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MONEY DEMAND IN NIGERIA: APPLICATION OF AUTOREGRESSIVE DISTRIBUTED LAG APPROACH

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ABSTRACT

Monetary authorities have shown an increasing appetite for a steady demand for money function in Nigeria because of its vital role in conducting effective monetary policy. This paper presents a clear position of the money demand function deemed important for monetary policy implementation, especially with regard to a monetary targeting framework. The paper aimed to estimate a broad money demand function using quarterly data from Q11981 to Q4 2018. The autoregressive distributed lag/bounds test model was utilized for the cointegration test. The characteristics of the time series for the study were determined with the aid of the augmented Dickey–Fuller (ADF) and Phillips–Perron tests. The empirical results show the existence of cointegration among broad money demand, income, interest rate (I), real exchange rate (REXR) and inflation rate (INFL) within the considered period. Consequently, an error correction model (ECM) was set up to explain the short-run dynamics and we observed that the short-run adjustment for disequilibrium correction was insignificant. From the empirical findings, it was noticed that the velocity of money in the economy is predictable and, as such, a money supply target could be employed to regulate income and price levels.

Contribution/Originality: This study contributes to literature by introducing variables, such as income, interest rate and exchange rate as well as expanding the scope of previous studies in Nigeria. The ARDL model was adopted for the estimation, and the findings showed that income, interest rate and real exchange rate are key determinants of money demand in Nigeria.

1. INTRODUCTION

Over the years, the Central Bank of Nigeria has been on a quest for a predictable and steady money demand because of its contribution to growth and the improvement in living standards. However, the question regarding whether money demand is stable or not has gained predominance in the minds of analysts. Nduka, Chukwu, Ugbor,

and Nwakaire (2013) argued that stability of money demand is a far-fetched issue and cannot be achieved without proper policy formulation, and they reiterated that unguided financial reforms can bring unbalance demand for money and affect the velocity of money. Dagher and Kovanen (2011) and Manasseh (2021) further stressed that the efficiency of monetary policy rests mainly on the constancy of the monetary transmission mechanism and money velocity, especially when the apex bank of a country targets money aggregate using reserve money to implement monetary policy. But Dagher and Kovanen (2011) made it clear that when the link is subjected to unexpected shifts, monetary targets lose their transparency and may not be able to indicate the appropriate position of the monetary policy. Hence, this argument could be perceived as a justification for many countries in Africa moving to inflation targeting, which does not depend on how stable money demand is, but rather on a comprehensive variety of information for evaluation purposes (Dagher & Kovanen, 2011).

The demand for money is a major determinant of liquidity preference and, when money demand is stable, the apex bank can reasonably predict the level of money supply in the economy. It is, therefore, important to select the correct monetary policy instruments since it may result in large fluctuations in output if wrongly selected (Aiyedogbon, Ibeh, Edafe, & Ohwofasa, 2013). Consequently, the existence of stable money demand, basic macroeconomic objectives, such as price stability and exchange rate stability, could promote the attainment of a low unemployment level, especially in oil-exporting countries. Owing to a mixed policy choice adopted in the early 1970s, the Nigerian economy experienced major structural changes that constrained the accomplishment of many macroeconomic objectives, which ordinarily could have helped to promote the level of investment in other sectors and less overdependence on oil revenue. Overtime, oil has become the main source of the country's revenue and accounted for about 58% of the total export value in 1970 and 95% since the 1980s. Due to the upsurge in oil revenue, there was a corresponding increase in Nigeria's external reserves in the 1970s. This led to rapid monetization, which resulted in large injections of liquidity into the economy and, consequently, induced rapid monetary growth. This growth increased the income of the people, which brought more money into the economy than the people could hold.

Subsequently, the upsurge in crude oil proceeds resulted in uncontrollable government spending, which rose from an average of 13% gross domestic product (GDP) between 1970 and 1973 to 25% between 1974 and 1980. Over this period, the rise in earnings from oil was more than attractive, thus stirring the fiscal balance from a surplus to a 2.5% fall in GDP on average per year. This resulted in the government borrowing from the apex bank (CBN) to fund domestic deficits, while foreign deficit financing led to enormous external debt that depleted external reserves (Nnanna, 2001). Due to worsening economic conditions in terms of declining GDP growth, the situation further pushed Nigeria into a deteriorating balance of payment, skyrocketing inflation, devastating debt burden, increasing fiscal deficits, unemployment and a high incidence of poverty. To curb these threats, austerity measures were introduced in 1982 by the Nigerian government. There were recorded success stories in 1985, which include a remarkable fall in inflation to a single digit, significant recovery of external current accounts from deficit to balanced positions and improvement in real GDP which grew by 9.5%. Hence, there was recorded progress in the fiscal and external positions in 1985 indicating the state of economic transition, but the system failed to build a foundation for sustained growth. To this effect, the structural adjustment program (SAP) pledged by the International Monetary Fund (IMF) was approved and implemented in June 1986 as a measure that could rejuvenate and put the Nigerian economy back on the path to sustainable growth. Even in the presence of different policy measures (e.g., SAP), bank consolidation, National Economic Empowerment & Development Strategy (NEEDS) as well as exchange rate liberalization had been initiated and implemented; and, the path to sustainable growth has been a question for many researchers and analysts in Nigeria, and this has led to the argument regarding whether a stable long-run money demand function actually exists as postulated by some scholars (e.g.,Tomori (1972)). On the contrary, the perception of a long-run stable money demand had been refuted by

