


# Structural Adjustment And The Stability Of The Nigerian Money Demand Function

Olugbenga A. Onafowora, (E-mail: onafowor@susqu.edu), Susquehanna University  
Oluwole Owoye, (E-mail: owoyeo@wcsu.edu), Western Connecticut State University

## Abstract

This paper uses cointegration 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 in order to ascertain whether recent macroeconomic developments such as the implementation of the structural adjustment programme (SAP) in 1986; the liberalization of the exchange rate, domestic interest rate, and capital accounts; financial deepening and innovations; changes in monetary policy regimes; and increased integration of the economy with the rest of the world may have caused the real broad money demand function to become structurally unstable. Our empirical results indicate 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 confirm the stability of the short- and long run parameters of the real money demand function. The stability of the parameters of the money demand equation provides the justification for the monetary authority to target the broad money supply in its bid to manage inflation and stimulate economic activity in Nigeria.

## Introduction

 Over the past two or more decades, the primary objective of many developed and developing countries has been the maintenance of price stability that supports sustainable economic growth and employment growth. Nigeria as an open small economy is no exception<sup>1</sup>. As in most countries worldwide, the Central Bank of Nigeria (CBN) relies on a money demand function in the design and implementation of its monetary policy. The money demand function is used both as a means of identifying medium term growth targets for money supply and as a way of manipulating not only the interest rate and reserve money for the purpose of controlling the total liquidity in the economy but also for managing inflation. The CBN's reliance on a money demand function in the conduct of monetary policy is predicated on the assumption of a stable long-run relationship between money, prices, real output and some other key economic variables.

Since the implementation of Structural Adjustment Programme (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 emphasis, and (f) the reliance on market determined indirect instruments of monetary policy. 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<sup>2</sup> (see CBN Briefs, 1998).

<sup>1</sup> By definition, price stability in Nigeria refers to the attainment of a low single-digit inflation rate on an annual basis.

<sup>2</sup> The CBN (Amendment) Decree Number 37 also defines price stability as the central bank's major policy objective.

This study is an empirical examination of the relationship between real broad money, inflation, real income, domestic and foreign interest rates, and the expected exchange rate in Nigeria during the SAP period 1986:1 to 2001:4. In addition, the long-run stability of the money demand relationship is investigated because the stability of the money demand function has important implications for the way monetary policy should be conducted by the CBN.

To reduce the possibility of inadvertent bias and subjective judgments, we adopt the Johansen/Juselius (1990) multivariate cointegration method to find the appropriate dynamic specification for the money demand function and analyze its behavior both in the short-run and long run. Studies in the empirical literature show that the Johansen/Juselius cointegration analysis is a very useful tool to analyze the demand for money in industrialized and developing countries. However, the technique is not informative relative to the stability of the parameters in the model [see Bahmani-Oskooee and Shin (2002, p.86)], and because of this setback, this paper uses the CUSUM and CUSUMSQ tests developed by Brown, Durbin and Evans (1975) to examine the stability of the short-run dynamics and long-run coefficients of the money demand function.

### **Evolution of the Current Monetary Policy Framework in Nigeria**

In Nigeria, the overriding objective of monetary policy is price and exchange rate stability<sup>3</sup>. The monetary authority's strategy for inflation management is based on the view that inflation is essentially a monetary phenomenon. Because targeting money supply growth is considered as an appropriate method of targeting inflation in the Nigerian economy, the CBN has selected a monetary targeting policy framework to achieve its objective of price stability. The broad measure of money (M2) is the intermediate target, and the monetary base is the operating target. In implementing monetary policy, the CBN utilizes a mix of indirect market-determined instruments to achieve its monetary objectives. These include reserve requirements, open market operations of Nigerian Treasury Bills (NTBs), liquid asset ratios, and the discount window (IMF, 2003).

The CBN's focus on the price stability objective represents a major departure from past practices in which the promotion of rapid and sustainable economic growth and employment were the overriding objectives of monetary policy. Prior to 1986, in order to achieve its objective of sustainable growth and employment, the CBN relied on the use of direct (non-market) monetary instruments such as credit ceilings on the deposit money of banks, administered interest and exchange rates, as well as prescription of cash reserves requirements. The most popular instruments of monetary policy were the setting of targets for aggregate credit to the domestic economy and the prescription of low interest rates. With these instruments, the CBN hoped to direct the flow of loanable funds with a view to promoting rapid development through the provision of finance to the preferred sectors of the economy (agriculture, manufacturing, and residential housing)<sup>4</sup>.

