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STRUCTURAL BREAKS, DEMAND FOR MONEY AND MONETARY POLICY IN NIGERIA**

The paper estimates an endogenous structural break date of the money demand for Nigeria for the period 1960-2008. Using the Gregory and Hansen 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. In addition, it was established that the Central Bank of Nigeria has effectively used money supply as an instrument of monetary policy.

Keywords: Demand for money, structural breaks, monetary policy, cointegration, Nigeria

1. Introduction

The empirical estimation of money demand stability has received growing attention during the past decades in many countries. This is particularly important for emerging economies that switched from use of direct monetary instruments such as credit ceilings, selective controls, administered interest and exchange

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rates, as well as prescription of cash reserve requirements and special deposits. The use of market based instruments was not feasible initially because of the perceived underdeveloped nature of their financial markets and the deliberate restraint on interest rates. Since the 1980s however, following the deregulation policies in most developing economies, many of central banks in these countries switched to the use of bank rate as the major instrument of monetary policy. Unexpectedly, some industrial economies in the late 1980s equally switched to bank rate as their main instrument of monetary policy, claiming that the liberalization of their financial markets was responsible for the unstable nature of the demand for money in their economies (Rao and Kumar, 2007). If 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, then it would be proper to test the stability of money demand in the developing economies since the policy shift. This can be done by applying methods in time series techniques like test for cointegration in models with regime and trend shifts.

Series of studies have applied these recent time series techniques in sub-Saharan Africa on varied topics. Few studies however, based on cointegration technique have been reported to have tested the stability of money demand function in Nigeria particularly since the 1986 structural policy shift (see for instance, Akinlo, 2006; Teriba, 2006 a,b; Owoye and Onofowora, 2007; Omotor, 2009; Chukwu, Agu and Onah, 2010 among others). These studies from a policy perspective, did not examine the implication of the estimates of the demand for money to understanding whether the Central Bank of Nigeria has successfully used monetary policy to achieve its objectives.

The second objective of this paper is to fill this gap in the empirical literature on the stability of the demand for money in Nigeria by allowing for structural breaks in the cointegrating relationship following the lead of Gregory and Hansen (1996a) as amplified by Rao and Kumar (2007). The Gregory and Hansen technique test is used to estimate cointegrating equations by endogenously determining the single break date, as against the Juselius (1996) test which assumes the single break date is known *a priori*. Although in recent times there exist complementary techniques in simultaneously determining two or more breaks, endogenous determination of a single break date using Nigerian data is mute in the empirical literature. It is thus reasonable to determine such a single break date endogenously (very reliable for measuring policy effectiveness) from the time series as it may be different from that which is exogenously fixed *a priori*.

The structure of the paper following the introduction is as follows: section 2 highlights some empirical literature on the study of money demand. Nigeria's monetary policy episodes are discussed in section 3 while section 4 presents the Gregory and Hansen (1996) cointegration approach with structural breaks as relayed by Rao and Kumar (2007). The empirical estimates of the break date and

their implications in determining the success of monetary policy in Nigeria are examined in section 5. Section 6 provides the conclusion.

2. Review of Empirical Literature

There has been a vast number of studies of money demand in sub-Saharan African countries; most of them on the Nigerian economy. Table 1 summarizes the estimated income coefficients and their main findings. Majority of the studies found the income coefficient to be positive with its value near unity. We briefly discuss some of the studies summarized in Table 1.

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. Arinze, Darrat and Meyer (1990) however found foreign interest rate to be inversely related to the demand for money.

Nwaobi (2002) and Nwafor, Nwakanma, Nkasah and Thopmson (2007) examined the stability of money demand for Nigeria using vector autoregression approach. Their results confirmed a stable money demand function for Nigeria. Akinlo (2006) using an autoregressive distributed lag (ARDL) technique combined with CUSUM and CUSUMQ tests, examined the cointegrating property and stability of broad (M2) money demand in Nigeria. The results show 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.