Bahmani-Oskooee and Chomsisengphet (2002) with evidence of significant growth in the public demand for money in Nigeria. Given the above discussion, this study investigates the factors that significantly influence money demand in Nigeria and establishes the short-run and long-run relationships between money demand and its determinants. Also, the study further investigates if money demand responds to changes in interest rate and income in Nigeria, all within the context of the autoregressive distributed lag model. Moreover, the outcome of this study will provide vital information that could help in tracking both interest rates and money stock. This is essential because it may help to evaluate the effects of money demand as a monetary policy tool in Nigeria and add to the limited amount of available literature. This paper is organized as follows: section two discusses the literature, section three explains the data source and methodology for data analysis, section four presents the results and analysis, and section five presents the policy implications and a summary of the study.

2. REVIEW OF LITERATURE - THEORY

Following the work of Keynes on the "General Theory of Employment, Interest and Money" in 1936, the "traditional quantity theory of money" was discarded by economists, while at the University of Chicago, the "quantity theory" continued to pave ways and form the central and dynamic part of the discussions throughout 1930s and 1940s. At Chicago, scholars, such as Milton Friedman, Henry Simons, Lloyd Mints, Frank Knight and Jacob Viner, built a version of the theory considered more subtle and relevant with a strong link to the general price theory. This transformed into a leading advocate of the Chicago version called "Monetarist Revolution". To explain the revolution of money, Friedman developed an essay on the quantity theory of money, which was published in 1956. In this essay, Friedman asserts:

> "The quantity theory is in the first instance a theory of the demand for money. It is not a theory of output, or of money income, or of the price level."

The demand for money on the part of ultimate wealth holders is formally identical with that of the demand for a consumption service. He regards the amount of real cash balances (M/P) as a commodity, which is demanded because it yields services to the person who holds it. Thus, money is an asset or capital good and the demand for money forms part of the capital or wealth theory. For ultimate wealth holders, the demand for money, in real terms, may be expected to be a function primarily of variables, such as total wealth, division of wealth between human and non-human forms, and expected rates of return on money among other assets.

> "The total wealth is the analogue of the budget constraint. It is the total that must be divided among various forms of assets. In practice, estimates of total wealth are seldom available. Instead, income may serve as an index of wealth."

Thus, according to Friedman, income is a surrogate of wealth. A major source of wealth is the productive capacity of human beings, but the conversion of human wealth into non-human wealth, or the reverse, is subject to institutional constraints. This can be done by using current earnings to purchase non-human wealth or by using non-human wealth to finance the acquisition of skills. Thus, the fraction of total wealth in the form of non-human wealth is an important additional variable. Friedman calls the ratio of non-human to human wealth, or the ratio of wealth to income, *w*. These rates of return are the counterparts of the prices of commodities and their substitutes and complement the theory of consumer demand. The nominal rate of return may be zero, as it generally is for currency, negative as it sometimes is for demand deposits subject to net service charges, or positive as it is on demand deposits on which interest is paid, and generally onetime deposits. The nominal rate of return on other assets consists of two parts: first, any currently paid yield or cost, such as interest on bonds, dividends from equities and costs of storage for physical assets, and second, changes in the prices of these assets, which become especially important under the conditions of inflation or deflation. Variables other than income may affect the utilities attached to the services of money which determine liquidity properly. Besides liquidity, variables are the tastes and

preferences of wealth holders. Another variable is trading in existing capital goods by ultimate wealth holders. These variables also determine the demand function for money along with other forms of wealth. Such variables are denoted as u by Friedman. Broadly, total wealth includes all capitalized sources of income or consumable services. By income, Friedman means "permanent income" which is the average expected yield on wealth during its lifetime. Wealth can be held in five different forms: money, bonds, equities, physical goods and human capital. Each form of wealth has a unique characteristic of its own and a different yield. Money is taken in the broadest sense to include currency, demand deposits and time deposits, which yield interest on deposits. Thus, money is luxury good. It also yields real return in the form of convenience and security to the holder which is measured in terms of the general price level (P).

