds between real money demand with scale and opportunity variables. Stable demand function is said to hold when there is cointegration between real money demand and its determinants. Otherwise, the author concludes that money demand is not stable. Co-integration techniques such as Engle and Granger, Johansen and Gregory and Hansen tests were predomintantly employed. Most of this studies arrived at the same conclusion that money demand is stable. The study by Chaisrisawatsuk et al. (2004) examined money stability in five Asian developing countries, namely Indonesia, Korea, Malaysia, Singapore and Thailand and employed Johansen cointegration test. The authors used data that span over the period of 1980Q1 and 1996Q4. In the study, a narrow definition of money was used. Their cointegration test results show that the variables used were cointegrated and then concluded that in the selected countries, the demand for money is stable. Using ARDL

bounds test for cointegration, James (2005) tests for stability of money demand in Indonesia using quarterly data that span from 1983Q1 to 2000Q4. In the study, the author used broad money to measure monetary aggregate and found that M2 is cointegrated with its determinants and then concluded that money demand in Indonesia is stable. Barros et al. (2016) focused on Kenya and used monthly data over the period of January 2000 to August 2013 to examine whether or not there is stable money demand. Based on Johansen cointegration test, they found that the variables considered were cointegrated and hence remarked that Kenya's money demand was stable.

Bahmani-Oskooee and Rehman (2006) argued that demand for money might be cointegrated and still be unstable. According to them, cointegration test is not sufficient. Hence, there is need to perform a parameter consistency test in addition to a cointegration test before someone can conclude that demand for money is stable. To make their argument clear, they test for the stability of money demand in seven developing Asian countries, namely, India, Indonesia, Malaysia, Pakistan, Phillipines, Singapore, and Thailan using both M1 and M2. The data used span over the period of 1973 and 2000. The ARDL cointegration test was employed, whereas the CUSUM and CUSUMSQ tests were used to ascertain parameter consistency. Their findings show that both M1 and M2 were stable in all the selected countries except in Singapore. The found out that the model M1 and M2 were cointegrated in all the selected countries. The authors then argued that cointegration does not imply a stable demand function. In a similar pattern, Anwar and Asghar (2012) test for the stability of both M1 and M2 in Pakistan using annual data that span over the period 1975-2009. For cointegration test, the authors used ARDL bounds test and found that the both M1 and M2 and their determinants were cointegrated. The authors then proceeded to test for stability of the demand function using CUSUM and CUSUMSQ tests. Their findings show that M2 is stable while M1 is unstable. The stability nature of M2 in Pakistan was confirmed by Khan and Hye (2013). Singh and Kumar (2012) used different estimation techniques, namely, General to Specific (GETS), Johansen Maximum Likelihood (JML), Fully Modified Ordinary Least Squares (FMOLS) to test for the existence of cointegration between monetary aggregate and its determinant. The study focused on twelve (12) developing countries, namely: Fuji, Vanuatu, Samoa, Solomon Island, India, Indonesia, Philippines, Thailand, Kenya, Malawi, Jamaica and Rwanda. The authors arrived at a similar conclusion as the different techniques used. After which, they proceeded with the CUSUM and CUSUMSQ tests and discovered that in the selected countries money demand is stable.

In the study by Kumar (2011) which focused on 20 developing countries, the authors examined the effects of financial reforms on the stability of money demand in the selected countries. The study covered the period of 1975 to 2005 with the analysis carried out in different time periods. The empirical evidence was based on GETS. The findings showed that the coefficient of income and interest rate does not change significantly over the different time periods. Using CUSUM and CUSUMSQ tests, they found that demand for money is temporarily stable. Hence, they conclude that demand for money is stable and that the coefficient of income and interest rate is unaffected by financial reforms. In addition, Ndirangu and Nyamongo (2015) tested whether financial innovation makes money demands unstable in Kenya. The authors used quarterly data that span over the period of 1998Q4 to 2013Q3 and employed ARDL bounds test. The found out that in the face of financial innovation, money demand in Kenya is stable. Similar to this, an earlier study by Nachega (2001) tested for the effect of financial liberalization on money demand in Uganda based on data that span over the period of 1982Q4 to 1998Q4. The author employed Johansen cointegration test and found that M2 and its determinants are cointegrated. Thereafter, the author used Chow test to assess the stability of the money demand during the period when a financial reform was implemented in the study. They found out that the introduction of financial liberalization does not make M2 unstable in Uganda.

Studies that examined the stability of money demand in Nigeria are many, but the findings of few of these studies are discussed in this paragraph. The selected studies examined the stability of money demand in Nigeria within the context of financial reforms. The study by Anoruo (2002) measured monetary aggregate using M2, and employed a Johansen test. The study's findings showed that M2 and its determinants are cointegrated. Based on the results from Hansen, CUSUM and CUSUMSQ tests, the author concluded that demand for M2 is stable in Nigeria. Akinlo (2006) used another cointegration technique called ARDL bounds test. The author used quarterly data over the period of 1970Q1 to 2002Q4. The author measured monetary aggregate using M2 and found it to be cointegrated with its determinants. The study further tested for parameter consistency test using CUSUM and CUSUMSQ tests and the results obtained by Akinlo are mixed. The result from CUSUM showed that M2 is stable while the finding from CUSUMSQ showed that M2 is unstable. Furthermore, Kumar et al. (2013) measured monetary aggregate using M1. The study used annual data over the period of 1960 to 2008 and employed Gregory-Hansen cointegration test. Their results show

that M1 and its determinants are cointegrated. Furthermore, they employed CUSUM and CUSUMSQ tests and found out that M1 is stable in Nigeria.

