Empirical Analysis of Money Demand Function in Nigeria: 1986 – 2010

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Abstract

The paper investigates the role of monetary authority in its control of real cash balances through money supply. If money demand in Nigeria is stable the Central Bank of Nigeria can predict the level of money supply and there will be no inflationary pressure in the economy. The empirical analysis of the study involves application of tests for co-integration and vector error correction model. A test of stability was also conducted. The variables of the study are real money demand function (MD), gross capital formation (GCF), interest rate (INT), inflation rate (INF), exchange rate (EXR), government expenditure (GEX) and openness of the economy (OPE)) and co-integration test revealed long run equilibrium relationship. In the long run, it was discovered that interest rate, INF and OPE have negative impact on MD while the impact of GCF, EXR and GEX on the other hand are positive on MD in Nigeria. In the short run, lag values of MD, GCF, INT and EXR have negative relationship with current MD while the impact of INF and OPE are positive. The test of stability shows that real money demand function in Nigeria is stable as neither the CUSUM nor the CUSUMSQ plots cross the 5 percent critical boundaries. The study recommended that there should be a clear cut distinction between short run and long run objectives as the monetary authority, for example, can use inflation to reduce the level of money demand in the long run and increase it in the short run.

Key Words: Stable Money Demand Function, Money Supply, Monetary Policy, Co-integration and Vector Error Correction Model

I. Introduction

The level and stability of the demand for money has recently received enormous attention in the literature because an understanding of its causes and consequences can usefully inform the setting of monetary policy. The demand for money is found to be a major determinant of liquidity preference. When money demand (which is the people preference for cash instead of assets) is stable, the central bank can reasonably predict the level of money supply in the economy. Poole (1970) argued that the rate of interest should be targeted if liquidity preference is unstable while the money supply should be targeted if the investment-savings relationship is unstable and the demand for money is stable. It is therefore, necessary to select the correct monetary policy instruments since selecting the wrong instruments may result in large fluctuations in output.

Since the 1980s countless deregulation and liberalization policies, Central Banks in many advanced economies switched between instruments of monetary policy by moving away from policies that influence the money supply towards those which influence the bank rate. A large number of developed country case studies show that the demand for money has become unstable due to financial reforms and hence support the targeting of the rate of interest by central banks (Maki and Kitasaka, 2006; Caporale and Gil-Alana, 2005).

The Central banks in many developing economies have followed suit and switched towards monetary policies directed at the bank rate. A major part of this policy switching is grounded on the view that their own financial market reforms and liberalizations might have contributed to the instability in their own money demand functions. However, recent studies have raised doubts about the validity and strength of Central Bank interest rate targeting in developing economies (Bahmani-Oskooee and Rehman, 2005; Rao, et.al., 2009).It is argued that the choice of bank rate as an instrument of monetary policy may result to stable money demand as against financial markets liberalization perceived by industrial economies before the recent financial meltdown. If that is the case then it would be proper to test the stability of money demand in the developing economies like Nigeria. Few studies in Nigeria have been conducted on the stability of money demand function in Nigeria particularly since the 1986 structural policy shift (Owoye and Onofowora, 2007). Several variables were modeled in these studies in which many of them agreed that money demand in Nigeria is stable. However, none attempted to open up the Nigerian economy in their submissions.

Nigeria instituted the IMF's Structural Adjustment Program (SAP) in 1986 with the aim of putting the economy on the path towards a drastic reduction in international debt; sadly this program was abandoned in 1988. Such economic and political structural changes exerted significant influence on a range of economic relationships. These included high inflation rate, structural unemployment and decline in productivity and high interest rate. Presently, interest rate has been on the increase and thus small scale enterprises have not been able to obtain loanable funds resulting in declining economic activities while prices are continuously rising. This has resulted in under capacity utilization, closure of many business premises; and general low economic activities.

These challenges have been attributed to reckless and poor management of monetary policy coupled with large scale corruption in the country. The gap between policy pronouncements and implementation has been increasing. Transparency and accountability in the use of public resources have been lacking. Monetary policies are unstable and inconsistent. There are serious resource constraints and uncertainties as well as considerable delay in policy implementation. All these often make it difficult for the monetary authority to target a stable money demand function for Nigeria. In addition, government fiscal recklessness resulted in deficit financing and this has caused inflation which contradicts the fundamental monetary policy objective of price stability. This has the potentials of destabilizing the macro-economic environment thereby retarding economic productivity and development and the difficulties of conducting monetary and fiscal policies in a deregulated environment and in an era of globalization (Ohwofasa and Mayuku, 2012; Mayuku, et al. 2012).

Thus, the objective of this paper is to empirically identified the determinants of money demand in Nigeria by incorporating the foreign sector as part of global economy and test for the constancy of money demand function to ascertain its stability or otherwise. The rest of the paper is structured as follows. Section two undertakes brief review of related literature. In section three, the method of study is unveiled while section four presents results of findings. Finally, section five concludes the study with policy remarks.

II. Concept of Money Demand

Defining the money demand function is a central concern for monetary policy authority because the combination of money supply and money demand determines interest rates, and therefore affects the goals of monetary policy. By definition, demand for money is a situation in which the citizens prefer to hold their cash balances instead of assets. This is referred to as the liquidity preference.

A stable money demand allows for better predictions of the effects of monetary policy on interest rates, output, and inflation, and therefore reduces the possibility of an inflation bias (Cziraky and Gillman, 2006). Stable money demand is a precondition for an effective monetary policy, especially for countries pursuing a monetary targeting framework.

Since the SAP in 1986, the Nigerian economy has undergone a number of important structural and institutional changes which included (a) the liberalization of the external trade and payment systems, (b) substantial degree of financial deepening and innovations in the banking sector, (c) the adoption of a managed float exchange rate system, (d) the dismantling of price and interest rate controls, (e) changes in monetary policy, and (f) the reliance on market determined indirect instruments of monetary policy (Owoye and Onafowora, 2007). These developments may have altered the relationship between money, income, prices and other key economic variables, and may have caused the money demand function to become structurally unstable. Consequently, determining whether the financial reforms undertaken under the SAP have impacted the money demand relationship is important to the effective formation and implementation of monetary policy in Nigeria. Issues related to the behavior and stability of the money demand relationship have assumed greater urgency since the broad monetary aggregate officially became the intermediate target for policy with the CBN (Amendment) Decree Number 37 of 1998 (CBN Briefs, 1998).

Concept of Monetary Policy

Monetary policy is the process by which the central bank or monetary authority of a country controls the supply of money, availability of money, and cost of money or rate of interest to attain a set of objectives oriented towards the growth and stability of the economy (Nelson, 2008). It is the specific actions taken by the Central Bank to regulate the value, supply and cost of money in the economy with a view to achieving Government's macroeconomic objectives. For many countries, the objectives of monetary policy are explicitly stated in the laws establishing the Central Bank, while for others they are not (CBN, 2006). Monetary policy focuses on the relationship between the rates of interest in an economy, that is the price at which money can be borrowed, and the total supply of money. Monetary policy uses a variety of instruments to control one or both of these, to influence outcomes like economic growth, inflation, exchange rates with other currencies and unemployment. Where currency is under a monopoly of issuance, or where there is a regulated system of issuing currency through banks which are tied to a Central Bank, the monetary authority has the ability to alter the money supply and thus influence the interest rate to achieve policy goals.