From 1970, the Nigerian economy experienced major structural change that made it increasingly difficult to achieve the aims of monetary policy. Oil dominated the country's export basket and this accounted for about 58 percent of total export value in 1970 and over 95 percent since the 1980s. Because of the increased revenue accruing to government from oil, Nigeria's external reserves rose rapidly in the 1970s. Rapid monetization of the increased crude oil receipts resulted in large injections of liquidity into the economy, which induced rapid monetary growth. The concomitant rise in government spending, from an average of 13% of gross domestic product (GDP) during 1970-73 to 25 % in 1974-80, was so strong that the increased revenue earnings from oil over the period was more than absorbed thus moving the fiscal balance from a surplus to a deficit that averaged 2.5% of GDP a year. The result was that the government resorted to borrowing from the banking system, especially the Central Bank, to finance the domestic deficits, while the financing of foreign deficits led to massive foreign borrowing and the drawing down of external reserves. To reverse the worsening economic conditions in terms of declining GDP growth, deteriorating balance of payment conditions, skyrocketing inflation, debilitating debt burden, increasing fiscal deficits, increasing unemployment and high incidence of poverty, the government embarked on austerity measures in 1982. The austerity measures achieved some success by 1985 as inflation fell to a single digit, the external current account moved from deficit to balanced positions, and real GDP grew by 9.5%. However,

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<sup>3</sup> These objectives are spelled out in the circular "Monetary, Credit, Foreign Trade and Exchange Policy Guidelines" of the CBN (CBN, 2001).

<sup>4</sup> For detailed discussion of this, the interested reader should see all the National Development Plans since 1964.

improvements in the fiscal and external positions in 1985 proved transitory and failed to establish a basis for sustained economic growth.

As a policy option to put the Nigerian economy back on the path to sustainable growth, the government adopted the International Monetary Fund (IMF) sponsored comprehensive Structural Adjustment Programme (SAP) in June 1986. The SAP involved both structural and sectoral policy reforms. The main strategies of the SAP were the liberalization of the external trade and payment systems, the adoption of a market-based exchange rate for the domestic currency (Naira), the elimination of price and interest rate controls, and the reliance on market forces as the major determinant of economic activity. The adoption of SAP marked the start of a regime of financial sector reforms characterized by the free entry and free exit of banks and the use of indirect (market-based) monetary control instruments for implementing monetary policy in Nigeria (Nnanna, 2001).

The developments in the Nigerian economy since 1986, and most importantly, the adoption of M2 as an intermediate target for monetary policy by the CBN pose two central questions: Is the real M2 money demand function stable as an intermediate target? Is the CBN justified in its choice of M2 as a target? As discussed earlier, the recent developments in monetary system and the increased openness may have caused the money demand function to be unstable. The monetary policy implications inherent in these questions cannot be over-emphasized. As economic theory suggests, if the money demand function is unstable and experiences substantial shifts over time, then the income velocity of money will be unpredictable, and the quantity of money (M2 in this case) may not be a good predictor of economic activity. In other words, the choice of M2 as an intermediate target portends serious economic problem for the Nigerian monetary authority if M2's demand function is found to be unstable.

### **The Model and Data**

In order to answer the central questions posed in this paper, we employ an econometric analysis based on an open economy portfolio balance approach of money demand [see Thomas (1985), and Handa (2000)]. Agents may hold money either as an inventory to smooth differences between income and expenditures, or for its yield as an asset in a portfolio. Either motive suggests a specification in which the demand for money depends on a scale variable such as real income or wealth and the rates of returns to money and to alternative assets. In open economy macroeconomics, money is considered as part of portfolio, which consists of domestic financial and real assets, and foreign assets. The return on the domestic money is the "own" rate of interest. The return on real assets is the expected rate of inflation. Because the purchasing power of money erodes quickly under high inflation, while the real value of real assets is maintained, economic agents may wish to switch into real assets when the inflationary expectations are strong (Friedman, 1956).

