A Reassessment of Money Demand in Nigeria

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This paper re-examines broad money (M2) demand and its stability in Nigeria using the Autoregressive Distributed Lag (ARDL) bounds testing procedure. First, the results indicate that a stable long-run relationship exists between M2 and its determinants including GDP, stock prices, foreign interest rates and real exchange rate. Furthermore, stock prices showed a significant and positive effect on the long-run broad money demand, which in some ways reflect increased 'financialization[3] and integration of the Nigerian economy into the global economic system. Overall, the findings of this study lend credence to the continued relevance of the broad money aggregate, M2, as a benchmark for monetary policy implementation in Nigeria.

Keywords: Money Demand; Stability; ARDL Model; Bounds Test.

JEL Classification: E41, C42.

1.0 Introduction

The discourse on the demand for money in Nigeria has remained active after many years of concerted research and debate on the subject. The decade of the 1970s witnessed pioneering works on the subject by Tomori (1972), Ajayi (1974), Teriba (1974), Ojo (1974) and Odama (1974). These discussions and debates drew a lot of attention in both academic and policy circles at that time and earned the acronym 'TATOO' debate.[4] Since then, new entrants into the discussion have tended to build on the pioneering works of these great Nigerian scholars. This study draws some inspiration from these works. The subject has remained alive globally, owing mainly to the importance of the issues for macroeconomic management and monetary policy in particular. Policymakers need to know always how monetary policy affects the real economy and whether aiming to control money matters for the goal of stabilizing prices. To that extent, knowledge of the demand for money will continue to prove essential.

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[3]Increase in size and influence of financial institutions in an economy.

[4]TATOO is simply a coinage of the first letters of the last names of the pioneers (Tomori, Ajayi, Teriba, Ojo and Odama) of the debate on the demand for money in Nigeria.

Today, some of the policy-related developments that motivated the rigorous investigation of demand for money in Nigeria have not changed substantially. For example, the Central Bank of Nigeria (CBN) in 1974 adopted monetary targeting as the framework for the implementation of monetary policy. One of the key requirements for a successful targeting of monetary aggregates is the stability of money demand (Anoruo (2002), and Khan and Ali (1997)). Knowing the arguments of money demand is essential in the selection of instruments and targets, just as the transmission mechanism of monetary policy depends on the arguments of the demand for money. Till date, the Central Bank of Nigeria has continued to target money as its main monetary policy strategy.[5]

Nevertheless, every fresh attempt at studying the demand for money in Nigeria must be vigorously justified. The demand for money itself is a dynamic phenomenon. The determinants of money demand change over time especially when we consider the growing trends in financial innovation. In the past, many studies had, for example, reported interest rate neutrality in the demand for money function in Nigeria owing to the undeveloped nature of the financial market and narrow range of financial assets, such that rather than substituting between cash and financial assets, economic agents tended to substitute between cash and physical assets.[6] It will be interesting and useful to know if this situation has changed in view of recent milestones in financial deepening. This paper is aimed at reassessing the demand for money in Nigeria in the light of recent developments in the economy including the rapid expansion in incomes, greater number and variety of financial assets, and increased openness of the Nigerian economy. Furthermore, the paper seeks to examine whether equity prices matter for monetary policy formulation in Nigeria.

The rest of the paper is structured as follows: Section two presents a review of

[5]There have been significant refinements over the years especially with the adoption of an interest rate corridor and replacement of the minimum rediscount rate by the monetary policy rate (MPR) in 2006. Notwithstanding these modifications, monetary targeting continues to be an integral part of the Central Bank of Nigeria's monetary policy strategy.

[6]see Ndebbio, 1998.

both theoretical and empirical literature on the demand for money. Section three discusses the data and method of analysis while the estimation and results are presented in Section four. In section five, we present the conclusions and policy implications.

2.0 Literature Review

2.1 Theoretical Framework

The literature on the demand for money, also referred to as the demand for real balances[7], is quite vast. The empirical literature on the demand for money in Nigeria is equally rich. At the theoretical level, the motives for holding money are clearly distinguished; transactions, speculative and precautionary motives. The Keynesian theory identifies all three motives for holding cash balances (Keynes, 1936). Both the post-Keynesian and the classical quantity theories, however, focus on particular motives for holding money. In all, the theories of demand for money essentially rely on the functions of money in explaining the determination of money demand (Teigen, 1971).

Keynes argued that economic agents hold a certain proportion of money for the sake of medium of exchange function, that is, to effect transactions. This motive is viewed as dependent on income. The relationship between the transactions demand for money and income is postulated to be stable. Cash balances are also held to bridge receipts and payments since people are sometimes unsure as to when they will have need to make payments. This motive, which Keynes refers to as precautionary, also depends on the level of income. The third motive for holding money in the Keynesian theory of demand for money is speculative purposes. He argued that individuals hold cash balances in order to speculate or invest. The speculative demand for money is hypothesised to depend on expectations about future (or expected) rates of interest.[8] Post-Keynesians, in particular, Baumol

[7] The demand for money or real balances is that amount of cash balanaces that economic agents are willing to hold at any given time.

[8] Economic agents prefer to hold money when interest rates are low with the expectation that interest rates would rise in the future and the price of bond (the alternative means of holding wealth) would fall.