Theoretical Literature

The theoretical underpinnings of the demand for money have been well established in the economic literature with widespread agreement that the demand for money is primarily determined by real cash balances. Keynes (1936) developed three motives for holding real money balances: transactions, precautionary and speculative motives. Following the emergence of liquidity preference theory, several authors have questioned Keynes's rationale for a speculative demand for money and have contributed to the theoretical literature by distinguishing broadly between the transactions demand.

Laidler (1977) points out that Keynes did not regard the demand for money arising from the transactions and precautionary motives as technically fixed in their relationships with the level of income and therefore emphasizes that the most important innovation in Keynes' analysis is his speculative demand for money. The primary result of the Keynesian speculative theory is that there is a negative relationship between money demand and the rate of interest. That is, in a period of high interest rate, people hold less cash and probably make more savings.

Friedman (1956) opposes the Keynesian view that money does not matter and presented the quantity theory as a theory of money demand. He modeled money as an abstract purchasing power (meaning that people hold it with the intention of using it for upcoming purchases of goods and services) integrated in an asset and transactions theory of money demand set within the context of neoclassical consumer and producer behavior microeconomic theory. Friedman argued that the velocity of money is highly predictable and that the demand for money function is highly stable and insensitive to interest rates. This implies that the quantity of money demanded can be predicted accurately by the money demand function.

Chuku (2009) argues that the economic environment that guided monetary policy before 1986 was characterized by the dominance of the oil sector, the expanding role of the public sector in the economy and over-dependence on the external sector. In order to maintain price stability and a healthy balance of payments position, monetary management depended on the use of direct monetary instruments such as credit ceilings, selective credit controls, administered interest and exchange rates, as well as the prescription of cash reserve requirements and special deposits.

During this period of indirect monetary control, CBN's monetary policies focused on fixing and controlling interest rates and exchange rates, selective sectoral credit allocation, manipulation of the discount rate and moral suasion. Reviewing this period, Omotor (2007), observes that monetary policy was ineffective particularly because the CBN lacked instrumental autonomy and goal determination, being heavily influenced by the political considerations conveyed through the Ministry of Finance.

Al-Samara (2011) opines the analysis of money demand function is regarded as a key factor in conducting reliable strategy of monetary policy and selecting the suitable nominal anchor that monetary policy makers use to tie down the price level. The marvelous strides in monetary analysis showed why a nominal anchor, such as the inflation rate, an exchange rate, or the money supply, is such a crucial element in achieving the price stability. Continuing further, Al-Samara (2011) emphasizes that the choice of the intermediate target in the monetary policy strategy is one of the principal purposes of the Central Banks.

Empirical Literature

A number of studies, including Bahamani-Oskooee and Bohl (2000), Bahamani-Oskooee and Barry (2000), and Bahamani-Oskooee (2001), have examined the stability of money demand function in the context of cointegration analysis. Thus, Bahamani-Oskooee and Bohl (2000) analyzed the stability of M3 money demand function for Germany following the monetary unification. Their results indicated that M3 money demand function in Germany is not stable. Bahamani-Oskooee (2001) explored the stability of M2 money demand function in Japan and found that M2 money demand function is stable in Japan, since M2, real income and interest rate are cointegrated. Bahamani-Oskooee and Barry (2000), investigated the stability of the M2 money demand function in Russia. They found evidence of cointegration between the series in the system. While the plot of the cumulative sum of recursive residuals (CUSUM) provided evidence of stability, the plot of the cumulative sum of squares of recursive residuals (CUSUMSQ), on the other hand, revealed that M2 money demand function is not stable.

Al-Samara (2011), in his study in the analysis of money demand function in Syria found that real money demand M2 and its economics determinants are weakly cointegrated. On the other hand, stability test and error correction model have provided a support that money demand function is unstable in the Syrian economy, and this instability could be due to structural changes in the function. These findings support the choice of exchange rate as a nominal anchor for Syrian monetary policy to tie down the price level and achieve its stability.

Nell (1999) empirically evaluated the existence of a stable long-run demand for money function in South Africa over the period 1965-1997; given that after the adoption of money market-oriented monetary policy measures in 1980, South Africa Reserve Bank primarily relied on setting predetermined growth targets for M3. The empirical results suggest that M3 was stable while M1 and M2 display parameter instability. This suggests that M3 money stock could serve as an indicator for monetary policy for South Africa. Adam (1992) successfully established a series of single equation demand for money functions (*M0*, *M1*, *M2* and *M3*) for the Kenyan economy from 1973 to 1989. Application of the Johansen technique suggested that income elasticities of money demand were around unity for *M0* and slightly lower at around 0.8 for the other monetary aggregates; therefore he found that the demand for *M1* is stable.

Back home, Teriba (1974) is one of the earliest studies of money demand in Nigeria and probably the foremost to model demand deposit. Using a double log specification and static Ordinary Least Squares (OLS) technique with annual data from 1958-1972, the study reported a high significant income-elasticity of demand deposits in Nigeria while interest rates were not statistically significant. Anoruo (2002) explored the stability of the M2 money demand function in Nigeria in the SAP period and his results from the Johansen and Juselius (1990) cointegration test suggested that real discount rate, economic activity and real M2, are cointegrated. His CUSUM and CUSUMSQ stability test results indicated that the M2 money demand function in Nigeria is stable for the study period. The results of the study showed that M2 is a viable monetary policy tool that could be used to stimulate economic activity in Nigeria. Omotor and Omotor (2011), estimated an endogenous structural break date of the money demand for Nigeria for the period 1960-2008. Using the Gregory and Hansen (2007) procedure, an endogenous break date of 1994 was estimated for the cointegrating equation of the demand for money. The study also joins previous ones to affirm a stable money demand function for Nigeria and established that the CBN has effectively used money supply as a monetary policy instrument.

Ditimi *et al*. (2011) appraised monetary policy development in Nigeria and also examined the effect of monetary policy on macroeconomic variables for the period 1986 to 2009. The study adopted a simplified Ordinary Least Squared technique and the findings of the study showed that monetary policy had a significant effect on exchange rate and money supply and an insignificant influence on price instability. Nwaobi (2002) examined the stability of money demand for Nigeria using vector auto regression approach. His results confirmed a stable money demand function for Nigeria. Akinlo (2006), using an autoregressive distributed lag (ARDL) technique combined with CUSUM and CUSUMSQ tests, examined the cointegrating property and stability of broad (M2) money demand in Nigeria. The results showed M2 to be cointegrated with income, interest rate and exchange rate. The CUSUM test weakly reported a stable money demand for Nigeria. Omotor (2009), also applied the ARDL technique and equally found a stable money demand for Nigeria.