From the above studies, the stability of the demand for money is contingent on the definition and measurement of monetary aggregates. In all studies that used M1, it was observed that monetary aggregate is stable while this could not be said of all studies that employed M2. This suggests that more research on this theme is necessary, especially inquiries that articulate both measures of monetary aggregate in an attempt to have a more comprehensive picture on the stability of money demand. Thus, this study intends to fill this gap by using Nigeria as a case study.

Methodology

Based on the above theoretical insights, we adopt and modify the demand function used in Hossain (1993, pp. 91). Here, demand is a function of both scale and opportunity variables. The scale variable used in this study is real income while two distinct opportunity variables are used, namely: interest rate and inflation rate. According to Bahmani-Oskooee and Gelan (2009), the use of interest rate as a measure of opportunity variable in Africa will result into misleading results due to underdevelopment of the financial sector. In the light of this skepticism, the authors argued that in countries with underdeveloped financial sectors, the interest rate does not reflect the full market condition. As a result, the authors advocated for the use of inflation rate. Existing studies on demand for money in Nigeria, such as Anoruo (2002) and Akinlo (2006), used interest rate to capture opportunity variables while Kumar et al. (2013) have employed both interest rate and inflation rate in the same regression as measures of opportunity variables. The result of the study is subject to multicollinearity. To address this weakness, in this study, interest rate and inflation rate are employed separately in the demand function. The findings of the study are consistent with Bahmani-Oskooee and Gelan (2009) on the appropriateness of the use of inflation rate as a measure of an opportunity variable, when estimating demand function in Nigeria.

In addition to scale and opportunity variables, the literature on the demand for money has highlighted the importance of incorporating currency substitution as well as foreign countrries' interest rates into the demand function. Chaisrisawatsuk et al. (2004) citing Mckenzie (1992) pointed-out that as long as foreign bond are regarded among the citizenry as an alternative investment vehicle, the expected return on such investment should affect the

domestic demand for money. Hence, money demand is influenced by foreign interest rate and exchange rate respectively. The effect of exchange rate on demand for money is referred to as currency substitution whereas the effect of foreign interest rate on demand for money is referred to as a capital mobility effect.

Based on the above arguments, the demand for money in this study is expressed as follows:

$$M/P = f(y, op, R^f, E) \quad (1)$$

where M/P is real monetary aggregate, M is nominal monetary aggregate, p is price level, y is income variable, op is opportunity variable, R^f is foreign interest rate and E is real effective exchange rate.

We re-express equation (1) in a double log form

$$(\ln(M/p)_t^i = \beta_0 + \beta_1 lny_t + \beta_2 R^d{}_t + \beta_3 R^f{}_t + \beta_4 \ln E_t + \varepsilon_t \quad (2a)$$

$$(\ln(M/p)_t^i = \beta_0 + \beta_1 lny_t + \beta_2 INF_t + \beta_3 R^f{}_t + \beta_4 \ln E_t + \varepsilon_t \quad (2b)$$

where, ln is natural logarithm, y is real income, R^d is domestic interest rate, INF is inflation rate, β's are the coefficients for the variables considered in the study, ε is the residual term and t is time.

Superscript i in equations (2a) and (2b) allows us to show that we are considering more than one type of real money demand. Specifically, in this study, we examined two measures of real monetary aggregate, namely: narrow and broad money. The use of the two measures will avail us the opportunity to compare our findings with existing studies in Nigeria in order to improve the extant literature.

Since, the variables used in the study are time series, estimating equations (2a) and (2b) without testing for the stationary property of the series might lead to spurious empirical results. Hence, we test for the stationary properties of the variables using Ng Perron test. Ng Perron test has been adjudged to be efficient and reliable over well-known unit root tests such as Augmented Dickey Fuller (ADF) and Phillip-Perron (PP) tests, as it was able to address weak power associated with those tests (Dejong *et al.*, 1992).

Thereafter, we examined the existence of long-run relationships among the variables used in the study by employing autoregressive distributed lag (ARDL) bounds test approach to cointegration developed by Pesaran *et al.* (2001). This test was used due to its merit over

other tests, such as the Engel and Granger and Johansen tests: compared to these, it does not require all variables to be integrated of the same order. The ARDL model for the study is specified in equations (3a) and (3b).

$$\Delta(\ln(M/p)_t^i = \delta_0 + \delta_1(\ln(M/p)_{t-1}^i + \delta_2 lny_{t-1} + \delta_3 R^d{}_{t-1} + \delta_4 R^f{}_{t-1} + \delta_5 lnE_{t-1} + \delta_6 Trend + \sum_{j=1}^{l} \tau_{1j} \Delta(\ln(M/p)_{t-j}^i + \sum_{j=0}^{m} \tau_{2j} \Delta lny_{t-1} + \sum_{j=0}^{n} \tau_{3j} \Delta R^d{}_{t-1} + \sum_{j=0}^{o} \tau_{4j} \Delta R^f{}_{t-1} + \sum_{j=0}^{p} \tau_{5j} \Delta lnE_{t-1} \varepsilon_t \quad (3a)$$

$$\Delta(\ln(M/p)_t^i = \delta_0 + \delta_1(\ln(M/p)_{t-1}^i + \delta_2 lny_{t-1} + \delta_3 INF_{t-1} + \delta_4 R^f{}_{t-1} + \delta_5 lnE_{t-1} + \delta_6 Trend + \sum_{j=1}^{l} \tau_{1j} \Delta(\ln(M/p)_{t-j}^i + \sum_{j=0}^{m} \tau_{2j} \Delta lny_{t-1} + \sum_{j=0}^{n} \tau_{3j} \Delta INF_{t-1} + \sum_{j=0}^{o} \tau_{4j} \Delta R^f{}_{t-1} + \sum_{j=0}^{p} \tau_{5j} \Delta lnE_{t-1} \varepsilon_t \quad (3b)$$

Performing Bounds test involves estimating equations (3a) and (3b). This is carried out using ARDL estimation technique. The optimal lag for each of the variables was determined based on the Schwarz information criterion (SIC). Afterward, we estimate the F-statistics through Wald restriction by imposing restriction on the lag value of all the level series in equations (3a) and (3b) as stated in Pesaran et al. (2001). The value of the F-statistics was used to adjudge the existence of long run relationship among the variables used in the study.