Nachega (2001) applies a cointegrated analysis and error correction modeling to investigate the behavior of broad money demand in Cameroon over 1963/64 – 1993/1994. The cointegrated VAR analysis identified a stable money demand function and an excess aggregate demand relationship for Cameroon. Further empirical estimates provided support for both purchasing power parity (PPP) and an international Fisher parity between Cameroon and France.

Nell (1999) empirically evaluated the existence of a stable long-run demand for money function 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.

Table 1.

STUDIES ON MONEY DEMAND AND THEIR FINDINGS

Author	Period/ Monetary Aggregates	Country	Method of Study	Income Elasticity	Interest Rate Elasticity	Main Findings
Teriba (1974)	1958 to 1972 DD	Nigeria	Static OLS	2.057 (1.97)	-0.07 (0.73)	Established roles for both treasury bills deposit rates as the relevant domestic opportunity cost in deposit demand.
Drama, Bedi Guy Herve and Yao , Shen (2010)	1980 to 2007 M1	Cote d'Ivoire	ECM	5.312 (6.164)	-0.191 (0.243)	The effect of aggregate (M2) is not so stable
Darrat, A.F. (1986)	1969:1 to 1978:4. M1	Kenya	OLS	1.843* (8.91)	-0.169 (3.40)	The results suggest that the estimated money demand equations for Kenya are temporally stable
Nwaobi (2002)	1960 to 1995 M1	Nigeria	VAR	0.639 (4.33)*	-0.098 (0.889)	Income as the most appropriate variable in money demand estimation.
Akinlo (2006)	1970:1 to 2004:4 M2	Nigeria	ARDL, CUSUM	1.094 (43.8)*	-0.097 (1.91)*	Stable M2 money demand
Teriba (2006a)	1960:1 to 1995:4 DD	Nigeria	OLS, ARDL (DD)	1.63* (19.91) -0.81* (-4.61)	1.66* (11.57) -0.97* (-2.9)	M1 more stable than DD. M1more suitable for policy inferences. Rate of inflation which was favoured in some previous studies over interest rates have no place in the long-run demand for money models.
Teriba (2006b)	1960:1 to 1995:4 M1	Nigeria	OLS, ARDL (M1)	1.44* (21.08) 1.68* (8.94)	-0.74* (-4.77) -0.85 (-1.8)	

Author	Period/ Monetary Aggregates	Country	Method of Study	Income Elasticity	Interest Rate Elasticity	Main Findings
Owoye and Onafowora (2007)	1986:1 to 2001:4. M2	Nigeria	VEC	2.067 (5.33)*	0.306 (8.191)*	Interest rate positively signed. Stability of long-run money demand
Nwanfor, *et.al.* (2007)	1986:3 to 2005:4 M2	Nigeria	VAR	5.43 (1.64)	0.48 (0.78)	Stable M2
Omotor (2009)	1970 to 2006 M2	Nigeria	ARDL	0.0913 (2.002)*	0.042 (0.481)	Income is more significant than real interest rate in the money demand function. A stable real money demand function
Chukwu, Agu and Onah (2010)	1986:1 to 2006:4 M2	Nigeria	'Psudo' Structural Breaks	-2.022 (1.45)	0.044 (3.86)	Stable money demand without statistically establishing a structural period.
Nachega (2001)	1963/64 to 1993/94 M2	Cameroon	ECM	0.7* (2.0)	0.9 (1.3)	The stability of the short-run dynamics of the broad money demand function is confirmed.
Nell (1999)	1965 to 1997 M3	South Africa	E-G, OLS	1.38* (14.39)	-0.04 (-0.67)	Stable long-run money demand for M3. M1 and M2 display parameter instability.
Kallon (1992)	1996:1 to 1986:4 M1	Ghana	2SLS	0.667* (2.034)	-0.0048* (4.529)	Nominal adjusted specification as the appropriate short-run adjustment mechanism for real M1. No significant effect of foreign interest on the demand for money.