According to Friedman, all forms of wealth have special and distinctive futures of their own and yield different exclusive forms of interest, dividends and labor income, or implicitly service a form of money measured in terms of P and inventories. He also stated that the discounted value of expected income in the form of wealth establishes the current value of wealth, which is expressed as:

$$W = y/r \qquad (1)$$

Where W represents the current value of total wealth, y is the total flow of expected income from the forms of wealth and r is the interest rate. Equation 1 implies that wealth is a capitalized income. However, the study by Friedman. and Schwartz (1982)on monetary trends in the United States and United Kingdom led to the money demand function, that signifies an individual wealth holder with little deviation from his previous study in 1956, and is specified as:

$$M/P = f(y, w; R_m, R_b, R_e, G_p, u) \qquad (2)$$

According to Friedman, M signifies the aggregate money stock demanded, while P, y and w represent the price level, real income and wealth fraction in non-human form, respectively. R_m denotes the likely nominal rate of return on money, while R_b, R_e and $G_p = (1/\mathrm{P})\frac{\mathrm{dP}}{\mathrm{dt}}$ are the foreseeable rate of return on bonds, anticipated nominal rate of return on equities and the expected rate of change in prices of goods, and hence the expected nominal rate of return on physical assets, respectively, and u stands for variables other than income which may affect the utilities attached to the services of money. However, Friedman brought in predictable changes to the prices in the expected rate of return on bonds and expected changes to prices for the expected nominal rate of return on equities. In Friedman's theory, the overall demand for money comprises the individual demand functions together with M *and* y, which referred to per-capita money holdings and per-capita real income, respectively, and w is the fraction of aggregate wealth in non-human form. From the money demand function, Friedman maintained that an increase in the expected earnings from different assets R_b, R_e, G_p, can lead to a reduction in the amount of money demanded. Also, he argued that a rise in wealth increases the demand for money. In the reaffirmation of the quantity theory of money, Friedman emphasized that both supply and demand for money are independent of each other. He further stressed that the unstable nature of money supply is caused by the actions of the monetary authorities but believed demand for money to be stable. This theory is related to the desire of people to hold money in cash or bank deposits, which, according to Friedman, is connected to people's permanent income.

Amidst, increase in supply of money through the purchase of securities by central bank, increases holding of money in relation to increased permanent income of people. Consequently, this will result to increase in spending (i.e. excess holding of money) partly on assets and, consumer goods and services, and in turn reduces their money balances and most likely raises the nominal income. On the contrary, a reduction in money supply by the apex bank through the sales of securities will reduce the holdings of money by buyers. Hence, this reduction in money holding could be raised partly by selling assets and reducing consumption expenditure on goods and services and in turn

reduce nominal income. Thus, on both counts, the demand for money remains stable. According to Friedman, a change in the supply of money causes a proportionate change in the price level, income or in both. Given the demand for money, it is possible to predict the effects of changes in the supply of money on total expenditure and income. If the economy is operating at less than full employment level, an increase in the supply of money will raise output and employment with a rise in total expenditure, though he pointed that this could only be possible in the short run.

Over time, Friedman's perception of on the quantity theory of money has led to much argument and, consequently, led to the emergence of many studies, including the works of Keynesians and the monetarists. Friedman's conclusion regarding demand elasticity for money, which was based on the argument that interest rates increase on time deposits, results in an increase in demand for time deposits with commercial banks (M_2) and a corresponding decrease in demand for currency and demand deposits (M_1). But this analysis was perceived as weak by Keynesians and Monetarists on the grounds that Freidman did not account for the alterations in the interest rate that may occur between the long and short terms. This school of thought argued that in a situation where demand deposits (M_1) are used, a short-term rate is preferable to a long-term rate, which is most suitable with time deposits (M_2), believing that the arrangement of interest rate could influence the demand for money. They further reiterated that Friedman's theory of money is weak and baseless and pointed to other issues, such as his consideration of money as a luxury good and giving priority to wealth indicators other than income and operation of wealth. Although he was properly guided by Johnson, who saw income as a return on wealth, he argued that the present value of income is wealth. In addition, another point that attracted attention was the claim that supply of money is exogenously determined, suggesting that instability of money supply is due to the influence of monetary authorities. But the monetarists contradicted Friedman with the proposition that supply of money is not exclusively exogenous. They stated:

"In the United States the money supply consists of bank deposits created by changes in bank lending. Bank lending, in turn, is based upon bank reserves which expand and contract with (a) deposits and withdrawals of currency by non-bank financial intermediaries; (b) borrowings by commercial banks from the Federal Reserve System; (c) inflows and outflows of money from and to abroad; and (d) purchase and sale of securities by the Federal Reserve System. The first three items definitely impart an endogenous element to the money supply."

However, despite these criticisms, Friedman's conception of demand for money remains the bedrock of other theories because the significance of the theory is realistically based on the understanding of the integration of wealth and income and its influence on human behavior. Friedman's theory could be termed the most vital and significant development of monetary theory since the general theory propounded by Keynes. The theory as postulated by Friedman differs from the one put together by Keynes in many ways. First is the broader definition of money as pointed out earlier. From Friedman's side, money was treated as an "asset or capital good" which could serve as a temporary purchasing power, while the Keynesian view of money was from the angle of "demand deposits and non-interest-bearing debt of the government". However, in a real sense, it seems that the perception of Keynes was more realistic than that of Friedman. In the view of Keynes, economic activities may be indirectly affected by monetary changes through alterations in bond prices and interest rates, while Friedman believed that monetary changes directly affect prices and production of all goods. Regarding the differences on the purpose of holding money balances, Keynes believed people hold money for transactions, as a precautionary measure and for speculative motives, while Friedman argued and believed that people hold money for a variety of reasons other than those given by Keynes. He added that motives for holding money could include the intentions of purchasing physical assets, human wealth, general preferences, tastes and anticipations. Thus, the theory of money demand is encompassing and has generated ideas and understanding and determined the relevance of money in our society.