(1952) and Tobin (1956) indicated that this motive for holding money is also income elastic, in addition to providing greater insights about the role of interest rate in the demand for money. The Baumol-Tobin model explains money holding in terms of transactions demand. Hence, when income increases, the transaction demand for money increases less proportionally. This leads to rise in income velocity of money. Post-Keynesian theories of demand for money include the inventory-theoretic approach and the buffer-stock/portfolio models (for detailed explanation of these theories, see Sriram, 1999). Post-Keynesian theories of demand for money include the Inventory-theoretic approach and the buffer-stock/portfolio models (for detailed explanation of these theories, Sriram (1999). From the forgoing, the demand for real balances increases with the level of income and decreases with interest rate. Zecher (1974) expressed this symbolically as:

$$\frac{M_d}{P} = Y^k I^{-h} \tag{1}$$

$\frac{M_d}{P}$ is demand for real money balances; Y is income, and I is interest rate. k and $-h$ are elasticities with respect to income and interest rate, respectively.

Earlier, the classical school of the quantity theory had made significant imprints on the field of monetary economics. The postulations of the classical thought are represented by the Fisher's equation of exchange and the Cambridge approach.

The Fisher's equation of exchange is symbolically presented as:

$$MV = PT \tag{2}$$

where, M is the quantity of money, V is the velocity of circulation, P is the price level and T is transactions volume.

MV, which is total spending, equals PT (what is purchased) simply implies that money is demanded for transactions sake only. This strict position was later modified in the Cambridge approach also known as the cash balance approach. In this formulation, money is held as part of an individual's wealth and has an opportunity cost. The store of value function of money is emphasised. It nevertheless admits income as a key determinant of the demand for money in addition to the opportunity cost variable and the rate of interest (Laidler, 1993).

2.2 Empirical Literature

The empirical literature on the demand for money in developing countries is quite vast, with studies that have used Nigerian data contributing a fair share. The earliest studies on the demand for money in Nigeria were; Tomori (1972), Ajayi (1974), Teriba (1974), Ojo (1974), and Odama (1974). These scholars intensely debated the determinants, their relative importance and the stability of the demand for money in Nigeria. Virtually all the studies found income as a determinant of the demand for money in Nigeria. They, however, differed on interest rate. Some of the studies found interest to be insignificant and they defended this finding by arguing that the hugely underdeveloped financial market and the attendant dearth of alternative financial assets provided credence to the result.

Table 1a: Summary of the Empirical Literature on Money demand in Nigeria

Author(s)	Period	Aggregate	Model	Results
Ajayi (1977)	1960-1970	M2	OLS	Demand for money is inelastic with respect to income and price changes expectation. Unstable money demand; Real income and real interest rate.
Arize and Lott (1985)	1960-1983	M1	OLS	Income and expected rate of inflation; control of money stock is essential for price stability
Ajewole (1989)	1973-1986	M1 and M2	McKinnon	Demand for money is influenced by GDP and return to Physical assets. M2 performs much better than M1 in the Nigerian Context. No significant difference between in real money demand when expected and current income are used and interest rates do not significantly influence money demand in Nigeria.
Oresotu & Mordi (1992)	1960-1991	M1 and M2	OLS	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.
Hassan, et al (1995)	1976-1988	M2	ECM	Stable demand for money; Cointegration among variables,
(Nwaobi, 2002)	1960-1995	M1 and M2	VAR	Stable demand for money; Income as a suitable scale variable
Anoruo (2002)	1986-2000	M2	ECM/OLS	Stable demand for money; M2 still a relevant monetary policy target; income, M2, real discount rate were co-integrated
Owoye & Onafowora, (2007)	1986-2001	M2	OLS and ECM	Stability of money demand reported; cointegration among real broad money, inflation rate, real income, interest rate and foreign interest rate
Nwafor et al, (2007)	1986-2005	M2	Johansen and julieus Cointegration Test	Money demand function is stable and cointegration among the series was established.

In recent times, many other studies have investigated this same phenomenon and have provided further insights about the arguments and stability of the demand for money in Nigeria. Some of these studies and their main findings are summarised in Tables 1a and 1b. The earliest studies on the demand for money in Nigeria referred to as the TATOO debate essentially focused on definition of money, income as a key variable and a bit of stability issues (Yamden, 2011). Studies that are more recent have leveraged on the tremendous progress in economic research methodologies and econometrics to shift the debate to a higher level. Rather than dwelling on the traditional variable of money demand suggested by theory, they have sought to identify more efficient proxies for opportunity cost especially. In this wise, variables such as expected exchange rate depreciation and equity yield have emerged as useful proxies for the opportunity cost of holding money in money demand models for Nigeria (see for example Owoye and Onafowora (2007) and Yamden, (2011). Issues such as cointegration (existence of long-run relationship), existence of endogenous structural breaks and stationarity, which the more recent studies have brought on board, have significantly improved model efficiency and results.

To summarise, we have learned from the survey of the empirical literature on the demand for money in Nigeria that income, expected inflation rate, and other proxies of opportunity cost (equity yield, real discount rate, expected exchange rate depreciation) generally perform well in money demand functions using Nigerian data. The particular opportunity cost variable adopted is critical to finding a significant, negative relationship as suggested by theory. In addition, there seems to be some consensus on income as an appropriate scale variable and stability of parameters of the demand for money function. Stable demand for money is especially important as it suggests that targeting monetary aggregates (M2 in particular) is key to boosting economic activity and that they remain a viable monetary policy instrument for Nigeria (Kumar, *et* al. (2010); and Arize and Lott (1985). Interestingly, we note that the income elasticity of money demand tends to be higher when a broad definition of money is used, sometimes even higher than unity (see for example, Hassan, *et* al. (1995); Anoruo, (2002); Owoye and Onafowora (2007); Akinlo (2006)). Studies using other countries' data have similarly reported income elasticity higher than one (see Laidler, 1993). Finally, we note also the presence of endogenous structural breaks even though studies have differed with respect to the exact point in Nigerian data.