The opening up of the Nigerian economy since 1986, which included a significant degree of trade liberalization as well as financial deepening, suggests that the domestic demand for money cannot be realistically estimated without considering the impact of foreign monetary developments. If residents holding of money change with foreign monetary developments then the exclusion of foreign influences could cause model misspecification and lead to a restrictive view of the characteristics of the money demand function. To capture the influence of foreign factors, some studies of money demand have considered the impact of foreign interest rates and the expected rate of depreciation of the currency [see, for example, Arango and Nadiri (1981), Thomas (1985), Arize et al (1990), Chowdhury (1997), Ibrahim (2001), Bahmani-Oskooee and Shin (2002), Civcir (2003)]. The inclusion of the foreign interest rate in the money demand function is to capture the effects of capital mobility. Empirical studies suggest that an increase in the foreign interest rate increases the returns on foreign assets relative to the returns on domestic assets; therefore, this may cause agents to decrease their demand for domestic money holdings [see, McKinnon (1983)].

The expected exchange rate captures the substitution between domestic and foreign currencies. Its impact on the domestic demand for money is ambiguous, meaning that it can either be positive or negative. In the studies by Arango and Nadiri (1981), Bahmani-Oskooee and Pourheydarian (1990), and Bahmani-Oskooee and Rhee (1994), they argued that if residents evaluate their asset portfolio in terms of the domestic currency, a depreciation of the exchange rate that increases the value of their foreign holdings would enhance wealth. To maintain a fixed share of

the wealth invested in domestic assets, residents will shift parts of their foreign holdings to domestic assets, including domestic currency. The increase in the share of wealth held in domestic assets, including domestic currency, suggests a rise in the demand for the domestic currency. Also, studies have argued that if depreciation of the domestic currency leads residents to anticipate further depreciation, then as hedge against the exchange rate risk, they may wish to adjust their portfolio towards holding more of the foreign currency and less of the riskier domestic currency. The shift in portfolio away from the domestic currency to foreign currencies amounts to a decline in the demand for the domestic currency (i.e., the currency substitution effect).

Following the discussion above, the long-run money demand function can be written in semi log-linear form as:

$$\Delta \ln \left( \frac{M}{P} \right)_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 R_t + \alpha_3 \ln \pi_t + \alpha_4 \Delta \ln FX_t + \alpha_5 R_f_t + e_t \quad (1)$$

where,  $\ln$  is natural logarithm,  $M$  is the nominal M2 money stock,  $P$  is the domestic price level,  $(M/P)_t$  is the demand for real M2 money balances,  $Y_t$  is the scale variable (real income or wealth),  $R_t$  is the domestic nominal interest rate (the “own” rate of return),  $\pi_t$  is the inflation rate,  $FX_t$  is a measure of the expected exchange rate,  $R_f_t$  is the foreign interest rate, and  $e_t$  is a white noise disturbance term. To summarize, prior expectations for the coefficients are as follows:  $\alpha_1 > 0$ ,  $\alpha_2 > 0$ ,  $\alpha_3 < 0$ ,  $\alpha_4 < 0$ , and  $\alpha_5 < 0$  or  $\alpha_5 > 0$ .

The money demand model is estimated using quarterly data from 1986:1 to 2001:4 gathered from the IMF’s International Financial Statistics 2002 CD-ROM. The real M2 money demand is measured as the nominal M2 money stock divided by the consumer price index (CPI). The real income as a measured scale variable is proxied by the real industrial production because quarterly data on real GDP for Nigeria for the entire sample period are not available. A crude approximation would have been the use of an interpolated quarterly GDP. The domestic interest rate (“own” rate of return) is proxied by the three-month interbank rate<sup>5</sup>. The inflation rate is the quarterly rate of inflation, which is derived as the quarterly percentage change in the CPI. Since well over 40% of Nigeria’s international trade is conducted with the United States (US), the US three-month Treasury bill rates and the Nigerian naira/US dollar exchange rates are used as the foreign interest rate and the nominal exchange rate, respectively.

Several studies have shown that it is quite difficult to measure the expected rate of depreciation of the domestic currency, and as a result, these studies use different methods, however, a common method is the use of forward exchange rate data to capture market expectations. Furthermore, forward exchange rate data for the Naira-US dollar is not available. Given this, we opt to measure the expected rate of depreciation of the domestic currency by fitting a first order autoregressive time series model to the first difference of the logarithm of the exchange rate and then use the fitted values from this equation as a series of one-step-ahead forecasts for the depreciation rate. The estimated autoregressive model, AR (1), takes the following form:

$$\Delta \ln FX_t = 0.058 + 0.892 \Delta \ln FX_{t-1} + u_t \quad (2),$$

(2.774) (7.225)

$$R^2 = 0.313, \text{SER} = 0.194, \text{DW} = 2.019, \text{LB} = 4.91 (0.23).$$

The number in parentheses below the coefficients are t-ratios,  $R^2$  is the coefficient of determination, SER is the standard error of the regression, DW is the Durbin Watson statistics, and LB is Ljung-Box Q statistic test for a fourth order serial correlation process in the errors, and the number in parentheses is the probability (p) value for this statistic.