3. REVIEW OF EMPIRICAL LITERATURE

Given the controversy surrounding the theory of demand for money, a lot of research has been carried out but with mixed findings. Some of these studies, such as Onakoya and Yakubu (2016),investigated the stability of money demand function in Nigeria. Using annual time series data for the periodfrom1992 to 2014, and multiple regression analysis, the study revealed that money demand function was stable during this period. Further investigation showed that instability of some parameters at a given point showed stability. Following the outcome of the findings, it was concluded that, in Nigeria, the broad money demand function is stable for the period of the study. In a study on the impact of official and black market exchange rates on money demand in Nigeria, Ogbonna (2015)used monthly data from 2005 to 2013 to estimate the variants of the money demand model. With the aid of a stability test approach, and cointegration and system equation techniques, the study revealed that the public sector demanded a greater percentage of foreign exchange, while the official exchange market supplied a large proportion of foreign exchange needed by the private sector due to substantial differences in the rate in Nigeria. On the other hand, Imimole and Uniamikogbo (2014)explored the stability of the broad money demand function in Nigeria. The study adopted the ARDL bounds testing technique in order to analyze the possibility of a macroeconomic environment influencing the demand for real broad money with emphasis on when the 1986 structural adjustment program (SAP) was introduced in Nigeria. The study was extended to investigate if the M_2 choice was a feasible instrument for a policy to support money demand function stability. The findings showed a long-run relationship between M_2 money aggregate and its determinants during this period. The findings also suggested that M_2 was stable during the period evidenced in the outcome of CUSUM and CUSUMQ tests.

In addition, the role of monetary authority in controlling real cash through money supply in Nigeria was investigated by Aiyedogbon et al. (2013). They found evidence that the apex bank in Nigeria has power to determine the supply of money and put essential measures in place to control pressure from inflation. Furthermore, an extension of the study with the cointegration and vector error correction model techniques showed that inflation rate, openness and interest rate were negatively related to money demand function. The study also revealed that government expenditure, exchange rate and gross capital formation were positively related to demand for money function in Nigeria. In similar studies in other countries around the globe the results varied, though the objectives of these studies also varied. Anwar and Asghar (2012)investigated if demand for money in Pakistan was stable or not, and as well analyzing the long-run relationship between demand for money, real income, inflation rate and exchange rate with the adoption of the autoregressive distributed lag model, which revealed that monetary aggregate, M_2 particularly, is cointegrated with its determinants. The study also found that in the long run, M_2 and its determinants seem to be stable. Hence, it was suggested that policy makers and authorities should only focus on a long-run stabilization policy in Pakistan. Using a sample period from 1959–60 and 1977–78 and an aggregate approach, Khan (1980) study on demand for money in Pakistan had no significant difference. Effort was made to confirm the results by adopting a disaggregated method in the estimation of demand for different components of money. However, the results were found to be similar with that of the aggregate approach. Furthermore, Khan (1992) extended the study by comparing the determinants of money demand in Pakistan and India from 1967 to 1987. The focus of the study was to measure the effect of interest rate, income and price level on money in the two countries. His findings showed that income was significantly related to demand for money (M_2) in both countries, but interest rate was found to be insignificantly related to demand for money (M_1) in Pakistan. Other variables, such as inflation rate, positively and significantly influenced demand for money in both countries. Similarly, Khan (1994) further tested demand for money in Pakistan using cointegration and error correction techniques in the analysis of quarterly data that covered the period from Q1 1971 to Q2 1993. Here, he extended the previous study by investigating financial reform influence on demand for money. From the findings, he revealed a cointegrated M_2

monetary aggregate, real interest rates, real income, nominal interest and the inflation rate. A similar result was found when he tested the relationship between M_1 and other variables included in the study.

Teriba (1974) critically re-examined the works of Tomori (1972). He believed that Tomori's analyses were weak, sohe re-specified the money demand model adopted by Teriba and carried out an evaluation by adopting a double log specification and static ordinary least squares (OLS) technique with annual data that ranged from1958 to 1972. The study showed that the civil war period had no significant effect on demand for money. It also revealed that the income elasticity of demand deposit is highly significant, while interest rate is not. Also reacting to Tomori (1972),Ajayi (1974) faulted his methodology and made reference to his conclusion regarding M as a narrow definition of money, which he assumed performed better than a broad definition of money denoted by M*. According to Ajayi (1974), the perception that "M performs better than M*" is baseless. He argued that "M" should have been interpreted within the context of institutional realities. Hence, Ajayi (1974) findings suggest that income only explains about 81% of demand for money, especially when a narrow definition of money is used, instead of 85% to 86% when the broad money definition is used. From the findings, he concluded that the elasticity of demand for money is very low. He equally noticed that money demand is not sensitive to interest rate changes in the short term. Taiwo (2012) studied the implications of the effectiveness of demand for money on economic performance in Nigeria from 1970 to 2008 using the OLS method. He concluded that money demand has a major effect on the aggregate demand, which accounts for the GDP of the economy. His results showed that by ensuring efficiency in the demand for money, aggregate demand would be achieved along with adequately sustained growth to ensure that minimum inflation will be achieved in the economy.