Table 1b: Summary of the Empirical Literature on Money demand in Nigeria (Cont'd)

Author(s)	Period	Aggregate	Model	Results
Kumar, et al (2010)	1960-2008	M1	ECM	Stable demand for money reported; study also identified 1992 and 1986 as the endogenous structural break points
Omanukwue (2010)	1990-2008	M1	Engle-Granger two–stage test for cointegration	Established the existence of long-run relationships among the variables. Weak unidirectional causality from money supply to inflation.
Omotor and Omotor (2011)	1960-2008	M2	ECM	Stable demand for money; study also identified 1994 as the endogenous structural break point
Yamden (2011)	1985-2007	M2, M1	OLS	Stable money demand during most of the sampled years with breakouts in a few years; study found dividend yield significant in both models in addition to income, inflation, and exchange rate.
Nduka,et al (2013)	1986-2011	M2	ECM	Stable demand for money; existence of structural break
Iyoboyi & Pedro (2013)	1970-2010	M1	ARDL/VECM	Empirical results found cointegration relations among narrow money demand, real income, short term interest rate, real expected exchange rate and inflation rate. Real income and intreset rate are significant variables in explaining demand for M1
Doguwa et al (2014)	1992-2013	M2	ECM	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.
El-Rasheed et al (2017)	1980-2014	M2	ARDL	Monetary uncertainty has significant influence on the demand for money function in Nigeria.

3.0 Data and Methodology

3.1 Data

The data used in this study is quarterly time-series data from 1985Q1-2016Q4.The data were sourced from World Development Indicators published by the World Bank (World Bank, 2016), OECD data bank, the Central Bank of Nigeria's statistics database and the Federal Reserve Bank of St Louis.

3.2 Empirical Model

This study uses an empirical model based on the transaction demand and the opportunity cost of holding money. The money demand model was first introduced by Baumol-Tobin (see Baumol, 1952 and Tobin, 1956)). Their paper found that the transaction demand for money exhibits economies of scale. Hence, when income increases the transaction demand for money increases less than proportionally. Therefore, the model takes the following format as in Baharumshah *et* al. (2009).

$$\frac{m}{P} = f(GDP, fir, Inf, Dir, SP, REER) \tag{3}$$

where m/p is real money stock; GDP is gross domestic product; fir is foreign interest rate; Dir is the domestic interest rate, SP is stock prices, Inf is change in consumer price index and $REER$ is the Real Effective Exchange rate. Several studies have incorporated the exchange rate in the money demand function (see Arango and Nadiri (1981) and Bahmani-Oskooee and Pourheydarian (1990)). Equation (3) is re-written in semi-log form as shown in (4), the model is semi-logged because of the variable that is in percentage i.e. inflation.

$$ln(M)_t = \rho_1 ln(GDP)_t + \rho_2 lnf_t + \rho_3 fir_t + \rho_4 lnDir_t + \rho_5 ln(SP)_t + \rho_6 ln(REER)_t + \varepsilon_t \tag{4}$$

The parameters in equation (4) capture the response of money demand to changes in its determinants. The income elasticity of money demand is expected to be positive. Both domestic and foreign semi-interest elasticity of money demand can be negative or positive depending on the strengths of the income and substitution effect on money balances. The introduction of stock prices in the money demand function is justified by the rapid growth and diversification of the capital market, particularly equities, in the last 10 to 15 years. Increasingly, investment in equities has become a viable alternative form of holding wealth in Nigeria. The REER was used to capture the substitution between domestic and foreign currencies which measure the value of a currency against a weighted average of several foreign currencies) divided by a price deflator or index of costs.

The size of the coefficient of the income variable can take the following forms: if it is equal to unity, $\rho_1 = 1$, the quantity of theory is applicable; furthermore, if the size of the coefficient on the income variable is half, $\rho_1 = 0.5$, the Baumol–Tobin approach is applicable; finally, if the scale variable is greater than unity, (that is, if $\rho_1 > 1$, money is considered as a luxury good, neglecting wealth effects.

3.3 Econometric Method

This study adopts the Pesaran and Shin (1998) ARDL model. The model is used because of its suitability in modelling a time series particularly in small samples. It has a big advantage in that regardless of the order of the variables (be it in level $I(0)$ or first-difference $I(1)$), it overcomes the unit-root pitfalls in regression, in addition to solving the often present problem of serial correlation in economic times series. Following Pesaran and Shin (1998), the error correction version of the ARDL model is stated as follows:

$$\Delta y_t = \phi + \sum_{i=1}^{k-1} A_1 \Delta y_{t-i} + \sum_{i=1}^{k-1} B_1 \Delta x_{t-i} + \delta_1 y_{t-k} + \delta_2 x_{t-k} + \mu_t \tag{5}$$

Equation (5) captures the error correction in the ARDL model in which , ϕ is the constant vector parameter, A and B are the short run parameters; y_t captures the endogenous vector variable, x_t is a vector of the other explanatory variables as outlined above and δ_1 and δ_2 are the parameters of the long-run relationship. μ_t is error term, assumed to be serially uncorrelated and homoscedastic.

As noted whilst introducing the ARDL model, all the variables have to be stationary, either in level or at first difference. To check this property before proceeding to the full ARDL model, the study uses the Phillips and Perron (1988) unit-root test.