Owoye and Onafowora (2007), employed cointegration and vector error correction analysis to test the stability of the demand for real broad money (M2) in Nigeria over the quarterly period 1986:1 to 2001:4. Their empirical results indicated that there exists a long-run relationship between the real broad money aggregate, real income, inflation rate, domestic interest rate, foreign interest rate, and expected exchange rate. Furthermore, both the CUSUM and CUSUMSQ tests confirmed the stability of the short- and long run parameters of the real money demand function in Nigeria.

Performance of the Nigerian Economy

The performance of the Nigerian economy has not been very impressive judging from a number of indicators. Table1 below showed the real growth rate of the economy at 5.9 percent in 2000, declined to 4.6 percent in 2001 and further to 3.5 percent. It oscillated to all record high of 10.2 percent in 2003 and thereafter hovered from 6 to 7.9 percent between 2004 and 2010. A look at inflation rate revealed that apart from 2000 with 6.9 percent, 2006 with 8.2 percent and 2007 with 5.4 percent, other years recorded double digit growth.

The performance of money and credit also saw a fluctuation in their growth rate. For example, net domestic credit to the economy which recorded negative value of -25.3 percent in 2000 oscillated to 79.9 percent in 2001. The figure declined to the trough of 12.0 percent in 2004 but increased again to 414.6 percent in 2009 before declining to 63.4 percent in 2010. Credit to private sector ranges from 19.7 to 90.8 percent for the period 2000 to 2009 before declining to negative of -4.1 percent in 2010. Narrow money supply (M1) was 62.2 percent in 2000, declined to 8.6 percent in 2004 and oscillated thereafter reaching 55.9 percent in 2008 and in 2010, the figure stood at 10.6 percent.

Similarly, the growth rate of M2 stood at 48.1 percent in 2000 before declining to 14.0 percent in 2004. It oscillated to 57.8 percent in 2008 before declining to 6.7 percent in 2010.

Table 1: Selected Macroeconomic and Social Indicators

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Domestic Output and Prices											
Real growth rate (%)	5.9	4.6	3.5	10.2	6.1	6.2	6.0	6.5	6.0	7.0	7.9
Inflation Rate (%)	6.9	18.9	12.9	14.0	15.0	17.9	8.2	5.4	11.6	12.5	13.7
Gross Fixed Capital Formation (% of GDP)	12.2	8.8	10.2	8.8	16.2	12.0	8.3	9.2	8.3	12.1	11.2
Gross National Savings (% of GDP	23.1	19.3	19.5	25.7	15.3	19.4	29.9	15.8	27.9	15.6	28.0
Federal Government Finances (% of GDP)											
Retained Revenue	13.1	15.4	13.1	13.9	14.9	11.2	10.4	11.2	13.3	10.7	10.5
Total Expenditure	15.4	19.6	18.6	16.7	16.7	12.2	10.9	11.8	13.5	14.0	14.2
Money and Credit (Growth Rate %)											
Net Domestic Credit	-25.3	79.9	64.6	32.7	12.0	14.5	77.6	-36.1	42.3	414.6	63.4
Credit to Private Sector (CPS)	30.9	43.3	19.7	27.1	26.6	30.8	32.1	90.8	59.4	26.6	-4.1
Narrow Money Supply (M1)	62.2	28.1	15.9	29.5	8.6	15.5	32.2	36.6	55.9	3.0	10.6
Broad Money Supply (M2)	48.1	27.0	21.6	24.1	14.0	16.0	43.1	44.2	57.8	17.5	6.7
Financial Development Indicators (%)											
M2/GDP	-	-	-	-	-	-	21.5	27.7	37.2	42.7	38.9
CPS/GDP	-	-	-	-	-	-	14.3	24.1	32.7	40.5	59.8
Social Indicators											
Population (m)	115.2	118.8	122.4	126.2	129.9	133.5	140.0	144.5	149.1	153.9	158.8
Population Growth (%)	2.8	2.8	2.8	2.8	2.8	2.8	2.9	3.2	3.2	3.2	3.2
Umemployment (%)	-	-	-	-	-	-	12.3	12.7	14.9	19.7	21.1
Incidence of Poverty	70.0	70.0	70.0	54.4	54.4	54.4	54.0	54.0	54.0	54.0	54.0

Source: CBN Annual Report and Statement of Account (various issues)

Money Supply and Economic Development

The financial market in Nigeria is still underdeveloped and this has not help to quicken the level of economic development in Nigeria. The ratio of M1 and M2 to GDP is still shallow by all standards. A cursory look at M1 and M2 as a ratio of GDP revealed that the monetary authority (CBN) focused more attention on M2 for monetary targeting as a means of stabilizing money demand function and controlling inflation in Nigeria.

Thus, for the period under investigation, M2 has a higher GDP ratio than M1 counterpart. The growth of M1 ranges between 7 and 20 percent while M2 was between 13 and 40 percent respectively during the reviewed period.

Table 2 below contained the growth rate of GDP at both nominal and real value and a number of monetary variables while the average values are in parenthesis and bolded. In 1987, nominal GDP has a growth rate of 92.2 percent and the real GDP recorded a negative 0.6 percent. Thereafter, the nominal GDP declined in the following five years while real GDP experienced increased growth.