Tang (2007) investigated the money demand function for Southeast Asian countries, namely Indonesia Malaysia, the Philippines, Singapore and Thailand using the ARDL approach. S Apart from the conventional determinants of money, such as interest rate variables and exchange rate, the study considered the major components of private and government sector expenditure on investment goods and consumption, as well as exports as scale variables. The results found that exchange rate, real M_2 aggregate, real expenditure components, and inflation rate were cointegrated for Malaysia, the Philippines and Singapore. The statistical significance of real income components suggests bias when using the single real income variable in the money demand specification (M_2 aggregate) for both short and long runs. The CUSUM and CUSUMSQ tests showed that the estimated parameters are stable for the Southeast Asian economies, except for Indonesia, which was based on a short-run specification.Budha (2011)used annual data to analyze the money demand function for Nepal during the period from1998 to 2010. The cointegration tests showed a long-run relationship between determinants of real money balances, interest rate and output and real money balances. However, the vector error correction model showed the short-run relationship between real money balance and its determinants. In addition, the dynamic ordinary least squares(DOLS)estimation of the money demand function proved that the signs of the output and interest rate coefficients were discovered to be compliant with the assumption of the money demand laws.

Lungu, Simwaka, Chiumia, Palamuleni, and Jombo (2012) used monthly data to study the money demand function for Malawi for the period between 1985 and 2010. It was observed that several structural changes occurred in Malawi's economy during this period. The structural adjustment programs of the mid 1980s, numerous political developments in the 1990s and policies made in the financial sector were some of the factors responsible for these changes. Also, there has been an increase in economic activity measured by strong growth in real GDP since 2002 and the financial innovations within the banking system introduced after 2000. The study did not find these factors to have any influence on the stability of the demand for money, hence increasing the probability of success for the conduct of monetary policy. Cointegration test results indicated a long-run relationship amongst real money balances, treasury bill rate, income, exchange rate, prices and financial innovation. The study recommended that short-run policy must be directed at increasing financial innovations, opening market activities and improving the

productivity of the economy to provide higher return on alternative investments. In Pakistan, dynamic demand for money function that covered the period from 1960 to 1999.was estimated by Qayyum (2005). The study revealed a long-run relationship between M_2, real income, rate of inflation, call money rate and government bond yield. Further investigation indicated income and interest rate as significant determinants of money demand function in the short-run. The study concluded that a stable model is preferred to a money demand model for policy analysis in Pakistan as it passes the stability test. Analyzing the impact of exchange rate changes on money demand for seven Asian countries from 1973 to 2009, Arize and Nam (2012)showed that exchange rate and domestic interest rates are positively related, but further investigation revealed that they are negatively related to money demand in all the countries. Thus, the studies concluded that broad money should be the main focus of the monetary authorities in all the countries studied in order to achieve their desired objectives.

4. METHODOLOGY AND DATA SELECTION

Broadly speaking, an ARDL model can be used to test for cointegration and can estimate long-run and short-run dynamics. The model allows us to determine what the effects are of a change in a policy variable. The model of the form used is as follows:

$$y_t = \beta_0 + \beta_1 y_{t-1} + \ldots + \beta_p y_{t-p} + \alpha_0 x_t + \alpha_1 x_{t-1} + \ldots + \alpha_q x_{t-q} + e_t \quad (3)$$

Here, e_t is a random disturbance term. The model is dubbed autoregressive because y_t is explained, in part, by the lagged values of itself. It also has a distributed lagged component in the form of successive lags of the X explanatory variables. We take $y_t$and x_t to be stationary variables and e_t as a white noise process.

The general specification of money demand in most macroeconomic literature postulates money demand as a function of income and interest rate. However, the conventional money demand function is extended by introducing exchange rate and inflation rate. Mundell (1963) suggested that exchange rate should be included in the standard money demand function to take the currency substitution phenomenon into account. Against this background, this research postulates an open economy money demand function, which relates real money balance as a function of real income, interest rates, inflation rate and exchange rate. To efficiently establish the determinants of money demand in Nigeria, Equation 4 is transformed into the ARDL model as indicated in Equation 5. Hence, it shows the linear relationship between money supply (LM) and other indicators, such as inflation ($INFL$), real exchange rate ($REXR$) and real gross domestic product ($RGDP$) growth.