3.4. ARDL and Bounds Testing Procedure

The Pesaran and Shin (1998) cointegration technique involves a 2-stage procedure in the estimation of the long-run relationship. In the first stage, the existence of cointegration amongst the variables (bounds testing) is tested using the standard Wald or Fisher F-test using equation 3. The null hypothesis is that the coefficients of the lagged regressors in the error correction version of the ARDL model (equation 5) are zero i.e. $H_0 : \delta_1 = \delta_2 = 0$. This null is tested against the alternative hypothesis of $H_1 : \delta_1 \neq \delta_2 \neq 0$. Pesaran and Shin (1998) provide critical values to test the hypothesis, with and without time trend. The critical values are grouped into "upper" and "lower" bounds, where, the upper bound assumes that all the variables are jointly first-difference stationary i.e. I(1) and the lower bound assumes that all the variables are level stationary or I(0). To reject the null hypothesis, the calculated F-statistic must be above the upper bound critical value. If the calculated F-statistic is found to be below the lower bound, a decision to fail to reject the null hypothesis is required for the model. As a final point, if the calculated F-statistic lies in-between the upper and lower bound, the test result is inconclusive. At this stage knowledge of the order of integration (or time series properties of the variables) is required to proceed. The second stage of estimation can only proceed once cointegration is established among the variables.

At this stage, the short-run and long-run parameters are estimated[9] using the following two equations:

Long-run equation

$$\hat{\delta}_1 y_t + \hat{\delta}_2 x_t = 0; \quad y_t = -\frac{\hat{\delta}_2}{\hat{\delta}_1} x_t \tag{6}$$

obtained from a version of equation (5) where appropriate lags would have been selected for both the dependent and independent variables using any of the information criterion after confirming the existence of long-run relationship in stage one.

Dynamic error correction equation for the short-run coefficients/parameters obtained from the equation below:

$$\Delta y_t = a + \sum_{j=1}^{p} \alpha_j \Delta y_{t-j} + \sum_{j=0}^{q} \beta_{1j} \Delta x_{t-j} + \phi ecm_{t-1} + v_t \tag{7}$$

where $ecm_{t-1} = y_{t-1} - \frac{\hat{\delta}_2}{\hat{\delta}_1} x_{t-1}$ obtained from (6) above; y_t and x_t are as previously defined; β_{1j} are the short-run parameters; ϕ measures the speed of adjustment to a new equilibrium whenever there is a shock. It also provides another means of validating the existence of cointegration or long-run relationship among the variables. It is expected to be negative and significant and less than one in absolute

[9]The lag length and lag criterion are chosen; the criterion could be any of Schwartz, Hannan Quinn or the Akaike. Stability and diagnostic checks are carried out for heteroscedasticity, serial correlation, functional form misspecfication and normality of the data.

value for the model to be stable.

3.5. Stability checks

A stability check is carried out on the model using Brown, *et* al. (1975) model of stability verification. The cumulative sum (CUSUM) and cumulative sum of square (CUSUMSQ) are called out on recursive regression residual. To accept that the model is stable, the plots must fall within 5% critical bounds of significance.

The CUSUM test is based on the cumulative sum of recursive residuals based on the first set of n observations. It is updated recursively and plotted against the breakpoints. If the CUSUM statistic stays within the 5% significance level, the estimated coefficients are said to be stable. A similar procedure is used to carry out the CUSUMSQ that is based on the square of recursive residuals.

4.0 Estimation and Results

This section discusses the empirical results comprising of the preliminary results, unit root test, the bounds testing for cointegration, the long-run and short-run estimates of the model and finally, the stability and diagnostics test results.

4.1 Preliminary results

4.1.1 Summary statistics

Table 2 presents the descriptive statistics of the variables of interest in the study over the period, 1985Q1 to 2016Q4. The standard deviation in the data set range from 0.127 to 21.8176 while skewness ranges from -0.74 to 2.75. The variable with the highest mean is REER with 30.30 and the lowest mean was FIR with 1.63. The Jacque-Bera statistic shows the goodness of fit of the data. From the p-values we can observe the data is not normally distributed as it rejects the null hypothesis of normality.

Table 2: Summary statistics

	M2	GDP	INF	FIR	DIR	SP	REER
Mean	6.894879	4.296955	4.970049	1.634831	4.698228	2.156555	30.30041
Median	6.950176	4.237249	3.065963	1.768597	4.510635	2.294355	22.90882
Maximum	7.678465	4.513010	19.10651	2.748105	8.120378	2.751988	142.1950
Minimum	5.961017	4.127328	0.465995	0.740723	2.271823	1.182588	9.291825
Std. Dev.	0.561085	0.126432	4.684975	0.617615	1.067838	0.466777	21.81765
Skewness	-0.176227	0.456104	1.554344	-0.091923	0.525628	-0.741412	2.751405
Kurtosis	1.743579	1.757067	4.068669	1.621837	4.644152	2.183826	11.73603
Jarque-Bera	9.081696	12.67737	57.63195	10.31003	20.31133	15.27950	568.5285
Probability	0.010664	0.001767	0.000000	0.005770	0.000039	0.000481	0.000000
Sum	882.5445	550.0102	636.1663	209.2583	601.3732	276.0390	3878.453
Sum Sq. Dev.	39.98172	2.030108	2787.522	48.44400	144.8153	27.67086	60453.26
Observations	128	128	128	128	128	128	128

4.1.2 Correlation Matrix

Table 3 presents cross correlations among the variables. The correlation matrix shows positive correlation of M2 with GDP and stock prices and negative correlation with inflation, domestic and foreign interest rates and REER.