Fig 1: M1 as a Ratio of GDP

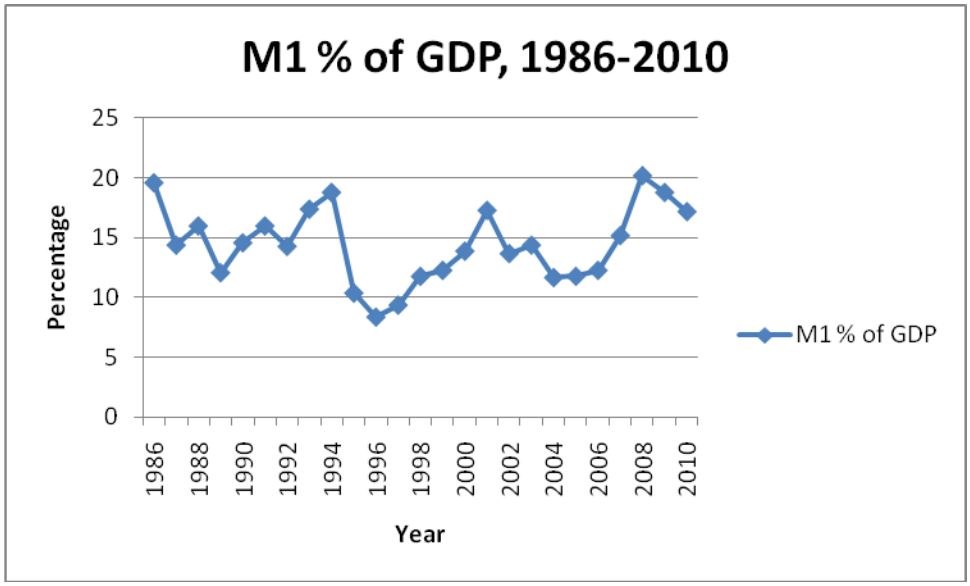
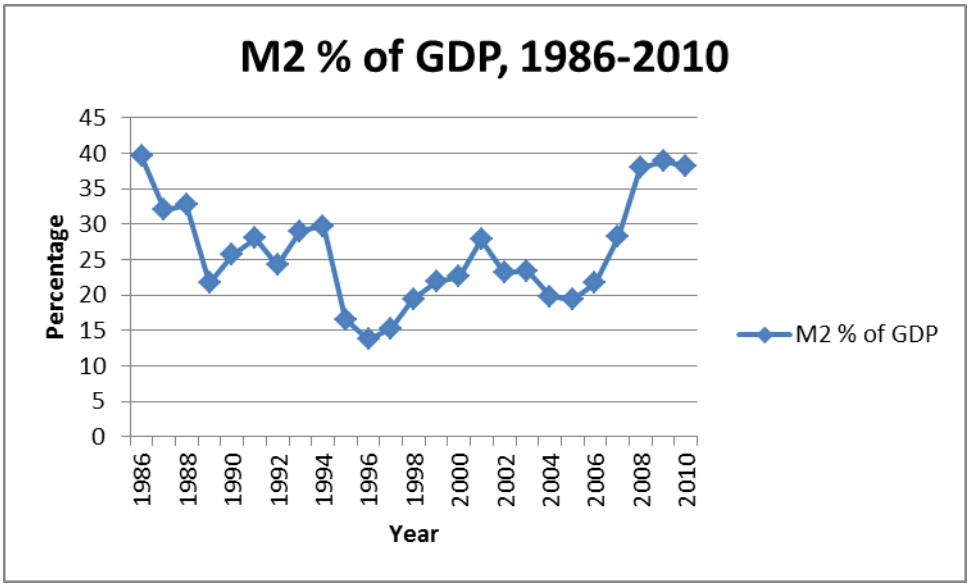


Fig 2: M2 as a Ratio of GDP, 1986-2010



In 1991, nominal GDP stood at 16.7 percent and an average growth rate of 44.1 percent for the period of 1987-1991while the average growth rate for real GDP in the same period was 3.9 percent. Nominal GDP oscillated astronomically to 70.6 percent in 1992 and reached all record high of 114.8 percent in 1995 with an average growth of 57.0 percent for the period 1992-1996 while real GDP recorded 2.5 percent in the same period. In the period 1997-2001, nominal and real GDP averaged 13.0 and 4.7 percent respectively. The growth rate increased to 31.7 and 10.9 percent for nominal and real GDP respectively between 2002-2006. Thereafter, it declined to the trough of 12.2 percent for nominal GDP and 6.1 percent for real GDP between 2007 and 2010.

Table 2: Growth Rate of Nominal/Real GDP and Monetary Variables, 1987-2010

Year	Basic GDP	Real GDP	M1	M2	Exchange Rate	Interest Rate	Inflation Rate	Lending Rate
1987	92.2	-0.6	12.1	22.9	4.0	15.3	10.2	19.2
1988	32.2	7.4	46.3	35.0	5.5	12.1	56.0	17.6
1989	55.9	7.7	18.2	2.5	7.4	12.6	50.5	24.6
1990	23.4	13.0	49.1	45.9	8.0	20.5	7.5	27.7
1991	16.7 **(44.1)**	-8.1 **(3.9)**	27.9 **(30.7)**	27.4 **(26.7)**	9.9 **(7.0)**	17.1 **(15.5)**	12.7 **(27.4)**	20.8 **(22.0)**
1992	70.6	2.3	51.7	47.5	17.3	22.3	44.8	31.2
1993	28.4	1.3	56.3	53.8	22.1	23.3	57.2	36.1
1994	31.6	2.2	42.6	34.5	21.9	15.0	57.0	21.0
1995	114.8	2.2	18.9	19.4	21.9	13.7	72.8	20.8
1996	39.8 **(57.0)**	4.4 **(2.5)**	12.9 **(36.5)**	16.2 **(34.3)**	21.9 **(21.0)**	13.2 **(17.5)**	29.3 **(52.2)**	20.9 **(26.0)**
1997	3.7	2.8	18.1	16.0	21.9	7.5	10.7	23.3
1998	-3.3	2.9	18.6	22.3	21.9	10.5	7.9	21.3
1999	17.9	4.2	23.4	33.1	92.7	12.8	6.6	27.2
2000	43.5	5.4	62.2	48.1	102.1	10.3	6.9	21.6
2001	3.1 **(13.0)**	8.4 **(4.7)**	28.1 **(30.1)**	27.0 **(29.3)**	111.9 **(109.5)**	10.5 **(10.3)**	18.9 **(10.2)**	21.3 **(22.9)**
2002	46.3	21.3	15.9	21.6	121.0	17.0	12.9	30.2
2003	22.8	10.2	29.5	24.1	129.4	13.1	14.0	22.9
2004	34.5	10.5	8.6	14.0	133.5	12.5	15.0	20.8
2005	27.7	6.5	29.7	24.4	132.2	10.4	17.8	19.5
2006	27.4 **(31.7)**	6.0 **(10.9)**	32.2 **(23.2)**	43.1 **(25.4)**	128.7 **(105.8)**	9.3 **(12.5)**	8.2 **(13.6)**	18.7 **(22.4)**
2007	11.3	6.4	37.6	44.8	125.8	9.7	5.4	18.4
2008	17.6	6.0	56.1	57.9	118.6	11.9	11.6	18.7
2009	2.0	7.0	-4.8	4.4	148.9	13.5	12.4	22.9
2010	17.8 **(12.2)**	5.1 **(6.1)**	11.1 **(25.0)**	16.0 **(30.8)**	150.2 **(135.9)**	14.0 **(9.8)**	13.3 **(10.7)**	22.5 **(20.6)**

Source: CBN (2010) Statistical Bulletin and Author's calculation

Narrow money supply (M1) and broad money supply (M2) witnessed a consistent increase in their growth rate. In 1987, the growth rate of M1 was 12.1 percent and M2 has an estimated growth rate of 22.9 percent. The growth rate of M1 and M2 increased in 1988 to 46.3 and 35.0 percent respectively while in 1989 both declined to 18.2 and 2.5 percent for M1 and M2 respectively. In the period 1987-1991, M1 has an average growth rate of 30.7 and M2 recorded 26.7 percent respectively.

The figure oscillated to 36.5 and 34.3 percent for M1 and M2 respectively for the period 1992-1996. In the following period 1997-2001, both M1 and M2 declined to 36.1 and 29.3 percent respectively. In 2002-2006, there was a further decline of both monetary variables, thus, M1 has an average growth of 23.2 percent while M2 recorded 25.4 percent. The average rates of M1 and M2 for the period 2007-2010 were 25.0 and 30.8 percent respectively. Table 2 also depicted the average growth of exchange, interest, inflation and lending rates. Thus, between 1987-1991, the average growth for these macroeconomic variables stood at 7.0 percent for exchange rate, 15.5 percent for interest rate, 27.4 percent for inflation and 22.0 percent for lending rate. In the following period 1992-1996, the rates for these variables oscillated and as such exchange rate recorded 21.0 percent, interest rate 17.5 percent, inflation rate 52.2 percent and 26.0 percent for lending rate.