Notes: t-statistics are in parenthesis and * denotes significance at 5% level. ARDL, VAR, VEC, CUSUM, ECM and 2SLS mean, Auto Regressive Distributed Lag, Vector Autoregression, Vector Error Correction, Cummulative Sum of Recursive Residuals, Error Correction Mechanism, and Two-Stage Least Squares respectively. PA, E-G, DD, M1 and M2 mean respectively, Panel Analysis, Engle-Granger, Demand Deposit, Narrow Money, and Broad Money. OLS is Ordinary Least Squares. 'Pseudo' is used to qualify the Structural Breaks technique used by Chukwu *et. al.* (2010) because their analysis did not follow the Gregory-Hansen formulation which they claim.

Kallon (1992) paper among other issues sought to determine whether the Ghanaian demand for real money balances was stable during the 1966:1 to 1986:4 period. The results failed to reject the null hypothesis of structural stability. The paper also finds evidence of the nominal adjustment specification as the appropriate short-run adjustment mechanism for the demand for real M1 balances. Further suggestion of foreign interest rates not having any significant effect on the demand for money in Ghana was evidenced.

Although most of the studies presented in the Table 1 relate to establishing a stable money demand using various techniques and models, however, in all the studies there are no formal tests for structural breaks in the relationships, except Chukwu, Agu and Onah (2010). Chukwu, *et. al* (2010) study 'claim' to apply the Gregory- Hansen (1996) framework to capture endogenous structural breaks in Nigeria for the period 1986:1 to 2006:4. The study analyzed four equations-level shift (change in intercept), level shift with trend, regime shift (where intercept and slope coefficients change) and regime shift (where intercept, slope coefficients and trend change). What is obvious in their presentations is that the Gregory-Hansen cointegration tests were not estimated either using the ADF procedure or the Phillips approach; rather, what they presented were estimates of slope coefficients and structural break periods. This further provides the impetus to formally tests for structural breaks in the money demand relationships using Nigerian data. Even if they did presumably, their study did not empirically determine the policy effectiveness of the Central Bank of Nigeria. This paper also bridges that gap.

3. Evolution and Development of Monetary Policy in Nigeria[1]

Nigeria monetary framework is characterized by various episodes of monetary policy probably due to the dissatisfaction with the ability of monetary policy strategy to achieve its target objectives of price stability and minimal inflation (Oluba, 2008). The institution responsible for this is the Central Bank of Nigeria (CBN).

The establishment of the CBN in July 1957 paved way for the use of monetary policy as instrument of economic management (Teriba, 1976) even if there instruments were direct. The major task of this section is to describe the changing emphasis on these objectives.

3.1. The Formative Years, July 1959 – March 1962

Prior to 1964, it has been argued, that no conscious monetary policies were implemented in Nigeria as operations of the CBN did not start until July 1959. In March 1962 following the launching of the country's Second National Development Plan (1961-1964), the CBN came into limelight of development financing. Monetary issues of concern (since the country was using the currency of the West African Currency Board) were the establishment of a strong financial base and the promotion of domestic financial infrastructures such as the money and capital market institutions and instruments (Gbosi, 1993:266). Notable actions taken during this period included the issuance of the Nigerian currency, introduction of the first Nigerian money market instrument – the Treasury Bills, establishment of the Nigerian Stock etc. The most active policy instrument during this period was the interest rate. For instance, between April, 1960 and December 1960, the discount rate and treasury rate were raised 10 and 13 times respectively. The aim of the Treasury bill then was to encourage commercial banks to repatriate short-term funds from London.

3.2. The Period 1962 – 1975

The first era of this period witnessed the Amendment Act of 1962 that strengthened the Central Bank for effective monetary policy promotion. Cheap monetary policy was adopted during this first era to enable the government borrow as cheaply as possible for purpose of financing the Second National Development Plan.

During the period 1964-1966, monetary policy was targeted at defending the balance of payments given the rapid credit expansion experienced in this period, which encouraged increased demand for imports and subsequent drain on foreign reserves. Monetary policy instruments used this period included fixing the exchange rate, interest rate, discount rate control, variable liquid assets and moral suasion to reserve the credit expansion.