Table 3: Correlation Matrix

	M2	GDP	INF	FIR	DIR	SP	REER
M2	1.000000	0.956737	-0.371132	-0.816721	-0.067136	0.947534	-0.264636
GDP	0.956737	1.000000	-0.382151	-0.833793	-0.184160	0.836305	-0.216566
INF	-0.371132	-0.382151	1.000000	0.249987	0.422351	-0.327753	-0.177893
FIR	-0.816721	-0.833793	0.249987	1.000000	0.014483	-0.695317	0.276350
DIR	-0.067136	-0.184160	0.422351	0.014483	1.000000	0.049813	-0.571144
SP	0.947534	0.836305	-0.327753	-0.695317	0.049813	1.000000	-0.291253
REER	-0.264636	-0.216566	-0.177893	0.276350	-0.571144	-0.291253	1.000000

4.2 Unit root test

Unit root examinations were carried out using the Phillips-Perron's (PP test).

Table 4: Unit root test

Variables	PP TEST		
	LEVELS	FIRST DIFF	ORDER of Integration
M2	-1.098	-3.430	I(1)
GDP	0.566	-4.2755	I(1)
INF	-2.623	-5.462	I(1)
SP	-2.499	-4.973	I(1)
FIR	-1.985	-4.298	I(1)
DIR	-2.214	-5.787	I(1)
REER	-3.406	-5.149	I(1)

From the PP unit root test result in Table 4, all the variables are integrated at order one which paves the way for the use of the ARDL bounds testing procedure to test for long-run relationship.

Table 5: Bounds Test

F-Bounds Test		Null Hypothesis: No levels relationship		
Test Statistic	Value	Signif.	I(0)	I(1)
			Asymptotic: n=1000	
F-statistic	4.417477	10%	2.12	3.23
k	6	5%	2.45	3.61
		2.5%	2.75	3.99
		1%	3.15	4.43
Actual Sample Size	121		Finite Sample: n=80	
		10%	2.236	3.381
		5%	2.627	3.864
		1%	3.457	4.943

As stated earlier, the ARDL model approach is implemented in two stages in estimating the long-run relationship. In the first stage, the existence of long-run relationship is tested using the bounds test. The bounds test F-statistic must be greater than the upper bound critical values at 5% or 10%.

The computed F-statistics from the bounds test is 4.417. This value is higher than the upper bound critical value at 3.61 at the 5 per cent level of significance. Hence, the null hypothesis of no-long run relationship can be rejected for the model. In effect, there exists a long-run relationship between the demand for money (M2) and its determinants.

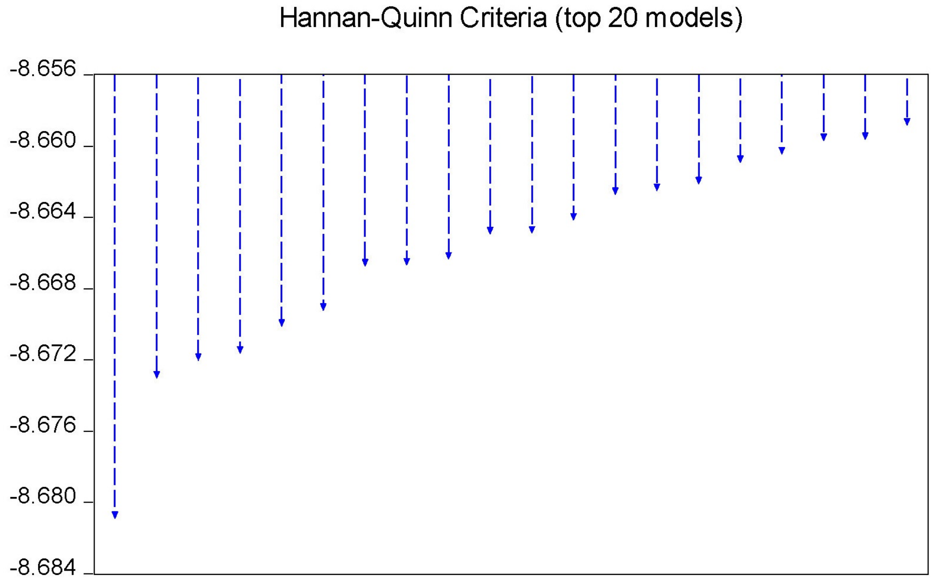

Figure 1: Selection Criteria

Table 6: Long Run Model

Variable	*Coefficient*	*Std. Error*	*T-statistic*	*P-value*
GDP	1.184670	0.650156	1.822133	0.0718**
INF	-0.013414	0.009663	-1.388183	0.1685
FIR	-0.110934	0.108392	-1.023454	0.3088
DIR	-0.024359	0.037573	-0.648318	0.5184
SP	0.616283	0.099097	6.219019	0.0000*
REER	-0.004737	0.002769	-1.710550	0.0906**

Notes: * and ** indicate level of significance at 5% and 10% respectively.

4.3 Long-run and Short-run Models

Table 6 presents the long-run ARDL model for money demand in Nigeria using data from 1985 to 2016. All the coefficients are with correct signs. There is a positive and statistically significant relationship between broad money demand (M2) and GDP as the income elasticity is statistically significant at the 10 per cent level. Hence, an increase in GDP leads to an increase in demand for money as outlined in economic theory. There is also a positive and significant relationship between broad money demand and stock prices. This is because the level of stock prices represents a broad proxy of financial wealth. In the long-run, stock market assets act as a store of value for the monetary aggregate. Both domestic foreign interest rates returned negative coefficients suggesting inverse relationships with broad money demand. By implication, an increase in the foreign interest rate may give rise to a fall in the demand for the local currency (Naira) and increase in the demand for the foreign currency (Dollar). Furthermore, Inflation is negative and statistically insignificant as inflation is negatively correlated to real demand for money. The Real effective exchange rate (REER) is negative and statistically significant at the 5% level. The significance of this indicates the existence of currency substitution in Nigeria.