In 1997-2001, the average growth of exchange rate stood at 109.5 percent, interest rate 10.3 percent while inflation and lending rates averaged 10.2 and 22.9 percent respectively. For the period 2002-2006, average exchange rate declined to 25.8 percent and so also lending rate 22.4 percent. On the other hand, interest and inflation rates increased to 12.4 and 13.6 percent respectively in the same average year.

Finally, for the last period 2007-2010, exchange rate averaged 135.9 percent, interest rate 9.8 percent, inflation rate 10.7 percent and lending rate recorded 20.6 percent.

Fig 3: Money Demand in Nigeria, 1986-2010

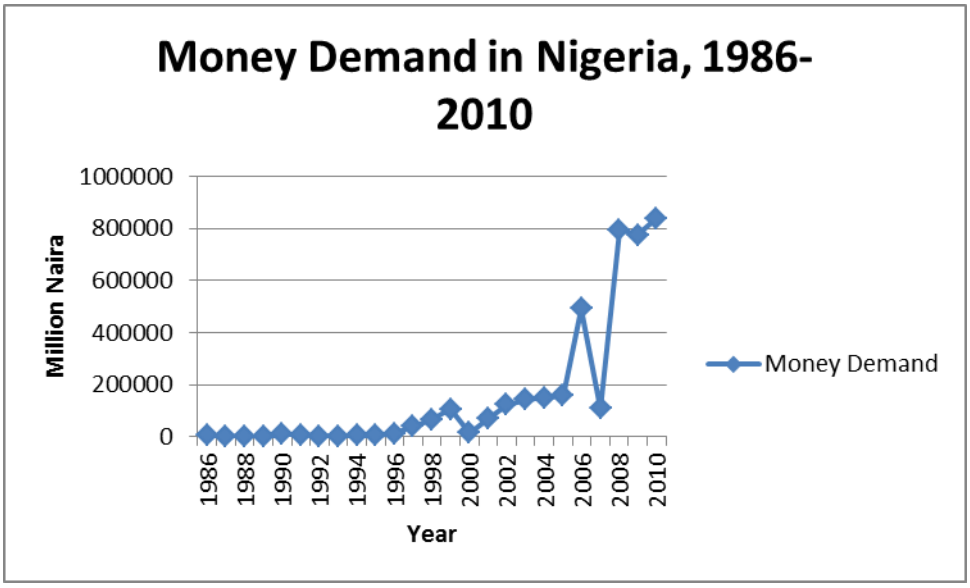


Fig 4: Interest Rate in Nigeria, 1986-2010

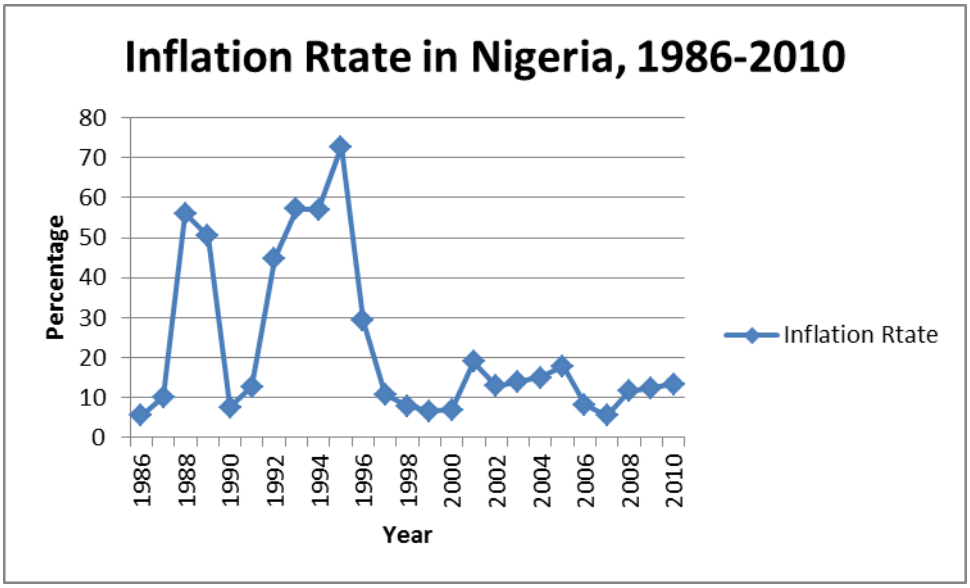


Fig 5: Interest Rate in Nigeria, 1986-2010

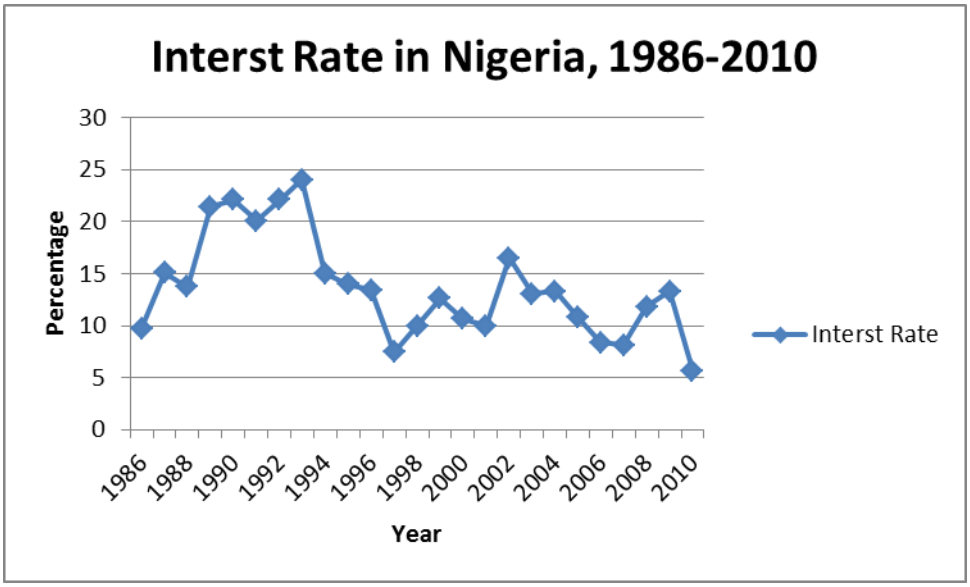


Fig 3-5 shows the trend of money demand, inflation and interest rates in Nigeria. The growth of money demand increases rapidly in 2000 and reached the peak in 2010. Inflation fluctuated with a higher digit between 1986 and 2000 and became moderate thereafter while interest ranges between 5 and 25 percent during the period under review.