The null hypothesis for the Wald restriction imposed on both equation (3a) and (3b) is that $\delta_2 = \delta_3 = \delta_4 = \delta_4 = \delta_5 = 0$. This denotes non-existence of long run relationship. The value of F-statistics obtained is compared with the upper and lower critical values which are given by Pesaran *et al*. (2001). According to this cointegration test, if the calculated F-statistics is greater than the upper critical value, the null hypothesis of no cointegrating is rejected, which denotes that the existence of long run relationship. On the other hand, if the value of the F-statistics is less than the lower critical value, a long run relationship does not hold. An inconclusive scenario is apparent, if the value of the F-statistics obtained falls between the lower and upper critical values.

Based on the result obtained from the cointegration test, we proceed to the Error correction model (ECM). This test indicates the speed of adjustment back to long-run equilibrium after a short run shock. In addition to the speed of adjustment, the ECM enables us to estimate the effect of income, interest rate and exchange rate on demand for money both in the long run and short run.

The ECM estimation process entails two steps. The first step is aimed at deriving the error correction term (ECT). This is obtained by regressing the independent variables on dependent variables and then subtracting the actual value of the dependent variable from the estimated value. This is illustrated as follows.

$$ECT = (\ln(M/p)_t^i - (\vartheta_0 + \vartheta_1 T + \vartheta_2 lny_t + \vartheta_3 R^d{}_t + \vartheta_4 R^f{}_t + \vartheta_5 lnE_t) \quad (4)$$

We introduced trend term based on the trending nature of the variables used in the study and it is significant in the regression result. The ECT obtained from equation 4 is incorporated into the dynamic form of equation 2 to arrive at equation 5, which is used to estimate the ECM. The value of τ measures the speed of adjustment. It is expected to be negative and significant for restoration of long run equilibrium after an exogenous shock, which ranges between 0 and 1. A value of 0 indicates no adjustment while 1 implies full adjustment one period after the time the shock occur. On the contrary, a positive value of suggests that converge to equilibrium after exogenous shock does not exist. In other words, exogenous shock leads to permanent deviation from equilibrium (Asongu, 2014). When inflation rate is used to proxy for opportunity variable, we follow the same step as documented in equations (4) and (5).

$$\Delta\ln(M/p)_t^i = \gamma_0 + \gamma_1 \Delta lny_t + \gamma_2 \Delta R^d{}_t + \gamma_3 \Delta R^f{}_t + \gamma_4 \Delta lnE_t + \tau ECT_{t-1} + \varepsilon_t \quad (5)$$

The aim of the study is to test for the stability of money demand in Nigeria. To achieve this, we follow existing studies such as Akinlo (2006), Kumar (2011), Khan and Hye (2013), and Kumar et al (2013) and then perform parameter consistency tests using CUSUM and CUSUM of square (CUSUMSQ) tests developed by Brown et al. (1975). CUSUM test is based on the cumulative recursive sum of recursive residuals. While CUSUMSQ test is based on the cumulative sum of squares of recursive residuals. We reject the null hypothesis of instability when the plots of the CUSUM and the CUSUMSQ stay within the 5% significance level. This suggests that whenever the plots of the CUSUM and the CUSUMSQ move outside the 5% critical lines, money demand function is unstable.

Furthermore, several diagnostic tests are conducted on the result obtained from the ECM. These diagnostics tests reveal the goodness of fit of the estimated model. Tests conducted includes, Jarque-Bera test for normality test and Breusch-Godfrey (BG) test for serial correlation test, Autoregressive Conditional Heteroscedasticity (ARCH) test for heteroscedasticity test.

Data Issues

In this study, we make use of quarterly data spanning the period of 1992:Q1 to 2015:Q4. The data used were all extracted from International Financial Statistics (IFS) and Central Bank of Nigeria (CBN) Statistical Bulletin. Data used in the study are real gross domestic product, real broad money, real narrow money (M1), three month treasury bills, inflation rate, London interbank overnight rate (LIBOR), and real effective exchange rate. Real gross domestic product (RGDP) is the monetary value of goods and services produced within an economy over a period of time evaluated at constant price. Real narrow money is the sum of currency in circulation plus current account deposits evaluated at constant price. Broad money is the narrow money plus time and savings deposits with commercial banks evaluated at constant price. Three month treasury bills is a short term interest rate charge on government security. Inflation rate is define as the percentage change in consumer price level. London interbank overnight rate (LIBOR) is the average interbank rate that banks in London charge each other for short term loan. While real effective exchange rate is the weight of a country's currency relative to a basket of major currencies of trading partners adjusted for price changes. Real gross domestic product, real broad money and real narrow money are derived by dividing nominal gross domestic product, broad money and narrow money respectively by consumer price index. Real gross domestic product is used to measure real income, Three month Treasury bill rate is used to measure domestic interest rate while LIBOR is used to measure foreign interest rate.