Table 7: Diagnostic Test

Diagnostic Test	
Serial Correlation	0.464(0.630)
Ramsey Reset	0.380(0.704)
White Test	0.638(0.917)

P-values are indicated in the brackets). Serial correlation test is carried out using LM test for serial correlation of variables, to test for functional form mis-specification Ramsey RESET test is used. Finally, heteroscedasticity is tested using white test. The p-values are presented wiith all showing a failure to reject the null hypothesis for all the tests.

4.4 The Short-Run Model

The dynamic error correction regression associated with the above long-run relationship based on the ARDL approach is reported in Table 7. The model selected is ARDL (3,6,1,6,1,1,7). The coefficients of all lagged first differenced variables in the ARDL model (Short-run coefficient estimates) are shown in Table 8. Not much can be inferred from the short-run model. As expected the error correction term carries a negative sign which highly significant at the 1% level[10] indicating that M2, GDP, Inflation, Stock Prices, REER and Domestic & foreign interest rates are cointegrated. The absolute value of the coefficient of the error-correction term indicates that about 1.5% per cent of the disequilibrium in M2 demand is counterbalanced by short-run adjustment in each quarter. This indicates that excess money is followed in the subsequent period (next quarter) by a reduction in the level of money balances, which people will hold. Thus, it is important to reduce the existing disequilibrium over time in order to maintain long-run equilibrium.

4.5 Stability Diagnostics

The existence of a stable and predictable relationship between the demand for money and its determinants is considered necessary for formulation and implementation of monetary policy strategies based on intermediate monetary targeting as outlined by Sharifi-Renani (2007). The stability of long-run coefficents is used to form the error-correction term in conjuction with the short-term dynamics. Some of the problems of instablity could stem from inadequate modelling of the shor-run dynamics charaterising departures from the long-run realtionship. Hence it is important to incorporate the short-run dyamics for consistency of long-run parameters. In view of this we apply the CUSUM and CUSUMSQ tests developed by Brown *et* al. (1975).

Analysis of Figure 2 showed that the plots for the CUSUM statistic for M2 are stable and within the boundary. However, the statistic for CUSUMSQ in Figure 3 crosses the critical value line's indicating some instability in M2 money demand. A plausible explanation for this occurrence is the fact that this period coincided with the implementation of a home designed Policy Support Instrument (PSI) programme with the International Monetary Fund (IMF). The Programme set as targets, some thresholds for reserve money and other monetary aggregates, which the CBN was, expected to comply with on quarterly basis, in order to have the support of the Fund in Nigeria's economic and financial reform programmes in

[10] This gives further credence to support the cointegration of the variavles of interest. The value normally lies between 0 and -1 where a value of 1 indicates 100 percent disequilibrium in the money deman function is corrected in the following quarter.

the negotiations leading to the Paris and London Club debt exit in 2005. The objective of the IMF endorsement for the PSI was to provide strong signals to donors, creditors, and investors about the effectiveness Nigeria's economic and financial policies. As expected, the stance of monetary policy during this period was mainly restrictive.

Table 8: Estimated Short Run Money Demand Model: ARDL ECM Approach

Variable	Coefficient	Std. Error	T-statistic	P-value
C	0.017915	0.002991	5.990146	0.0000*
D(M2(-1))	0.659242	0.077539	8.502070	0.0000*
D(M2(-2))	0.177610	0.069136	2.568996	0.0118*
D(GDP)	-0.504133	0.150483	-3.350101	0.0012*
D(GDP(-1))	0.455015	0.175329	2.595211	0.0110*
D(GDP(-2))	-0.030707	0.143330	-0.213249	0.8308
D(GDP(-3))	0.002377	0.142638	0.016661	0.9867
D(GDP(-4))	-0.808778	0.179052	-4.517003	0.0000*
D(GDP(-5))	0.681828	0.157473	4.329797	0.0000*
D(INF)	0.000288	0.000202	1.422116	0.1584
D(FIR)	-0.034068	0.004280	-7.960159	0.0000*
D(FIR(-1))	0.025128	0.005724	4.390161	0.0000*
D(FIR(-2))	0.007939	0.005624	1.411705	0.1614
D(FIR(-3))	0.000105	0.004787	0.021884	0.9826
D(FIR(-4))	0.020018	0.005038	3.973737	0.0001*
D(FIR(-5))	-0.013434	0.004234	-3.173058	0.0021*
D(DIR)	0.001778	0.000782	2.272058	0.0255*
D(SP)	0.009410	0.003880	2.434350	0.0173*
D(REER)	-0.000544	9.27E-05	-6.872199	0.0000*
D(REER(-1))	0.000377	0.000108	3.473265	0.0008*
D(REER(-2))	0.000150	0.000102	1.476926	0.1432
D(REER(-3))	4.87E-05	8.42E-05	0.578383	0.5645
D(REER(-4))	-0.001315	0.000111	-11.79985	0.0000*
D(REER(-5))	0.000914	0.000147	6.210912	0.0000*
D(REER(-6))	0.000288	0.000124	2.333111	0.0219*
ConintEq(-1)	-0.015269	0.002659	-6.743155	0.0000*