III. Methodology

Evidence of studies with stability of money demand abounds in the literature (see Owoye and Onafowora , 2007) but no studies have included the foreign sector in their modeling. Thus, the current study included the degree of openness of the economy in the analysis. Suppose M is assumed to be the nominal stock of money and P is the price level, real money demand is defined as M/P, which is a function of the interest rate, i and the output, Y. The model developed by Owoye and Onafowora (2007) is given below:

$\Delta InM^2/p = \beta_0 + \beta_1 \Delta InY_t + \beta_2 DIR_t + \beta_3 In\prod_t + \beta_4 \Delta InEER_t + \beta_5 FIR_t + \varepsilon$……..(1)

Where:
In = natural logarithm
M = nominal M2 money stock
P = domestic price level
M^2/p = real M2 money balances
Y = real GDP
DIR = domestic interest rate
$\prod$ = inflation rate
EER = expected exchange rate depreciation
FIR = foreign interest rate
ε = white noise disturbances term
t = time trend

In order to suit the objectives of the study, equation 1 is modified by dropping and adding some variables including the openness of the economy shown in equation 2 below.

$M^2/p = f(GCF, INT, INF, EXR, GEX, OPE)$……(2)

In log linear stochastic form, equation (2) becomes:

$InM^d/p = \beta_0 + \beta_1 InGCF + \beta_2 InINT + \beta_3 InINF + \beta_4 InEXR + \beta_5 InGEX + \beta_6 InOPE + \varepsilon_t$……(3)

Where:
Md= nominal M2 money stock, p= domestic price level, thus M^d/p = real money balances, GCF = gross capital formation (a proxy for real income, a scale variable), INT = domestic interest rate (opportunity cost of holding money), INF = inflation rate (a proxy for consumer price index), EXR = exchange rate, GEX = government expenditure and OPE = openness of the economy (export + import/GDP). The a priori expectations for the coefficients are as follows: $\beta_1, \beta_5, \beta_6, >0$; $\beta_2, \beta_3, <0$; $\beta_4 >$ or <0.

Unit Root Testing

To avoid a spurious regression, the Augmented Dickey-Fuller test is conducted, thus:

$$Y_t = \sum_{t=1}^{p} Ó Y_{t-1} + U_t$$

$$\Delta Y_t = \sum_{t=1}^{p-1} Ó^* , \ \Delta Y_{t-1} + Ó^*, \ Y_{t-1} + U_t , \quad U_t \sim iid(0, u^2)$$

$$Ó^* = (Ó_1 + Ó_2 + Ó_3 + \text{-------+} \ Óp) - 1$$

If $Ó^* = 0$, against the alternative $Ó^* < 0$, then Y_t contains a unit root. The model can be extended to allow for the possibility that the series contains deterministic components (constant and trend).

Cointegration Test and Vector Error Correction Model

A vector error correction (VEC) model is a restricted vector auto-regression (VAR) that has co-integration restrictions built into the specification, so that it is designed for use with non-stationary series that are known to be co-integrated. The co-integration term is known as the error correction term since the deviation from long run equilibrium is corrected gradually through a series of partial short-run adjustments. Let us consider a two variable system with one co-integrating equation and no lagged difference terms. The co-integrating equation is

$$y_{1,t} = \beta_1 y_{2,t} + \varepsilon_t$$

$$y_{2,t} = \beta_2 y_{1,t} + \varepsilon_t \quad \text{.....(4)}$$

and the VEC is

$$\Delta y_{1,t} = \gamma_1 (y_{2,t-1} - \beta_1 y_{1,t-1}) + \nu_{1,t}$$

$$\Delta y_{2,t} = \gamma_2 (y_{2,t-1} - \beta_1 y_{1,t-1}) + \nu_{2,t} \quad \text{.....(5)}$$

In equation (5), the only right-hand side variable is the error correction term. In the long run equilibrium, this term is zero. However, if y_1 and y_2 deviated from long run equilibrium in the last period, the error correction term is non-zero and each variable adjusts to partially restore the equilibrium relationship. The coefficients Y_1 and Y_2 measure the speed of adjustment but variables $\Delta y_{1,t}$ and $\Delta y_{2,t}$ have no trend and the co-integrating equations have an intercept, the VEC has the form:

$$\Delta y_{1,t} = \gamma_1 (y_{2,t-1} - \mu - \beta_1 y_{1,t-1}) + \nu_{1,t}$$

$$\Delta y_{2,t} = \gamma_2 (y_{2,t-1} - \mu - \beta_1 y_{1,t-1}) + \nu_{2,t} \quad \text{.....(6)}$$

However, equation 3 above is remodeled with ECM in-cooperated in it.

$$\Delta \text{InM}^d/p_t = a_0 + \sum_{i-1}^{n=1} a_{1t} \Delta \text{InM}^d/p_{t-1} + \sum_{i-1}^{n-1} a_{2t} \Delta \text{InGCF}_{t-1} + \sum_{i-1}^{n-1} a_{3t} \Delta \text{InINT}_{t-1} +$$

$$\sum_{i-1}^{n-1} a_{4t} \Delta \text{InINF}_{t-1} + \sum_{i-1}^{n-1} a_{5t} \Delta \text{EXR}_{t-1} + \sum_{i=1}^{n-1} a_{6t} \Delta \text{InGEX}_{t-1} + \sum_{i-1}^{n-1} a_{7t} \Delta \text{InOPE}_{t-1} + \lambda_8 \text{ECM}_{t-1} \text{..(8)}$$

Tests for Structural Stability

If money demand is stable and well-defined, it helps Central Banks to meet their goals in a money targeting or an interest rate targeting mechanism.

Again, how stable are the parameters of the real broad money demand equation? The study employed Bahmani-Oskooee and Shin (2002) to investigate the CUSUM and CUSUMSQ tests developed by Brown et al. (1975) to the residuals of equation (8). The CUSUM and CUSUMSQ test statistics are updated recursively and plotted against break points in the data. For stability of the short-run dynamics and the long run parameters of the real broad money demand function, it is important that the CUSUM and CUSUMSQ statistics stay within the 5 percent critical bound (represented by two straight lines whose equations are detailed in Brown et.al, 1975).

IV. Presentation and Interpretation of Results

Results of Stationarity

In table 3, the stationarity test from both the ADF and Phillips-Perron indicate that money demand (MD) and inflation are stationary at level. Stationarity for the other variables was achieved at first differencing at either 5 or 1 percent confidence level.