Empirical analysis

This study set-out to investigates the stability of money demand in Nigeria using both narrow and broad definitions of money. The description of the variables used in the study is presented in Table 1. We observed that the average of real broad money over the period covered in the study is approximately twice that of real narrow money. Narrow money is currency in circulation with current account deposits. The difference between the average of broad and narrow money suggests that money in time and savings deposits with commercial banks is equivalent to narrow money in the country over the period covered. Furthermore, domestic interest rate in the study is proxied using the three months Treasury bill rate. The domestic interest rate over the period covered is 12.401%. The average inflation rate is

19.715%. Hence, the average real interest rate is negative 7.314%. The average foreign interest rate is approximately one-third of domestic interest rate.

Table 1: Descriptive statistics

	Mean	Median	Maximum	Minimum	Std. Dev.
Real M1'Billion(N)	30.422	24.015	61.794	8.922	17.046
Real M2'Billion(N)	60.618	41.271	126.232	15.000	40.289
Real Income' Million(N)	51.343	48.580	81.977	22.316	20.374
Domestic interest rate (%)	12.401	12.500	26.500	1.707	5.076
Inflation rate (%)	19.715	12.002	87.892	-1.876	19.161
Foreign interest rate (%)	3.113	3.260	6.700	0.228	2.258
Real effective exchange rate	111.156	92.415	279.384	46.135	55.221

Notes: M1 is Narrow money, M2 is Broad money, % is percentage, Std. Dev. is standard deviation and N is Naira

Table 2: The result of the Unit root test

	MZα	MZt	MSB	MPT	Lag
$lnM1$	-3.203	-1.265	0.395	28.441	0
$lnM2$	-1.933	-0.982	0.508	47.072	0
lnY	-3.864	-1.389	0.360	23.576	0
INF	-6.156	-1.745	0.284	14.798	0
R^d	-14.699*	-2.708*	0.184*	6.219*	0
R^f	-12.001	-2.448	0.204	7.601	1
lnE	-4.855	-1.558	0.321	18.771	0
$\Delta lnM1$	-46.990***	-4.806***	0.102***	2.151***	0
$\Delta lnM2$	-43.282***	-4.652***	0.107***	2.105***	0
ΔlnY	-24.387***	-3.492***	0.143**	3.738***	3
ΔINF	-21.799**	-3.291**	0.151**	4.246**	0
ΔR^d	-44.163***	-4.671***	0.106***	2.212***	0
ΔR^f	-21.971**	-3.312***	0.151**	4.161**	3
ΔlnE	-26.116***	-3.613***	0.138***	3.493***	2
Critical value: 1%	-23.800	-3.291	0.143	4.030	
5%	-17.300	-2.910	0.168	5.480	
10%	-14.200	-2.620	0.185	6.670	

Notes: *, **, *** imply significance levels of 10%, 5% and 1% respectively.

Where M1 is real narrow money, M2 implies real broad money, Y is real income, INF is inflation rate, R^d is domestic interest rate, R^f is foreign interest rate, E is real effective exchange rate, ln is natural logarithm and Δ is difference operator.

We proceed to unit root test. The study employed Ng-Perron unit root test and the results obtained are presented in Table 2. The null hypothesis for this unit root test is the position that there is unit root. For the null to be rejected, the statistical value for each of the

dimensions of the test must be less than the critical value. The study results depicts that all the variables considered in the series were not stationary in level except for domestic interest rate. However, they were stationary at first difference. Afterward, we performed a cointegration Bound test. Results for the cointegration test are presented in Table 3. The null hypothesis for this test is the position that there is no cointegration. For the long run relationship to hold between monetary aggregates (M1 and M2) and their components, the null hypothesis has to be rejected. This implies that calculated F-statistics from the Wald test is greater than the upper bound critical value. The results presented in Table 3 show that M1 is cointegrated with its determinants and the same can be said of M2. This suggests that we can determined the long run impact of both scale and opportunity variables on both M1 and M2 in Nigeria. This is consistent with the study by Akinlo (2006) and Kumar et al. (2013) that used M2 and M1 respectively.

Table 3: The Results of the ARDL cointegration test

	ARDL structure	F-statistics	Adjusted Squared	Normality	ARCH test(1)	BG LM test(1)
F(lnM1/lnY,R^d,R^f,lnE)	(1,0,0,1,0)	4.912**	17.161	0.202	0.360	0.327
F(lnM1/lnY,INF,R^f,lnE)	(1,0,0,1,0)	5.387**	18.88	0.044	0.400	0.097
F(lnM2/lnY,R^d,R^f,lnE)	(1,0,0,1,0)	5.708**	21.726	0.505	0.406	0.551
F(lnM2/lnY,INF,R^f,lnE)	(1,0,0,1,0)	7.066***	26.070	0.143	0.728	0.141

Note: The upper (lower) bounds critical value at 1% and 5% are 5.72(4.4) and 4.57(3.47) respectively. These critical values are obtained from Pesaran et al. (2001) with unrestricted intercept and unrestricted trend. The reported value for Normality test, ARCH test and BG LM test are the probability value of the f-statistics. BG is Breusch-Godfrey Serial correlation LM test. In addition, ** and *** imply statistically significance at 5% and 1% respectively. Where M1 is real narrow money, M2 implies real broad money, Y is real income, INF is inflation rate, is domestic interest rate, is foreign interest rate, E is real effective exchange rate, ln is natural logarithm and ARDL is autoregressive distributed lag.