Notes: * and ** indicate level of significance at 5% and 10% respectively

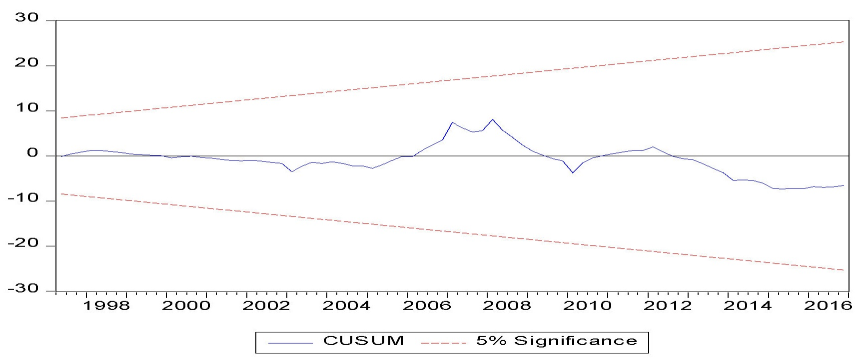

Figure 2: CUSUM Graph

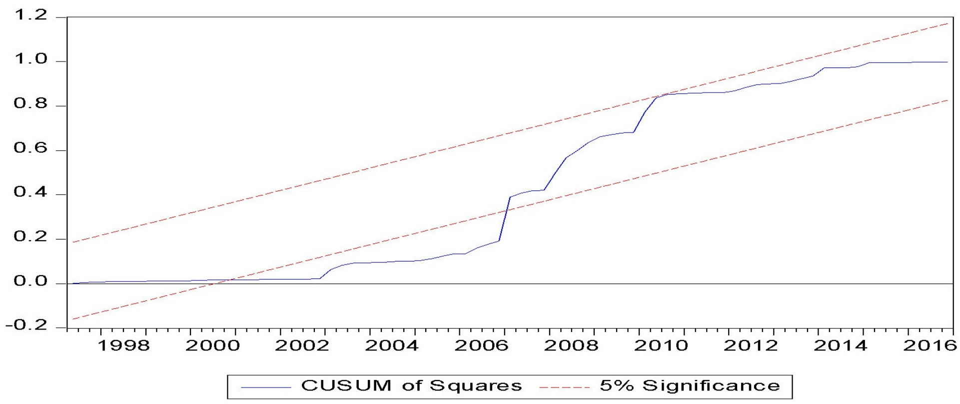

Figure 3: CUSUMSQ Graph

5.0 Conclusions and Policy Implications

The paper sets out to estimate the broad money demand function for Nigeria taking into account the equity market and its impact on money demand. Quarterly observations for the period, 1985Q1 to 2016Q4, were used. The paper adopts the Pesaran and Shin (1998) ARDL bounds testing aproach to determine whether a long-run relationship exist between the variables of interest.

In summary, the results suggest that broad money (M2) remains a credible intermediate target for monetary policy. In the long-run, movements in money demand are related to income, stock prices and foreign and domestic interest rates. The findings of this study are broadly in line with the results in Friedman (1988) and McCornac (1991). From empirical point of view, inclusion of stock prices is important for the stability of M2. These results show that changes in income have significant (positive) short and long-term effects on money; while the variable, stock prices, is positively significant only in long-run. This means that the variable (stock prices) comes into the money demand function for Nigeria as a wealth variable rather than an opportunity cost variable. Inflation is insignificant in the long run, which justifies the short-term orientation of monetary policy. Domestic and foreign interest rates, though properly signed, were statistically insignificant in the long run.

Three policy implications are derived from the findings of this study. First, the conduct of monetary policy in Nigeria should continue to focus on monetary aggregates, especially their growth rates. This is in view of the established stability of the broad money demand and the positive income elasticity in both the short and the long run. Second, the performance of the Stock prices captured by the All-Share Index in the model suggests that asset prices, particularly equity prices, matter for monetary policy in Nigeria. This is important when viewed against the debate about whether monetary policy should respond to asset price misalignments. In our view, and drawing from this study, the CBN monetary policymakers should begin to pay more attention to asset prices in the conduct of monetary policy. Finally, interest rate performed poorly in the model, and such, we may infer that any instrument that works essentially through interest rates (like the Monetary Policy Rate) will need to be complemented by other instruments to impact the intermediate target (money supply) of monetary policy.

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Appendix

Data Sources:

All data are quarterly for the 1985(1)- 2016(4) period. They were obtained from various sources such as World Development Indicators published by the World Bank (World Bank, 2016), OECD data bank, the Central Bank of Nigeria's statistics database and the Federal Reserve Bank of St Louis. Definition of Variables.

M2 – is broad money supply.

GDP- Is gross domestic Production.

Inflation- Is the inflation rate captured by the consumer price index.

Dir- is the domestic interest rate.

Fir- is the US interest rate.

REER- is the real effective exchange rate.

Unit Root Test.

Augmented-Dickey fuller test.

Given,

$$y_t = \mu + \omega_t + \eta y_{t-1} + \eta_1 \Delta y_{t-1} + ... + \eta_p \Delta y_{t-p} + \varepsilon_t$$

The random walk is obtained by imposing, $\mu = 0$ and $\omega_t = 0$. The random walk drift has $\omega_t = 0$; the trend stationary model ventures both parameters free.

The test statistic to carry out the test is then

$$DF_i = \frac{\hat{\eta} - 1}{StandardError(\hat{\eta})}$$

Based on the statistic,

$$DF_\eta = \frac{T(\hat{\eta} - 1)}{1 - \hat{\eta}_1 - ... - \hat{\eta}_p}$$

It has the advantage that it can accommodate higher autoregressive process in ε_t. Alternatively, by subtracting $y_(t-1)$ from both sides.

$$Deltay_t = \mu_t + \eta^* y_{t-1} + \sum_{j=1}^{p-1} \Pi_j \delta y_{t-j} + \varepsilon_t$$

where
$\Pi_j = -\sum_{k=j+1}^{p}$ and $\eta^* = (\sum_{i=1}^{p} \eta_i - 1)$. The null hypothesis for the Augmented-Dickey fuller is then $\eta^* = 0$ against an alternative of $\eta^* < 0$. If failure to reject the unit root holds, $\eta^* = 0$ then first-difference may be carried out.

$$Deltay_t = \mu_t \omega_t + \eta^* y_{t-1} + \sum_{j=1}^{p-1} \Pi_j \delta y_{t-j} + \varepsilon_t$$

The test is carried out using the joint-hypothesis that $\mu = \omega = 0$.