Table 3: Unit Root Test Results

ADF Test (Trend and Intercept)				**Phillips-Perron (Trend and Intercept)**		
Variable	Level	1st Diff	2nd Diff	Level	1st Diff	2nd Diff
LMD	-4.8408**	-5.2272**	-5.7105**	-4.6809**	-6.6571**	-10.4424**
LGCF	-3.3178	-5.1770**	-6.6547**	-4.3924*	-7.2789**	-10.3052**
LINT	-2.8333	-4.0949*	-5.9564**	-3.3228	-4.9364**	-7.2310**
LINF	-4.3755*	-5.8248**	-6.7104**	-3.2617	-3.9405*	-6.0266**
INF	-4.2460*	-5.5468**	-6.1713**	-3.0512	-4.1264*	-6.4884**
LEXR	-1.7086	-3.5623	-4.8319**	-2.1591	-4.8545**	-8.2353**
LGEX	-1.4053	-6.3577**	-7.8528**	-2.1132	-12.5066**	-23.1161**
LOPE	-2.8044	-4.7128**	-5.7863**	-5.3005**	-9.7131**	-14.3722**
		Test Critical Values				
1%	-4.4167	-4.4415	-4.4691	-4.3942	-4.4167	-4.4415
5%	-3.6219	-3.6330	-3.6454	-3.6118	-3.6219	-3.6330
10%	-3.2474	-3.2535	-3.2602	-3.2418	-3.2474	-3.2535

Results of Cointegration

The results of cointegration shown in table 4 revealed that the variables are cointegrated since at least four cointegrating equations are found. Thus long run relationship exist between money demand function and gross capital formation (GCF), interest rate (INT), inflation rate (INF), exchange rate (EXR), government expenditure (GEX) and openness of the economy (OPE) in Nigeria in the period under review.

Table 4: Cointegration Test Results

Null Hypothesis	**Alternative Hypothesis**	**Statistical Value**	**5% Critical Value**	**1% Critical Value**	**Eigen Value**
		Trace Tests			
r = 0	r ≥ 0	280.4	124.2	133.6	0.9972
r ≤ 1	r ≥ 1	145.6	94.2	103.2	0.8864
		Max-Eigenvalue Tests			
r = 0	r = 1	134.8	45.3	51.6	0.9972
r ≤ 1	r = 2	50.0	39.4	45.1	0.8864

The trace test indicates four cointegrating equations at both the 5 and 1 percent levels while the max-eigenvalue test indicates four and two cointegrating equations at 5 and 1 percent levels respectively. This means the variables are cointegrated and therefore have long run relationship.

Dynamic OLS Results

The results depicted in table 5 revealed that the results are robust in that the DW of 1.98 falls within the range of 1.59-2.41 of no serial correlation. The R^2 showed that the combined independent variables explained about 86 percent of money demand function in the period of analysis while the F-stat of 17.3 percent revealed that the entire equation is significant in explaining money demand function in Nigeria.

Table 5: Long run Dynamic OLS Results

Dependent Variable: LMD			
Variable	Coefficient	t-statistic	Probability
C	3.84	0.63	0.53
LGCF	0.05	0.48	0.64
LINT	-0.99	-1.31	0.21
INF	-0.02	-1.96	0.07
LEXR	0.70	1,06	0.30
LGEX	0.43	0.79	0.44
LOPE	-1.18	-1.13	0.27
R^2 = 0.86; F-stat = 17.3; DW = 1.98			

It can also be seen from table 5 that interest rate (INT), inflation rate (INF) and openness of the economy (OPE) have a negative determining influence on money demand function in Nigeria. For example, a one percent increase in INT, INF or OPE decreases money demand function by 0.99 percent for INT, 0.02 for INF and 1.18 percent OPE. Similarly, a one percent decrease in any of the same variables has the opposite effect on money demand function in Nigeria. However, only inflation is statistically significant in explaining money demand function within the period of analysis. This means that an increase in inflation have a dampening effect at the rate people held money in the period under review.

The table also showed that the impact of gross domestic product (GCF), exchange rate (EXR) and government expenditure (GEX) is positive on money demand function in Nigeria. Owoye and Onafowora (2003) and Nwaobi (2002) had earlier reached a similar conclusion.

VEC Estimated Results

Table 6 contained the results of the vector error correction model. In estimating the model, the parsimonious error correction model is adopted in which lag one is presented. The results showed that the entire model is significant as the F-stat revealed while the R^2 similarly showed that about 65 percent of money demand function is explained by all the independent variables. GEX variable was dropped from the VEC model to avoid a situation of a singular matrix which became problematic during the estimation.

It can be seen from the table that the lag values of MD, GCF, INT and EXR negatively impacted on current money demand function in the short run for the period 1986-2010. A one percent increase in GCF, for example, decreases money demand by 0.03 percent in the short run. None of the variables with negative values was significant in explaining short-run money demand function in Nigeria. On the other hand, INF and OPE have positive impact on money demand function during the period under investigation. However, while INF is significant OPE is insignificant in determining money demand function in Nigeria. A percentage increase in INF in the short run, for example, increases money demand by 0.50 percent and vice versa. This means that in the short run, as there are increases in general price level; people increase their stock of real money balances in order to meet up with increases in prices in Nigeria.

The t-stat for the ECM in table 6 is robustly high and conformed with the usual negative value as it reflects the speed of adjustment between the long run and the short run. Its coefficient of 0.19 showed that whenever a deviation from long run equilibrium occurred, it is corrected or returned back with a speed of about 19 percent. This finding gives credence to the works of Owoye and Onafowora (2007), Omotor (2009) in Nigeria, and Adam (1992) in Kenya.

Table 6: Vector Error Correction Estimates

Dependent Variable: DLMD		
Variable	Coefficient	t-statistic
C	0.12	0.82
DLMD(-1)	-0.08	-0.57
DLGCF	-0.03	-0.61
DLINT	-0.30	-0.62
DLINF	0.50	2.36
DLEXR	-0.53	-1.22
DLOPE	0.01	0.02
ECM$_{(t-1)}$	-0.19	-4.35
R^2 = 0.65; F-Stat = 4.0		

Test of Stability

The test of stability in figures 6 and 7 below showed that neither the CUSUM nor CUSUMSQ plots cross the 5 percent critical lines, therefore, we can safely conclude that the estimated parameters for the study are stable and useful for policy decision. In other words, with openness of the Nigerian economy (i.e. addition of the external sector) money demand function in Nigeria is stable. This means that the monetary authority can use M2 to control the level of liquidity preference in Nigeria no matter the level of external transactions. The results of the stability test confirmed with that of Owoye and Onafowora (2007), Omotor (2009), Omotor and Omotor (2011) in Nigeria, Bahamani-Oskooee and Barry (2000) in Russia, but contradicted that of Al-Samara (2011) who found unstable money demand function in Syria.