$$LM_t = \alpha_0 + \alpha_1 LRGDP_t + \alpha_2 I_t + \alpha_3 INFL_t + \alpha_4 LREXR_t + \mu_t \quad (4)$$

whereLM_t; is the log of real money balance demanded proxied by money supply (M_2/CPI), $LRGDP_t$; Log is the log of real gross domestic product, $LREXR_t$; is the log of real exchange rate, I; is the deposit rate, $INFL_t$;is the inflation rate, and μ_t; is the white noise or stochastic term. RGDP is expected to have positive elasticity with money demand. This is because the higher the income the higher the money demand because people will want to increase their spending in relation to an increase in income. Deposit rate is expected to have a negative relationship with money demand due to the fact that an increase in the interest rate offered to savers will result in a lower money demand from the banks. Inflation rate is expected to have positive elasticity with money demand. The higher the rate of inflation expected, the more people will tend to spend their money rather than save it for the future where the real value of money will reduce due to inflation. Real exchange rate is expected to have either a positive or a negative elasticity with money demand. According to Lungu et al. (2012), if the increase in exchange rate (depreciation of domestic currency) is perceived as an increase in wealth and leads to a rise in domestic money, the coefficient of exchange rate is positive, but if the increase in exchange rate leads to a decrease in domestic money demand (currency substitution), then the coefficient of exchange rate is negative as people will hold more foreign currency and less domestic currency. The ARDL model stipulated by Pesaran., Shin, and Smith (2001),as shown in Equation 3,is further established in Equation 5 using the key variables for the study.

$$\Delta LM_t = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta LM_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta LRGDP_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta I_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta INFL_{t-i} + \sum_{i=0}^{n} \alpha_5 \Delta LREXR_{t-i} + \beta_1 LM_{t-1} + \beta_2 LRGDP_{t-1} + \beta_3 R_{t-1} + \beta_4 INFL_{t-1} + \beta_5 LREXR_{t-1} + \quad (5)$$

Δ stands for the first difference operator, α_0; is the drift parameter and $e_t$is stands for the white noise residuals. Other variables remain as defined above. Equation 3 is what Pesaran and Shin (1999) referred to as a conditional error correction model. The left-hand side is the demand for money; parameters $\alpha_1 - \alpha_5$ represent the short-run dynamics of the model, while parameters $\beta_1 - \beta_5$ represent the long-run relationship in the model. To obtain the short-run effects of the variables on money demand, the following restricted error correction model was used:

$$\Delta LM_{t-i} = \alpha_0 + \sum_{i=1}^{n} \alpha_1 \Delta LM_{t-i} + \sum_{i=0}^{n} \alpha_2 \Delta LRGDP_{t-i} + \sum_{i=0}^{n} \alpha_3 \Delta I_{t-i} + \sum_{i=0}^{n} \alpha_4 \Delta INFL_{t-i} + \sum_{i=0}^{n} \alpha_5 \Delta LREXR_{t-i} + \lambda ECM_{t-1} + e_t \quad (6)$$

where λ is the error correction term that explains the speed of adjustment, which shows how much the short-run disequilibrium is corrected in each period. In addition, the model was tested for stationarity using the augmented Dickey–Fuller and Phillips–Perron tests as stated earlier. The model makes use of secondary time series in the form of quarterly data from Q11981 to Q42018, which were sourced from the Central Bank of Nigeria's statistical bulletin from various years. The autoregressive distributed lag model was originally introduced by Pesaran and Shin (1999) and was further extended by Pesaran. et al. (2001). The bounds test method of cointegration has certain econometric advantages in comparison to other methods of cointegration, which include the assumption that all variables of the model are endogenous; the application of the bounds testing method for cointegration irrespective of whether the variable is integrated of either order I (0) or I (1); the simultaneous estimation of short-run and long-run coefficients of the model; and the use of different optimal lags for different variables in estimating the model. Also, since the aim of any monetary policy is to achieve exchange rate and price stability, monetary authorities target stability of price.

5. RESULTS AND ANALYSIS

The results of the augmented Dickey–Fuller (ADF) and Phillips–Perron (PP) tests for the variables are shown in Table 1 below. The null hypothesis will be rejected when there is presence of unit roots in a variable. This occurs if the ADF or PP test statistic is greater than the critical values. The evidence from the results presented in Table 1shows that all the variables are stationary at order one, which suggests that the variables have no unit root. In addition, these results show the likelihood of a long-run relation, which means that they move together in the long-run.

Table1. Stationarity Test.

Variable	ADF-Stat	5%Critical Value	PP Stat	5% Critical Value	Order of Integration
LM	-2.964883	-2.885249	-4.651675	-2.884477	I(1)
LRGDP	-3.137439	-2.885249	-5.629350	-2.884477	I(1)
I	-2.073134	-1.943563	-6.122921	-2.884477	I(1)
INFL	-3.704671	-2.886074	-5.352268	-2.884477	I(1)
LREXR	-7.202355	-2.884477	-7.032880	-2.884477	I(1)

Note: All variables are integrated of order one.

Using two information criteria, the Schwarz Information Criterion (SIC) and Akaike Information Criterion (AIC), we determined the optimal lag length needed for the model, which is shown in Table 2 below. Following Pesaran. et al. (2001), the optimal lag length selection criteria test was performed to determine the actual lag order

for the estimation of the ARDL model. The basic criteria for selection, the SIC and the AIC, indicated that the optimal lag order of five (5) was suitable for the study.

Table2. Lag Selection Order Criteria.