<sup>5</sup> The importance of interest rate in money demand has been firmly established in the literature. However, considerable disagreement exists as to which interest rate should be used as the opportunity cost of holding money, e.g. long-term or short-term. According to Wong (1977), most people in developing country live near subsistence level and hold money for precautionary purpose over shorter periods. As such, the short-term interest rate is more appropriate in the case of Nigeria.

**Methodology and Empirical Results**

In modeling the money demand function, first, each series in the model was examined to determine whether it is stationary and its order of integration. The results of the augmented Dickey-Fuller (ADF) unit roots test procedure, reported in Table 1, indicate that all variables are non-stationary at their level and stationarity is achieved after first difference. Given the unit-root properties of the variables, we proceed to establish whether there is a long-run cointegrating relationship among the variables in equation (1) by using the Johansen full information maximum likelihood method (Johansen 1988; Johansen/Juselius 1990).

**Table 1 ADF Unit Root Test Results**

Variables	Levels	First Differences
<i>ln M2</i>	-1.337	-4.178*
<i>ln Y</i>	-2.518	-5.673*
R	-2.501	-4.998*
<i>ln π</i>	-1.219	-3.031**
<i>ln FX</i>	-1.693	-4.604*
Rf	-1.531	-3.722*

Note: \*, \*\*, and \*\*\* indicates significance at 1%, 5%, and 10% significance level, respectively.  
 McKinnon (1983) Critical Values: 1% (-3.5345); 5% (-2.9069); 10% (-2.5907)

The results of the cointegration tests are presented in Panel A of Table 2. Based on the eigenvalue statistics, we reject the null-hypothesis of no-cointegrating vector linking real M2 and its economic determinants at the 5% level of significance. In other words, our results show that there exists a unique long-run relationship between M2, Y, R, π, ΔFX, and Rf. The existence of one cointegrating vector implies that an economic interpretation of the long-run broad money demand function can be made by normalizing the estimates of the unconstrained cointegrating vector on the real M2. The parameters, which are the long-run elasticities of the cointegrating vector of the long-run broad money demand function, are presented in Panel B of Table 2.

**Table 2. Johansen Maximum Likelihood Cointegration Test Results for the stochastic matrix (*ln (M/P)*, *ln Y*, R, *ln π*, Δ*lnFX*, Rf)**

<b>Panel A: Maximum Eigenvalue Test for real M2 Demand Function</b>				
Eigenvalue	Likelihood Ratio	5 Percent Critical Value	1 Percent Critical Value	Hypothesized No. of CE(s)
0.409	91.184	68.52	76.07	None *
0.293	45.971	47.21	54.46	At most 1
0.122	19.503	29.68	35.65	At most 2
0.086	8.803	15.41	20.04	At most 3
0.016	1.342	3.76	6.65	At most 4
<b>Panel B: Normalized cointegrating coefficients of the real M2 demand equation</b>				
$ln (M/P)_t = -29.208 + 2.098 ln Y_t + 0.625 R_t - 0.037 ln π_t - 0.815 Δ ln FX_t - 0.253 Rf_t$				
	(8.526)	(4.809)	(4.251)	(3.735)
				(2.685)

Note: \* (\*\*) indicates rejection of the null hypothesis at 5% (1%) significance level.  
 t-statistics are in the parentheses below the coefficients.

These results in Panel B of Table 2 indicate positive and statistically significant relationship between the demand for real broad money and real income during the period examined. These results are consistent with what economic theory predicts to be the relationship between both variables. This suggests that as real income increased, people held more money. The coefficient (2.098) on the real income variable indicates that the long-run income elasticity for real broad money is significantly greater than unity. This would appear to contradict the hypothesis of the economies of scale in money holding predicted by the transaction and precautionary theories of money demand, however, this numerical value is consistent with those obtained in other studies of broad money demand in Nigeria.