Figure 6: Plot of Cumulative Sum of Recursive Residuals

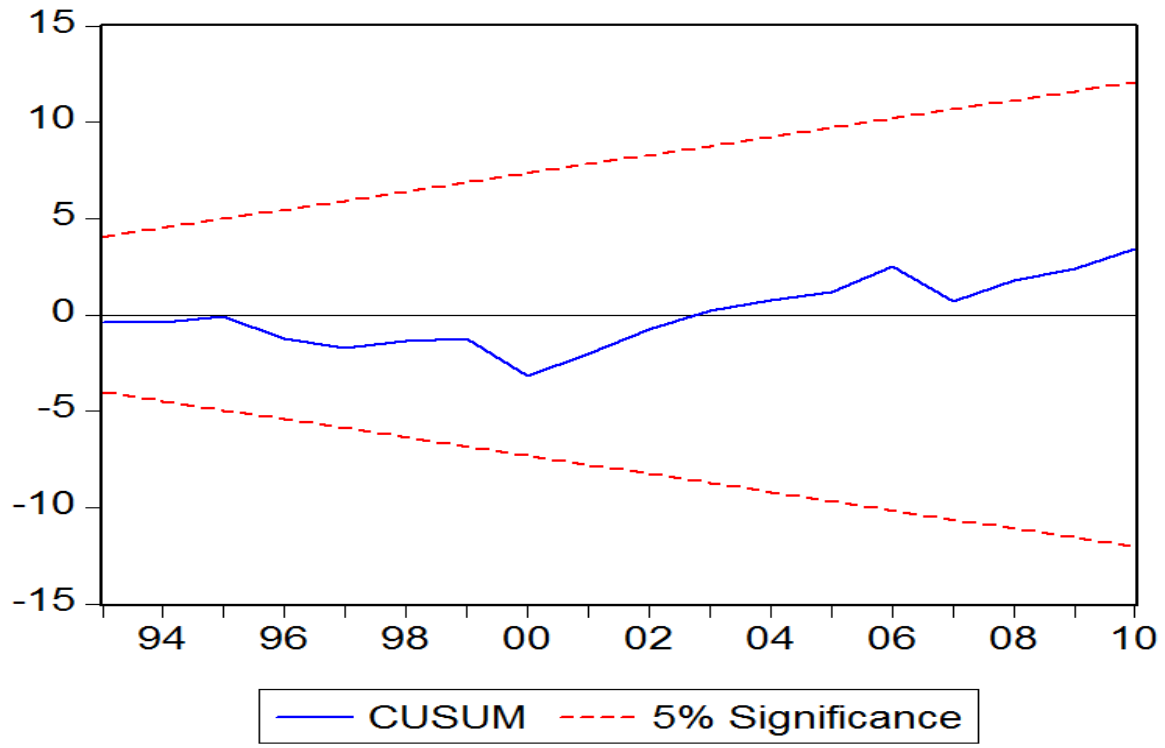
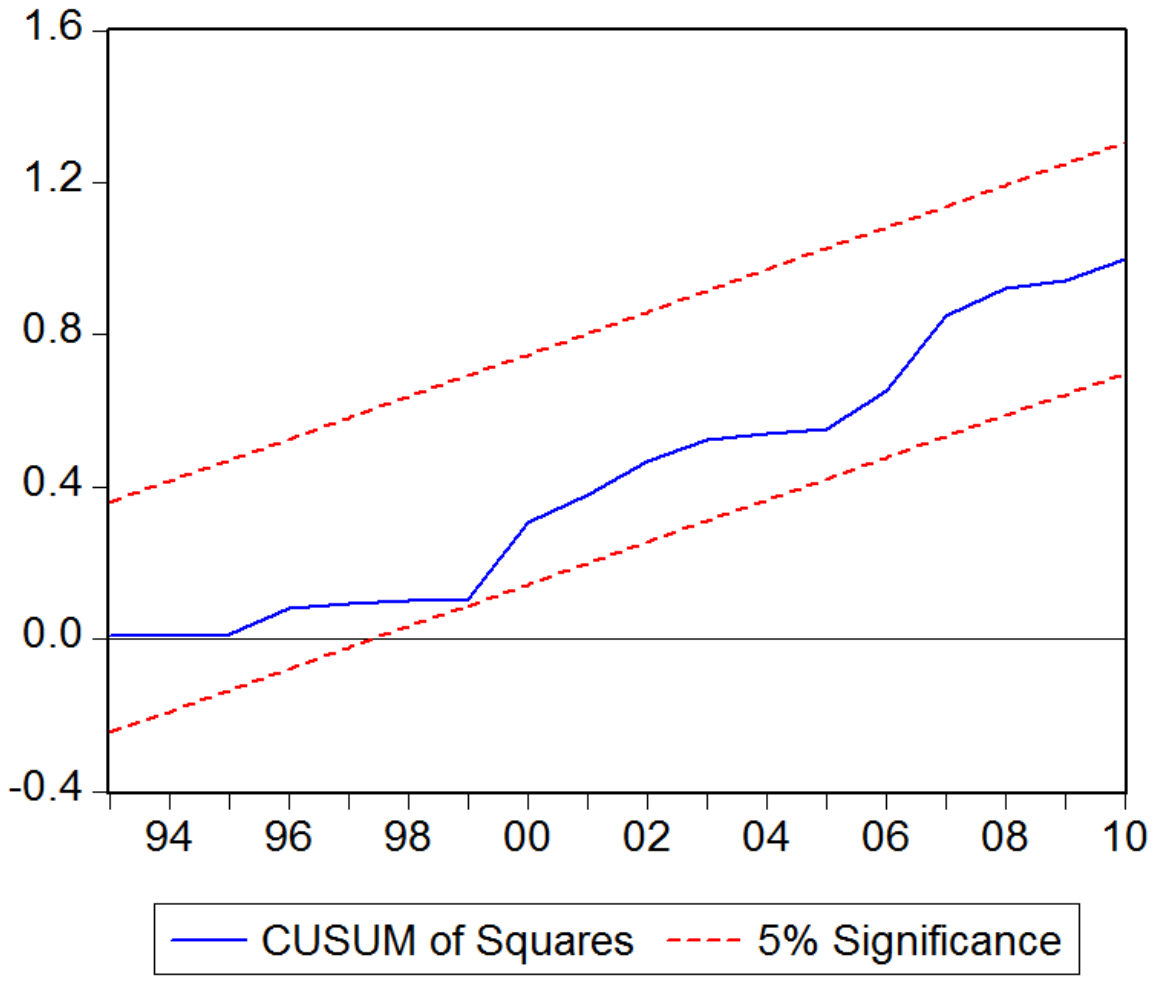


Figure 6: Plot of Cumulative Sum of Squares of Recursive Residuals



V. Concluding Remarks

The purpose of this study is to analyze money demand function and whether it is stable or not in Nigeria. The monetary authority in Nigeria tended to target M2 as a means of controlling inflation and liquidity preference. The analysis employed in the study revealed that broad money has been growing faster than other monetary variables such that M2 has in most times overshot target of the monetary regulating authority.

One of the empirical aspects of the study which involves test of test of stability showed that real money demand function in Nigeria is stable as neither the CUSUM nor the CUSUMSQ plots cross the 5 percent critical boundaries.

On the bases of the findings, the monetary authority should ensure that there should be a clear cut distinction between short run and long run objectives. Thus, the monetary authority, for example, can use inflation to reduce the level of money demand in the long run and increase it in the short run. Interest rate also can be used to reduce the money demand function both in the short and the long run.

Secondly, the estimation in this study provides no evidence that domestic interest rates neither influenced long-run real money demand nor short run money demand function in the period from 1986-2010 in Nigeria. This implies that rigid interest rate policy might become ineffective when the economy is becoming more open, following milestones such as the establishment of the Nigeria-US and Nigeria-EU Trade Agreements. On this note, in the context of Nigeria's increasing integration into the world economy, interest rate policies needs to be reformed towards market principles in order to improve the effectiveness of monetary policy.

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