LAG	AIC	SIC
0	-4.587758	-4.354218
1	-4.903138	-4.646244
2	-4.919617	-4.639369
3	-4.904753	-4.601151
4	-4.927411	-4.600455
5	-5.012906*	-4.662596*

We investigated for autocorrelation in the model using the Lagrange multiplier (LM) test. The results are shown in Table 3. The null hypothesis of no serial correlation is rejected if the probability is less than 0.05 and is accepted otherwise. However, this test enables us to determine the relationship between a given variable in the model and a lagged version of itself over various time intervals. It also measures the relationship between a variable's current value given its past value. The understanding of the presence of autocorrelation is that it produces biased estimated variances of the regression coefficients, leading to unreliable hypothesis testing. Thus, since 0.0959>0.05, the null hypothesis of no serial correlation is accepted (see Table 3).

Table3. Autocorrelation Test.

Variable	Coefficient	Std. Error	t-Stat.	Prob.
RESID(-1)	-0.399797	0.238001	-1.679810	0.0959

Note: There is no autocorrelation in the model at residual lag 1.

Figure 1 presents the dynamic stability of the ARDL model. The results of the test are important to determine if ARDL approach is suitable for the estimation of the study. The stability of the model is important to know if it is to be used for forecasting. The condition for stability of variables in the model, as shown in Figure 1below,is that all eigenvalues must lie inside the circle. The graphical representation of the results of inverse roots of AR/MA polynomial (s) shown in Figure 1, show that the model is stable and can be used for forecasting.

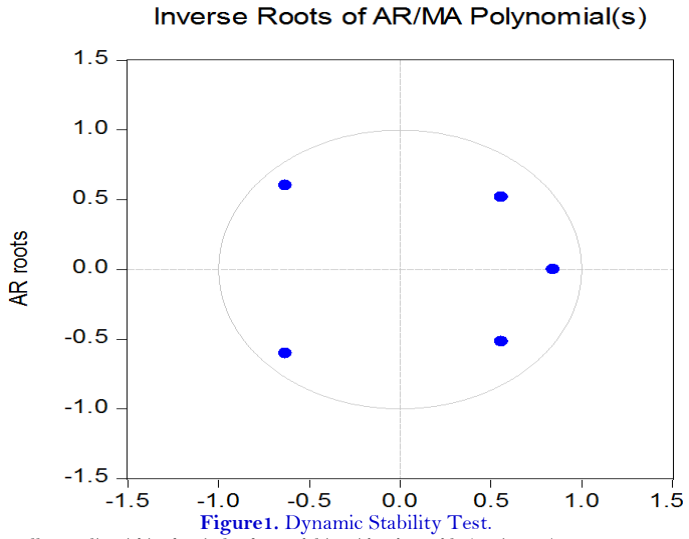

Figure1. Dynamic Stability Test.

Note: Since all roots lie within the circle, the model is said to be stable (stationary).

The bounds test was carried out to establish the long-run relationship among the variables using the Wald test, as suggested by Pesaran. et al. (2001),and the results are shown in Table 4 below. The null hypothesis, which states that the model is not cointegrated, will be rejected if the F-stat is less than the upper bounds F-critical value. The

results reported in Table 4 show that F-stat (4.154056) is greater than the upper bounds (4.01) value, suggesting the rejection of H_0. Thus, we concluded that there is a long-run relationship between the variables in the model.

Table4. Bounds Testing for Cointegration (Wald Test).

No. of parameters	F-Test Stat	F-Critical Value (5%)		Prob.
		Lower Bounds	Upper Bounds	
4	4.154056	2.86	4.01	0.017

Note: Since the F-stat is greater than the upper bounds F-value, we reject H_0 and conclude that there is a steady, long-run relationship among the variables.

In order to avoid other problems, such as heteroscedasticity, multicollinearity and serial correlation issues in the model, Newey–West heteroscedasticity and autocorrelation corrected (HAC) standard errors and covariance were adopted in the estimation.

Table5. ARDL Estimation Results.

Long-Run Coefficients

Variable	Coefficient	Std. Error	T-Stat.	Prob.
LRGDP	2.279173	0.123154	-7.663448	0.0000
I	-0.069670	0.007630	12.45876	0.0000
INFL	0.005068	0.001501	-7.143957	0.0010
LREXR	0.513570	0.026654	13.16525	0.0000
CONSTANT	-17.35121	1.537550	3.754371	0.0000

Note: **R^2** = 0.985573; **DW** = 0.109182; **F-Stat** = 2169.956; **F-stat (Prob.)**= 0.0000.

Table6. Unrestricted Error Correction Model (full long-run impact).

Variable	Coefficient	Std. Error	T-Stat	Prob.	LR Impact
LM(-1)	-0.009101	0.007910	-1.150695	0.2524	
LRGDP(-1)	0.012093	0.020962	0.576875	0.5652	1.32875508
I(-1)	0.001144	0.000896	1.277633	0.2041	0.12570047
INFL(-1)	-0.000393	0.000133	-2.957408	0.0038	-0.04318207
LREXR(-1)	0.010172	0.004223	2.408635	0.0177	1.11767938

Note: R2 = 0.650667 DW= 2.128919 F-Stat =17.098 F-stat (prob.) = 0.0000.