Since, we have established a that long-run relationship holds between monetary aggregates and their determinants, we proceed with an ARDL estimation which assesses the effects of income, interest rate, and exchange rate on the demand for money in Nigeria. The results for the study are presented in Tables 4 and 5. The presentation of the results follows the measure of opportunity variables, namely: interest rate and inflation rate. The results in Table 4 are based on interest rate while those of Table 5 are based on inflation. The study's findings corroborate the argument by Bahmani-Oskoosee and Reham (2006) on the appropriateness of inflation rate as the measure of an opportunity variable in countries with less developed financial sector.

From Table 4 it is observed that income has a significant and positive effect on both M1 and M2. An increase in income by 1% will lead to increase in M1 and M2 by 0.818% and

0.961%, respectively in the long run. In the short run, the effect of a change in income only has positive and significant impact on M1 whereas on M2, it is insignificant. This implies that both in the long run and short run, interest rate does not have the expected negative sign on M1 and M2. This could due to underdevelopment of the financial sector as argued by Bahmani-Oskoosee and Reham (2006). High interest rate should reduce money holding, but in this study the converse is observed. The effect of foreign interest rate on money holding is insignificant both in the short run and long run. Furthermore, the results of the study show that real effective exchange rate has a significant and negative effect on money holding. This suggests that as the Naira depreciates against other foreign currencies, households gain by increasing their demand for foreign currency. As a result, households demand for less of domestic currency in substitution for foreign currency. In addition, the coefficient of real effective exchange rate in the long run is higher than its short run value. It further depicts that as the Naira depreciates continuously, less amount of domestic currency will be held as people shift towards foreign currency as a medium of ensuring that their wealth is unaffected by negative the exchange depreciation. The ECT has the expected sign and it is significant. This implies that whenever there is disequilibrium, it converges back to its long run function. The CUSUM and CUSUMSQ tests as depicted in Figures 1a and 1b reveal that the demand for money is stable in Nigeria.

We turn to Table 5. Here the opportunity variable is captured using inflation rate instead of interest rate. The results obtained conform to the theoretical prediction that as the opportunity cost of holding money increases, the demand for money falls. However, it only has a significant effect on M2. M1 is insignificant. This implies that the definition of monetary aggregate is important with explaining the impact of opportunity cost on the demand for money. Since, M2 is M1 plus time and savings deposits, our results give an impression that time and savings deposits reduce as the inflation rate increases. The results suggest the existence of portfolio shift in asset in line with the rate of inflation. Holding money especially time and savings deposit becomes less attractive in the face of high inflation rate. Furthermore, income exhibits a positive and significant effect on the demand for money (both M1 and M2) in the long run. As observed in Table 4, the effect of foreign interest rate is not significant. This could be because it is lower than the domestic interest rate. In addition, the effect of real exchange rate on the demand for money is negative and significant both in the long run and in the short run. The ECT has the expected sign and it is significant. This implies that whenever there is disequilibrium, it converges back to its long run function. The

CUSUM and CUSUMSQ tests as depicted in Figures 1a and 1b reveal that the demand for money is stable in Nigeria.

Findings of the study confirm unitary income elasticity as it is close to 1. This supports the findings of Kumar et al. (2013). It is also in line with other studies that have focused on developing countries, notably: Singh and Kumar (2012), Nachega (2001) and Barro et al. (2016). The support of unity income elasticity suggests that money is mostly held for the purpose of medium of exchange. Also, this study advances the argument by Bahmani-Oskooee and Rehman (2006) that interest rate is not an appropriate measure of an opportunity variable in developing countries which have less developed financial markets. Using the result from inflation rate, we found that as the opportunity cost of holding money increases, the demand for money falls. And that the impact of an increase in the opportunity cost of holding money is higher in the long run than in the short run. Also, the magnitude of the effect of an increase in opportunity cost is observed to be higher under M2 compared to M1. This is because, time and savings deposits that constitute the part of M2 that is not in M1 is more sensitive to opportunity cost than to currency in circulation. Also, we have found the currency substitution effect to hold in our study. This finding is consistent with other studies that have focused on developing countries, notably: Nachega (2001) and Chaisrisawatsky et al. (2004). Lastly, using both M1 and M2, the demand for money is stable in Nigeria and it is not influenced by the measure of an opportunity variable. This findings supports existing studies which have utilized annual data, notably: Anoruo (2002) and Kumar et al. (2013).

Table 4: Regression analysis with the Interest rate as opportunity cost

Dependent variable: Long run estimation	$lnM1$	$lnM2$
Constant	-15.880**	-19.498*
	(6.347)	(10.514)
Trend	0.012***	0.020***
	(0.004)	(0.006)
lnY	0.818***	0.961**
	(0.249)	(0.407)
R^d	0.002	0.017
	(0.011)	(0.021)
R^f	0.044	0.089
	(0.036)	(0.059)
lnE	-0.364***	-0.355**
	(0.111)	(0.153)

Dependent variable: Short run estimation	$\Delta lnM1$	$\Delta lnM2$
Constant	0.002	0.004
	(0.007)	(0.006)
ΔlnY	0.217*	0.028
	(0.121)	(0.109)
ΔR^d	0.003	0.004*
	(0.003)	(0.003)
ΔR^f	-0.035	-0.021
	(0.030)	(0.022)
ΔlnE	-0.080**	-0.078***
	(0.031)	(0.025)
ECT(-1)	-0.181***	-0.121***
	(0.040)	(0.020)

Diagnostic test

	Value	
R-square	0.280	0.325
Adjusted R- Squared	0.240	0.287
F-statistics(prob. Value)	0.000	0.000
Jarque-Bera normality test	0.250	0.315
Breusch-Godfrey serial correlation LM test	(1)0.464; (2) 0.740; (3) 0.565	(1) 0.700; (2) 0.466; (3) 0.410
ARCH test	(1)0.581; (2) 0.831; (3) 0.941	(1) 0.814; (2) 0.960; (3) 0.740
CUSUM	Stable	Stable
CUSUM of Squares test	Stable	Stable

Notes: *, **, *** imply significance levels of 10%, 5% and 1% respectively. Where M1 is real narrow money, M2 implies real broad money, Y is real income, INF is inflation rate, is domestic interest rate, is foreign interest rate, E is real effective exchange rate, ln is natural logarithm, Δ is the difference operator, ECT is error correction term, and prob. value is probability value.