For example, Hassan et al (1995) investigated the demand for broad money demand in Nigeria over the quarterly period 1976-88, and they report long-run income elasticities to be 2.54 and 2.86. Based on these estimates, they concluded that “stronger liquidity motives in Nigeria may explain higher income elasticities of the demand for money” (p. 42). In a recent study of M2 money demand in Nigeria, Anoruo (2002) found the long-run income elasticity to be 5.44. Finally, we should point out here that these findings are consistent with Laidler’s (1993, p. 169) assertion that “broader definitions of money on the whole produce higher estimates of the income or wealth elasticity of the demand for money than narrow ones”.

The domestic interest rate (“own” rate of return) and inflation rate variables enter the long-run money demand model with different and predicted signs. The coefficient of domestic interest rate is positively related to real money demand. This implies that the higher the own rate of return, the higher demand for broad money. On the other hand, there is a negative relationship between inflation and real money demand. This suggests that the higher the rate of return on the alternative asset, the lower the demand for money. Finally, the coefficients of the foreign interest rate and the expected rate of depreciation of the exchange rate are both negative and statistically significant. The findings for these two variables highlight the importance of foreign effects in explaining the demand for money holdings in Nigeria during the sample period. Overall, the result of the foreign interest rate variable is supportive of the portfolio balance argument of capital mobility, while that of the expected exchange rate indicates the existence of the currency substitution in Nigeria.

**Dynamic Specification of the Money Demand Model**

Thus far, the results show that the variables in the real broad money demand model (Equation 1) tend to move together in the long run as predicted by economic theory. In the short-run, deviations from this relationship could occur due to shocks to any of the variables. In addition, the dynamics governing the short-run behavior of real broad money demand are different from those in the long run. Engle and Granger (1987) showed that if cointegration exists between non-stationary variables, then an error-correction representation of the type specified by Equation (3) below exists for these variables. Given the fact that the variables of the money demand equation are cointegrated, the next step is the analysis of the short-run dynamics within a Vector Error Correction Model (VECM) which is of the form:

$$\Delta \ln \left( \frac{M}{P} \right)_t = \alpha_0 + \sum_{i=0}^{k-1} \alpha_1 \Delta \ln Y_{t-1} + \sum_{i=0}^{k-1} \alpha_2 \Delta R_{t-1} + \sum_{i=0}^{k-1} \alpha_3 \Delta \ln \pi_{t-1} + \sum_{i=0}^{k-1} \alpha_4 \Delta \ln FX_{t-1} + \sum_{i=0}^{k-1} \alpha_5 \Delta Rf_{t-1} + \sum_{i=0}^{k-1} \alpha_6 \Delta \ln \left( \frac{M}{P} \right)_{t-1} + \alpha_7 EC_{t-1} + \mu_t \tag{3}$$

where all the coefficients retain their prior meanings and expected signs as previously discussed for equation (1);  $EC_{t-1}$  is the lagged error correction term — the fitted residuals from the cointegrating equation (1), and  $\mu_t$  is a white noise error term.

The VECM shows how the system adjusts to the long-run equilibrium implied by the cointegrating equation (1). A crucial question concerning the VECM is what the optimal lag on the right hand side variables should be. A popular technique is Hendry’s (1987) “general-to-specific” methodology, which proceeds by eliminating all insignificant lags. Accordingly, we initially estimated a VECM with four lagged differences of the explanatory variables, a constant term and one error correction ( $EC_{t-1}$ ) term. The dimensions of the parameter space were then reduced to a final parsimonious VECM specification by using sequential F-tests to exclude the statistically insignificant lags.

The results of the reduced short-run dynamic real broad money demand model and the various diagnostic tests are presented in Table 3. In the table, it is noted that the error-correction term ( $EC_{t-1}$ ) carries its expected negative sign and highly significant coefficient in the money demand function. This result, thus, substantiates the finding of cointegration among the variables documented earlier. More importantly, this result suggests that overlooking the cointegrating relationship among the variables would have introduced misspecification in the

underlying dynamic structure. The absolute value of the coefficient of the error-correction term indicates that about 6 percent of the disequilibrium in the real M2 demand is offset by short-run adjustment in each quarter. This means that excess money is followed in the next period by a reduction in the level of money balances that people would desire to hold. Thus, for maintaining long-run equilibrium it is important to reduce the existing disequilibrium over time.