From the results presented in Tables 5and 6 above, the full long-run (LR) impact of the variables' elasticities on the dependent variable can be seen. From the results in Table 5, RGDP has a positive and significant impact on real money balance demand. This suggests that a percentage increase in RGDP may result in a 2.28% increase in real money demand. The full long-run impact is a1.33% increase given a percentage increase in RGDP.

Table7. Short-run Coefficients.

Variable	Coefficient	Std. Error	T-Stat.	Prob.
C	0.012436	0.004717	2.636467	0.0096
D(LM(-1))	0.702209	0.091020	7.714933	0.0000
D(LM(-2))	0.185281	0.095714	1.935771	0.0554
D(LM(-3))	0.066359	0.097166	0.682949	0.4961
D(LM(-4))	-0.529002	0.095768	-5.523792	0.0000
D(LM(-5))	0.402322	0.091793	4.382945	0.0000
D(LRGDP(-1))	-0.169804	0.112326	-1.511717	0.1334
D(I(-1))	0.001937	0.002854	0.678577	0.4988
D(INFL(-1))	-0.000315	0.000369	-0.853975	0.3950
D(LREXR(-1))	-0.005470	0.015289	-0.357768	0.7212
W(-1)	-0.013226	0.007834	-1.688354	0.0942
R^2 = 0.607957	DW =2.068441	F-Stat = 19.76393	F-stat (prob.) = 0.0000	

However, the long-run impact is insignificant. Inflation (INFL) has a positive and significant relationship with money demand, which conforms to our a priori expectation that an increase in inflation will cause people to demand

more money and more goods. This implies that a unit increase in INFL will result in a 0.0051 increase in money demand. We observed a decrease in the long-run impact by 0.043%, and deposit rate had a negative and significant impact on money demand. Hence, a unit increase in the nominal deposit rate will cause money demand to reduce by 0.07% thus conforming to our a priori expectation. The full long-run impact, however, shows that an increase in the deposit rate by 1% will lead to a 0.13% increase. In addition, an increase in REXR by 1% could lead to a 0.51% increase in money demand, meaning that an increase in exchange rate is perceived as an increase in wealth. The full long-run impact of an increase in LREXR is an increase in money demand by 1.12%. The residuals in the model are also normally distributed with a Jarque–Bera coefficient of 0.05, which is tending towards zero.

Since the error correction term (w (-1)) is not significant, it implies that the model does not adjust to equilibrium in the short run. A possible reason for this could be that, in the face of policy adjustments, a significant percentage of the disequilibrium between money demand and its determinants is not corrected within three months.

6. POLICY IMPLICATIONS AND SUMMARY

From the results, it was found that income elasticity is greater than unity. This implies that the velocity of money falls in the long run and that money demand is relatively stable. The Nigerian economy, at present, is riddled with financial reforms that take place only on the pages of the dailies, breaking down at the juncture of implementation. For example, even a layman with a hazy knowledge of the subject knows that the cashless policy reform of the recent past has largely stuttered due to the lack of adequate technology to implement it. This fact and others combine to make the velocity of money in the economy predictable. As such, the CBN can target money supply to regulate income and price levels. The classical dichotomy is a reality in the Nigerian economic scene. Evidence from the results also shows that interest rate fluctuations strongly affect money demand. Over the years, Nigerian banks have paid a paltry rate of interest on savings and time deposits, but in recent times the situation has improved due to the bank consolidation policy initiated by the apex bank in 2004. This policy idea jettisoned dying banks from the banking industry. Furthermore, currency substitution is usually prevalent in most developing economies like Nigeria's. The coefficient of the exchange rate from the result also suggests this. Nigeria has got active speculators in the foreign exchange, or forex market, waiting to cash in on exchange rate differentials. Hence, currency substitution is a threat to the stability of the domestic economy.

In summary, we have sought to examine the peculiarities of money demand in Nigeria and show a clear understanding of the money demand function, which is imperative for the implementation of monetary policy, especially with regard to a monetary targeting framework. As such, we opted for the ARDL model to analyze the impact of the lags of both the dependent variable and the current and past values of the explanatory variables on real money demand. In this study, real money demand, which served as our explained variable, was proxied with broad money (M_2), and the selected explanatory variables included inflation rate, interest rate, real exchange rate and real gross domestic product, which was extracted from the CBN statistical bulletin from various years. Even in the presence of the versatility of the bounds testing approach, as suggested by Pesaran. et al. (2001),and before the post estimation, all the variables were subjected to stationarity conditions to investigate if there is a long-run relationship among them. As long as none is I(2), the ARDL model is suitable for the estimation. Upon the application of the bounds testing methodology, we found our variables to be cointegrated. This gave us the leverage to estimate a regression of the variables at level and specify an ECM model to pin down short-run issues. However, the long-run impact of our explanatory variables was seen from the estimated unrestricted error correction model. The adjustment in the short run for disequilibrium correction is insignificant. The empirical conclusion, therefore, is that the velocity of money in the economy is predictable and, as such, the CBN can target money supply to regulate income and the price level in the economy.

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