Phillip's and Perron Test (1988)
The philp-perron's test has been used to improve on the ADF test as it captures finite sample properties.
Given,

$$y_t = \theta_t + \eta y_{t-1} + \eta_1 \Delta y_{t-1} + ... + \eta_p \Delta y_{t-p} + \varepsilon_t$$

where θ_t, may be 0, μ or $\mu + \omega_t$. The (PP-Test) modifies the ADF test outlined above.

$$Z_l = \sqrt{\frac{C_0(e\hat{t}a - 1)}{av}} - \frac{1}{2}(a - C_0)\frac{Tv}{\sqrt{as^2}}$$

$$z_\eta = \frac{T(\hat{\eta} - 1)}{1 - \hat{\eta}_1 - ... - \hat{\eta}_p} - \frac{1}{2}(\frac{T^2 v^2}{s^2}(a - C_0))$$

where,

$$C_0 = [(T - K)/T]s^2$$

$$a = C_0 + 2\sum_{j=1}^{L}(1 - \frac{j}{L+1})c_j$$

where $c_j = \frac{1}{T\sum_{s=j+1}^{T} e_t e_{t-s}}$, $\quad j = 0, ..., p$, that is the j^{th} autocovariance residuals $s^2 = \frac{\sum e_t^2}{T-K}$ and v^2=variance of $\hat{\eta}$.

Null Hypothesis: M2 has a unit root
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.098988	0.7149
Test critical values:	1% level	-3.482453	
	5% level	-2.884291	
	10% level	-2.578981	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	8.14E-05
HAC corrected variance (Bartlett kernel)	0.000440

Null Hypothesis: D(M2) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.430390	0.0117
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	2.14E-05
HAC corrected variance (Bartlett kernel)	1.98E-05

Null Hypothesis: D(GDP) has a unit root
Exogenous: Constant
Bandwidth: 16 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.275526	0.0008
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	4.04E-06
HAC corrected variance (Bartlett kernel)	4.59E-06

Null Hypothesis: INFLATION has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.623964	0.0908
Test critical values:	1% level	-3.482453	
	5% level	-2.884291	
	10% level	-2.578981	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.656813
HAC corrected variance (Bartlett kernel)	4.613833

Null Hypothesis: D(INFLATION) has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.462637	0.0000
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1.060381
HAC corrected variance (Bartlett kernel)	1.077181

Null Hypothesis: FOREIGN has a unit root
Exogenous: Constant
Bandwidth: 8 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-1.985725	0.2928
Test critical values:	1% level	-3.482453	
	5% level	-2.884291	
	10% level	-2.578981	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.008668
HAC corrected variance (Bartlett kernel)	0.035836

Null Hypothesis: D(FOREIGN) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.298843	0.0007
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.003760
HAC corrected variance (Bartlett kernel)	0.003615

Null Hypothesis: DOMESTIC has a unit root
Exogenous: Constant
Bandwidth: 0 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.214452	0.2023
Test critical values:	1% level	-3.482453	
	5% level	-2.884291	
	10% level	-2.578981	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.079905
HAC corrected variance (Bartlett kernel)	0.079905

Null Hypothesis: D(DOMESTIC) has a unit root
Exogenous: Constant
Bandwidth: 18 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.787323	0.0000
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.061975
HAC corrected variance (Bartlett kernel)	0.039452

Null Hypothesis: SP has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-2.499546	0.1180
Test critical values:	1% level	-3.482453	
	5% level	-2.884291	
	10% level	-2.578981	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000483
HAC corrected variance (Bartlett kernel)	0.001467

Null Hypothesis: D(SP) has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.973392	0.0001
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000297
HAC corrected variance (Bartlett kernel)	0.000308

Null Hypothesis: D(SP) has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-4.973392	0.0001
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000297
HAC corrected variance (Bartlett kernel)	0.000308

Null Hypothesis: REER has a unit root
Exogenous: Constant
Bandwidth: 6 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-3.406467	0.0125
Test critical values:	1% level	-3.482453	
	5% level	-2.884291	
	10% level	-2.578981	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000810
HAC corrected variance (Bartlett kernel)	0.002351

Null Hypothesis: D(REER) has a unit root
Exogenous: Constant
Bandwidth: 13 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-5.149594	0.0000
Test critical values:	1% level	-3.482879	
	5% level	-2.884477	
	10% level	-2.579080	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	0.000540
HAC corrected variance (Bartlett kernel)	0.000483

Heteroskedasticity Test: Breusch-Pagan-Godfrey
Null hypothesis: Homoskedasticity

F-statistic	1.256482	Prob. F(41,79)	0.1913
Obs*R-squared	47.75980	Prob. Chi-Square(41)	0.2172
Scaled explained SS	71.03775	Prob. Chi-Square(41)	0.0025

Breusch-Godfrey Serial Correlation LM Test:
Null hypothesis: No serial correlation at up to 2 lags

F-statistic	2.081201	Prob. F(2,77)	0.1317
Obs*R-squared	6.205467	Prob. Chi-Square(2)	0.0449