In addition to the disequilibrium effect, the results in Table 3 show that the quantity of money demanded is influenced by changes in real income, changes in inflation, changes in domestic and foreign interest rates and changes in the expected depreciation of the domestic currency. The estimated coefficients of the short-run money demand equation have the expected signs and they are of magnitude similar to what is found in some studies of money demand in Nigeria. For example, Arize et al investigated the demand for narrow money (M1) in seven African countries including Nigeria over the annual period 1960-1987. For Nigeria, they report real total income elasticity of 0.28 for the short-run and 2.03 for the long run. In his study of the demand for narrow money (M1) in Nigeria, Nwaobi (2002) reports a short-run income elasticity of 0.639. Likewise, in their study of the broad money demand, Hassan et al (1995) estimated a short-run income elasticity of 0.235.

The diagnostic tests for the dynamic money demand model are presented in the lower panel of Table 3. The statistics show that there is no diagnostic problem with the model. The coefficient of determination (adjusted R<sup>2</sup>), used to measure the goodness of fit of the estimated model, indicates that the model is reasonably accurate in prediction. By looking at the probability value of the Jarque-Bera (JB) LM test, which is given in the squared brackets, the null hypothesis of normally distributed residuals cannot be rejected. The Lagrange Multiplier (LM) test of no error autocorrelation against autocorrelation of at most order k = 4 suggests that the residuals are not serially correlated. The Breusch-Pagan (BP) and Engel's autoregressive conditional heteroscedasticity (ARCH (4)) tests suggest that the disturbance term in the equation is homoskedastic. The Ramsey RESET test result shows that the calculated F-value is less than the critical value at the five percent significance level and therefore, there is no specification error.

**Table 3: Estimates of the Error-Correction Model of the Real M2 Demand**

Variable	Coefficient	t-statistic	t-Probability
Constant	-0.7188	-3.7892	0.0004
$\Delta \ln M_{t-1}$	0.2470	2.8903	0.0034
$\Delta \ln M_{t-3}$	0.1993	2.7054	0.0092
$\Delta \ln M_{t-4}$	0.1895	2.5051	0.0154
$\Delta \ln Y_t$	0.1679	4.0618	0.0002
$\Delta \ln Y_{t-1}$	0.2216	1.9902	0.0508
$\Delta R_t$	0.1181	2.5890	0.0124
$\Delta R_{t-4}$	0.1288	2.9327	0.0050
$\Delta \ln \pi_{tt}$	-0.0097	-9.5531	0.0000
$\Delta \ln \pi_{t-1}$	-0.0084	-8.3319	0.0000
$\Delta \ln FX_t$	-0.0507	-2.3975	0.0201
$\Delta \ln FX_{t-1}$	-0.0389	-1.8764	0.0662
$\Delta Rf_{t-4}$	-0.1974	-2.4680	0.0169
$EC_{t-1}$	-0.0618	-5.766	0.0000
<b>Diagnostic Statistics</b>			
Adj. R <sup>2</sup> = 0.7276; F-statistic = 16.3016 [0.000]; SSE = 0.0930; ARCH (4) = 1.3039 [0.8741]; BG = 0.5263 [0.3168]; JB [ $\chi^2$ (2)] = 0.4061 [0.9969]; RESET = 1.1377 [0.7894]			

Notes:

SSE: Sums of Squared Errors; ARCH: Engle's test for conditional Heteroskedasticity;  
BG: Breusch-Godfrey LM (4) test for serial correlation; JB: Jarque-Bera test for normality of residuals;  
RESET: Ramsey's test for specification error. The probability values are in the squared brackets.

**Test for Structural Stability**

Finally, how stable are the parameters of the real broad money demand equation reported in Table 2? It is now becoming standard practice to incorporate short-run dynamics in testing for stability of the long-run parameters of a money demand equation. To this end, we follow Bahmani-Oskooee and Shin (2002) and apply the cumulative sum of recursive residuals (CUSUM) and cumulative sum of squares of recursive residuals (CUSUMSQ) tests developed by Brown et al. (1975) to the residuals of equation (3). 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, Section 2.3.). As seen in Figures 1 and 2, the estimated short-run dynamics and long-run parameters of the money demand function are stable, since neither the CUSUM nor CUSUMSQ plots cross the 5% critical lines. The conclusion is that a stable real broad money demand function exists in Nigeria over the entire period of the analysis.