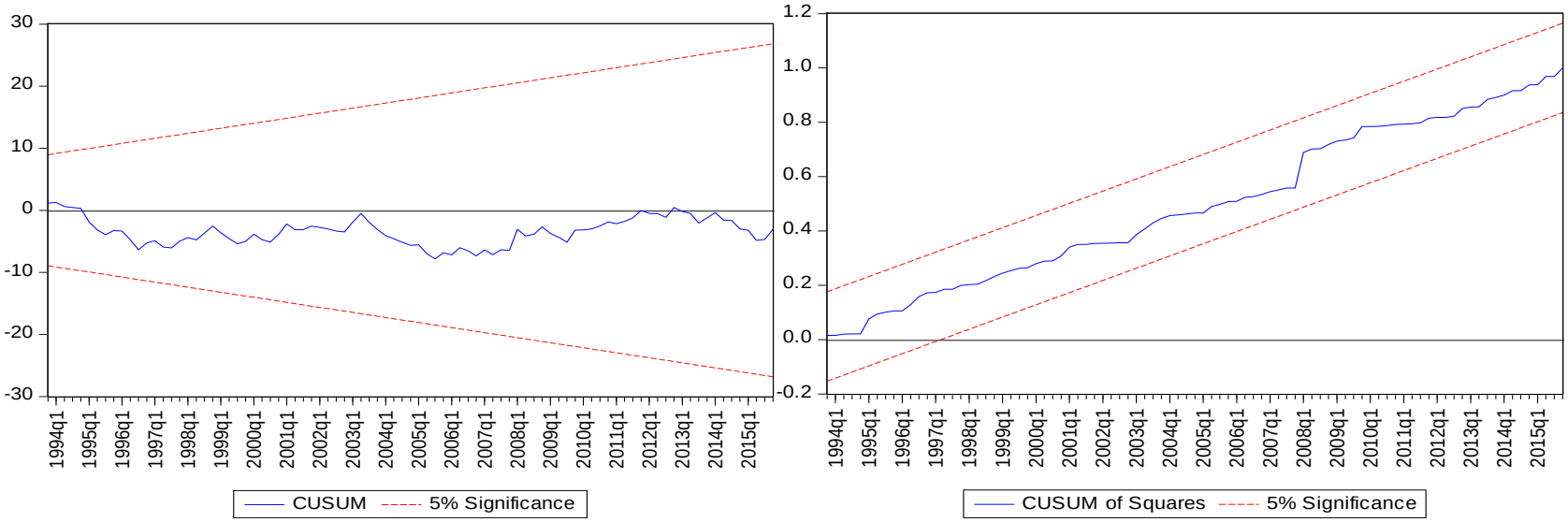

Figure 1a: Using Narrow Money (M1)

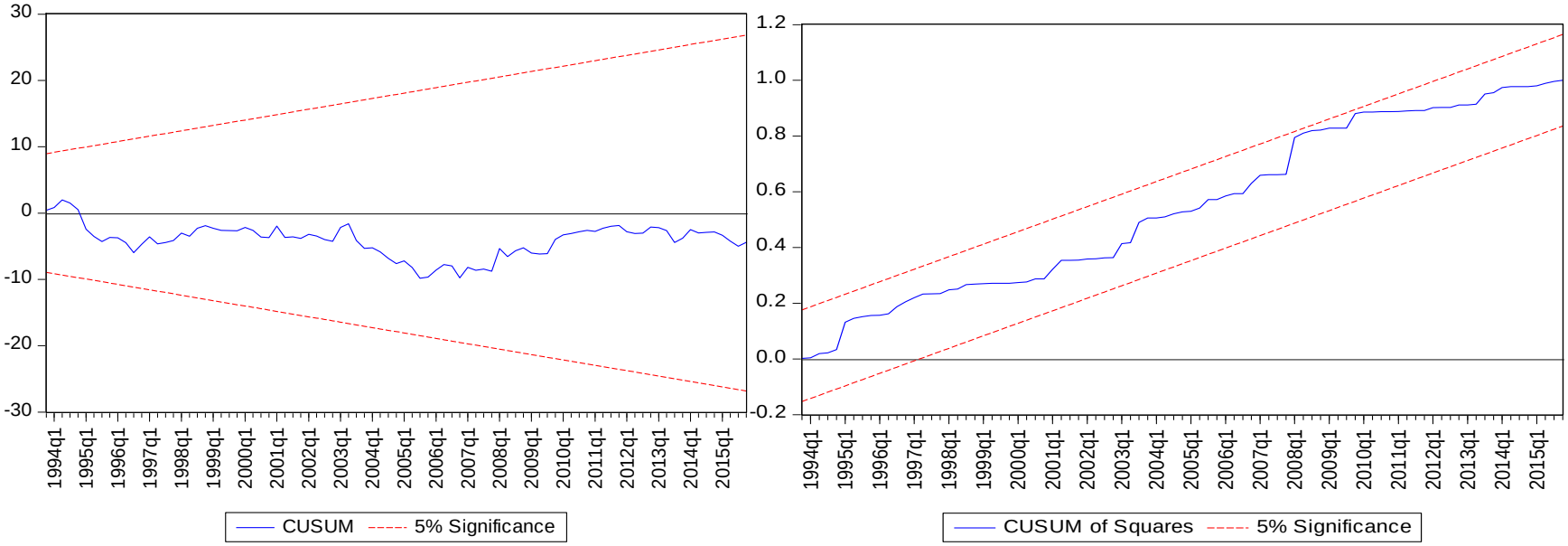

Figure 1b: Using Broad Money (M2)

Table 5: Regression analysis with the Inflation rate as opportunity cost

Dependent variable: Long run estimation	$lnM1$	$lnM2$
Constant	-17.040***	-18.642**
	(6.135)	(8.882)
Trend	0.009*	0.013*
	(0.005)	(0.006)
lnY	0.880***	0.983***
	(0.246)	(0.360)
INF	-0.005	-0.011**
	(0.004)	(0.006)
R^f	0.038	0.070
	(0.034)	(0.052)
lnE	-0.375***	-0.462***
	(0.111)	(0.151)

Dependent variable: Short run estimation	$\Delta lnM1$	$\Delta lnM2$
Constant	0.001	0.002
	(0.007)	(0.005)
ΔlnY	0.249**	0.049
	(0.119)	(0.090)
INF	-0.001	-0.003***
	(0.001)	(0.001)
ΔR^f	-0.035	-0.072
	(0.030)	(-0.023)
ΔlnE	-0.073**	-0.072***
	(0.029)	(0.023)
ECT(-1)	-0.160***	-0.093***
	(0.036)	(0.014)

Diagnostic test

	Value	
R-square	0.290	0.350
Adjusted R- Squared	0.251	0.313
F-statistics(prob. Value)	0.000	0.000
Jarque-Bera normality test	0.116	0.037
Breusch-Godfrey serial correlation LM test	(1)0.211;(2) 0.376; (3) 0.223	(1)0.174; (2) 0.072; (3) 0.042
ARCH test	(1)0.644;(2) 0.721; (3) 0.810	(1)0.968; (2) 0.996; (3) 0.862
CUSUM	Stable	Stable
CUSUM of Squares test	Stable	Stable

Notes: *, **, *** imply significance levels of 10%, 5% and 1% respectively. Where M1 is real narrow money, M2 implies real broad money, Y is real income, INF is inflation rate, is domestic interest rate, is foreign interest rate, E is real effective exchange rate, ln is natural logarithm, Δ is the difference operator, ECT is error correction term, and prob. value is probability value.

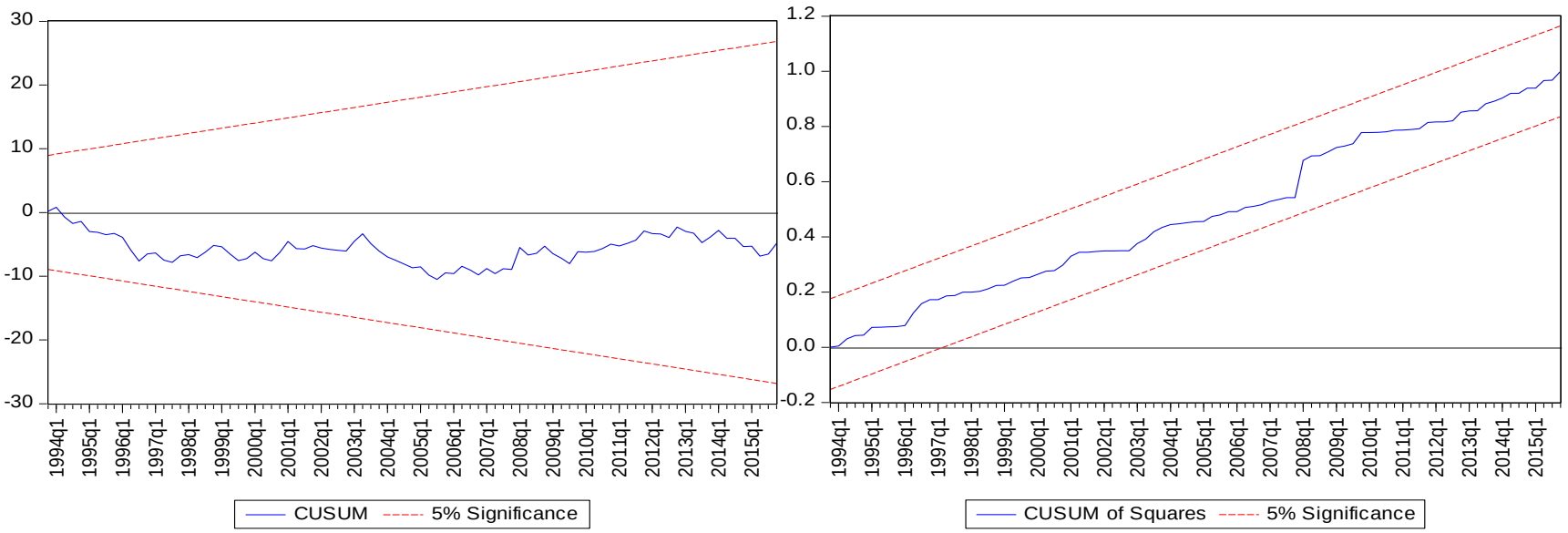

Figure 2a: Using Narrow Money (M1)