Figure 1: Plot of Cumulative Sum of Recursive Residuals

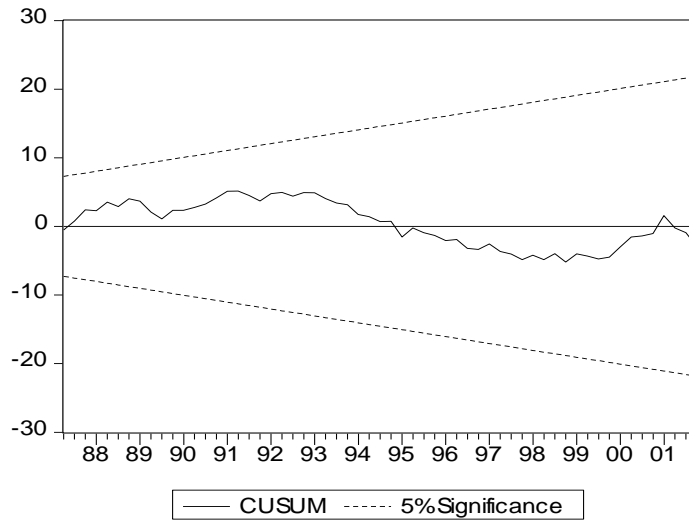
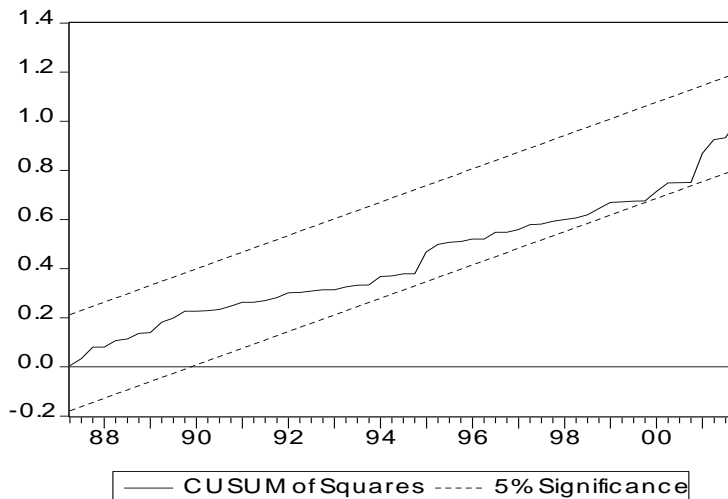


Figure 2: Plot of Cumulative Sum of Squares of Recursive Residuals





## Summary and Conclusion

This paper models and tests for the stability of the real broad money demand relation in Nigeria during the structural adjustment period 1986:1-2001:4. Empirical analysis carried out by means of Johansen maximum likelihood cointegration procedure shows that there is a long-run relationship between real broad money (M2), real income, domestic interest rate, inflation rate, foreign interest rate and expected depreciation rate of the domestic currency. The statistical significance of the expected exchange rate in the money demand equation suggests the existence of the currency substitution phenomenon in Nigeria. However, it is interesting to note that notwithstanding the currency substitution and the financial reforms that have occurred since the introduction of the SAP in 1986, the parameters of the real broad money demand equation remained stable over the entire period of the analysis.

The stability of the broad money demand relationship might provide justification for the Central Bank of Nigeria to use the broad money stock as an intermediate target for monetary policies. However, the existence of currency substitution introduces a different monetary policy dynamics. With foreign currencies as part of the components of domestic money supply, the Nigerian economy is exposed to external and internal shocks of varying degrees. For example, currency substitution exerts tremendous pressure on the exchange rate, and this affects the domestic monetary authority's ability to choose the appropriate monetary target. In other words, with currency substitution, the domestic monetary authority (CBN) does not have full control over the money supply, and this may not only undermine the Central Bank's ability to maintain a monetary target, but it can significantly limit its ability to formulate and implement an effective monetary policy.

Finally, with the incorporation of the effects of foreign variables such as foreign interest rates and exchange rates in the money demand function, our study shows that residents decisions to hold domestic currency is also affected by foreign monetary developments. Therefore, this paper concludes that it is important that the policymakers in Nigeria, and in other developing countries, take into consideration the influence of foreign monetary developments on the domestic environment as they design their monetary and exchange rate policies. Ignoring such external monetary influences will unavoidably lead to uncertain results.

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