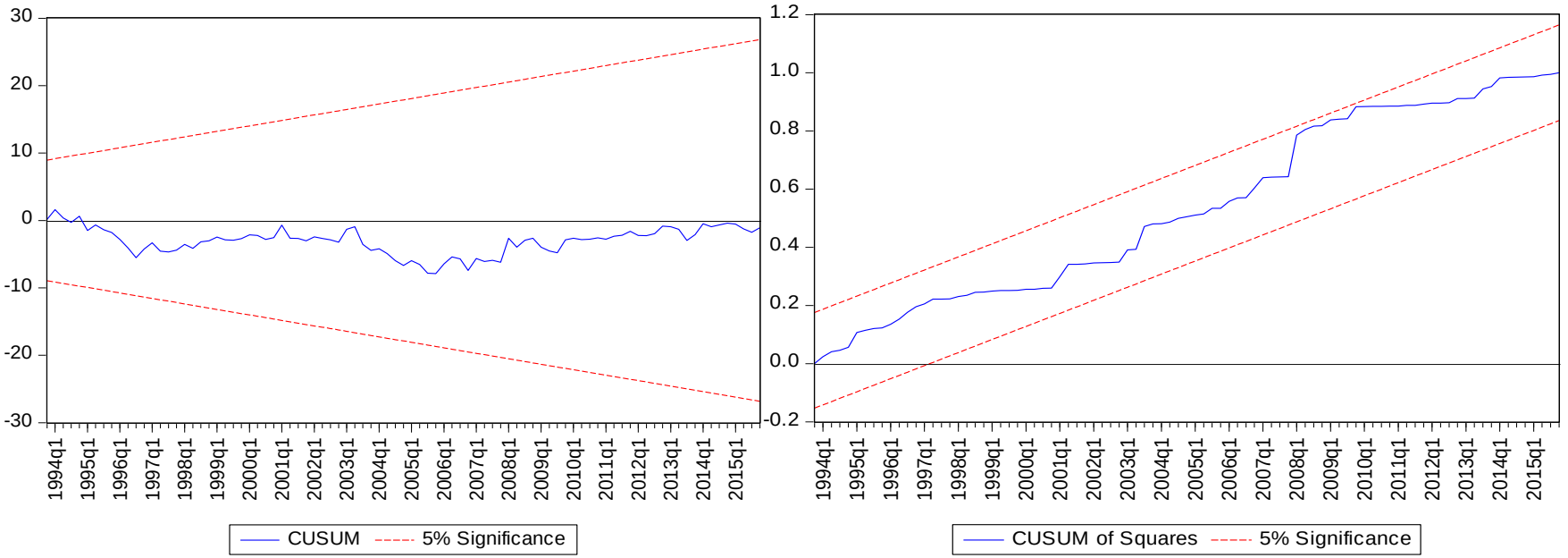

Figure 2a: Using Broad Money (M2)

Concluding implications and future research directions

While the debate on the appropriateness of the interest rate as a monetary policy instrument in Nigeria is still open, this study has investigated the stability of money demand in Nigeria after the first attempt by the government to liberalize the financial sector of the country. Both the narrow (M1) and broad (M2) definitions of money have been used for the investigation. Quarterly data spanning the period of 1992:Q1 to 2015:Q4 has been used in the study. In addition, an autoregressive distributed lag (ARDL) bounds test approach to cointegration developed by Pesaran *et al.* (2001) is used in the study to test whether or not there exist a long-run relationship between monetary aggregates (M1 and M2) and their determinants. From the findings, we conclude that a long-run relationship holds. Furthermore, the ARDL estimation technique has enabled us to examine both short-run and long-run effects of income, domestic and foreign interest rates, and exchange rate on money holding in Nigeria. Furthermore, using CUSUM and CUSUM of squared tests, the demand for money is stable in Nigeria using both narrow and broad definition of money. This supports existing studies by Anoruo (2002) and Kumar et al. (2013) which utilize annual data.

In addition to the above, the study's findings point-out that the coefficient of income in the long run approaches one, indicating that income elasticity in Nigeria is unitary. This supports the findings of Kumar et al. (2013). This is also in line with other studies that focus on developing countries such as Singh and Kumar (2012), Nachega (2001) and Barro et al. (2016). By implication, money is mostly held for the purpose of medium of exchange in Nigeria. Also, this study advanced the argument by Bahmani-Oskooee and Rehman (2006) that interest rate is not an appropriate measure of an opportunity variable in developing countries with less developed financial markets. When the inflation rate is used to measure the opportunity variable, we found that as the opportunity cost of holding money increases, the demand for money falls. Furthermore, the magnitude of the effect of an increase in opportunity cost is observed to be higher under M2 compared to M1. This is because time and savings deposits that constitute part of M2 that is not in M1 is more sensitive to opportunity cost than currency in circulation. This is contrary to what we find when we use interest rate to measure the opportunity variable. Here, the coefficient of interest rate was insignificant as it carries the wrong sign. Also, we found the currency substitution effect to hold. This is consistent with other studies that have focused on developing countries, notably: Nachega (2001) and Chaisrisawatsky et al. (2004).

Going by the theoretical prediction of Poole (1975), the continuous use of interest rate when the demand for money is stable can be viewed as the use of a wrong policy instrument. This might explain the ineffectiveness in the monetary outcomes over the last two years in Nigeria, which has translated to a negative output growth in the face of rising inflation and unemployment in the country.

A few limitations of our study need to be recognised and thus serves as directions for future research. In examining the effect of exchange rate changes on demand for money, appreciation and depreciation of exchange rates were assumed to have the same effect. Hence, it might be interesting to examine the effect of changes in exchange rate from an asymmetric perspective rather than from the symmetric perspective used in this study. Also, it will be interesting to determine whether financial innovation reduces money demand in Nigeria. This can be captured by including it to the money demand function in addition to scale and opportunity variables.

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