Owing to the civil war in 1970, the Nigerian economy experienced an inflationary spree. Other factors that fuelled inflation were the unrealistic wage increase awarded by the Adebo and Udoji Commissions in 1971 and 1974 respectively. Consequently, inflation became the most serious problem in Nigeria. The Central Bank to this effect embarked on some direct control measures in order to salvage the inflationary bite. This included encouragement of commercial banks to channel a greater and increasing percentage of their credit allocation to produc-

tive sectors of the economy (Ajayi and Ojo, 1979). Other measures were targeted at reducing the liquidity of commercial banks and issuance of 'stabilization securities'. Under this scheme, the CBN was given powers to sell or allocate these securities to, or repurchase from any banking institution (Gbosi, 1993).

3.3. The Period 1975-1992: Direct Control Era

This period has been abruptly described as the direct control era. The major objective of monetary policy during this period was to promote rapid and sustainable economic growth. To this end, monetary authority imposed quantitative interest rate and credit ceilings on the money deposit of banks and sustained the sectoral credit allocation policy to 'preferred' sectors (agriculture, manufacturing, and residential housing). Less 'preferred sectors' imports and general (commerce) and "others". This classification as explained by Nnanna (2001:5) enabled the monetary authorities to direct financial resources at concessionary rates to sectors considered as priority areas. These rates were typically below the CBN – determined minimum rediscount rate (MRR), though still low and not determined by market forces.

The CBN also compelled banks to deposit with it (special deposit) any shortfall in the allocation of credit to the designated preferred sectors. However, this policy of direct control in the allocation of credit to the priority sectors did not meet the prescribed targets and failed to impact positively on investment, output and domestic prices. As further observed by Nnanna (2002: 9), banks' aggregate loans to the productive sector between 1972 and 1985 averaged 40.7 per cent to total credit, about 8.7 percentage points lower than the stipulated target of 49.4 percent.

The period of the 'Control Regime' equally experienced an impaired effectiveness of monetary policy. One major factor often cited was lack of instrument autonomy of the Central Bank as the Ministry of Finance influenced by short-term political considerations largely dictated monetary policy. Empirical evidence as cited in Nnanna (2002) on the works of Fisher (1994) and Ojo (2000) support the goals of Central Banks' autonomy. Instrument autonomy of Central Banks (CBs) is predicated on the strong influence CBs have on monetary management and their ability to achieve monetary policy objectives.

In 1987 the monetary and credit policy measures adopted were designed to facilitate the achievement of the goals of the Structural Adjustment Programme (SAP). The adoption of SAP was as a result of harsh and severe economic difficulties in 1985. The SAP programme was aimed at reforming and dismantling

the control regime and enhancement, promotion and use of indirect instruments of monetary controls. This ushered in the current monetary policy framework.

3.4. The Period of Indirect Instrument of Monetary Control (1993-Date)

The era began with selective removal of credit ceilings for banks beginning in September, 1993 following the promulgation of the CBN Decree 24 and the Banks and Other Financial Institutions Decree (BOFID) 25 of 1991. In 1998 Decree Numbers 37 and 38 of the CBN (Amendment) and BOFID (Amendment) were promulgated. In overall, the CBN Act was amended and granted it more discretion and autonomy in the conduct of monetary policy.

The monetary policy framework of indirect controls involved the use of market instruments, particularly the Open Market Operations (OMO) introduced at end of June 1993 and is conducted wholly on Nigeria Treasury Bills (TBs), including Repurchase Agreements (REPOS). The OMO is complemented by the CBN with the use of reserve requirements are the Cash Reserve Ratio (CRR) and the Liquidity Ratio (LR). The CRR has been progressively increased from 6 percent in 1995 to 12.5 percent in April, 2001. In 2005 there was an upward adjustment of the CRR by a total of 150 basis points and subsequent reduction.

The conduct of monetary policy during this era particularly in the early period was very phenomenal especially when viewed from the socio-political issues that characterized it. First, it was observed that the financial deepening index of M2/GDP which crashed from 35.9 in 1986 to 24.2 in 1992 increased by 29.7 in 1994. Second, the performance of the economy deteriorated in 1994 owing to the disruption caused by the prolonged political crisis and macroeconomic instability, arising from government's policy of guided deregulation.

The Minimum Rediscount Rate (MRR) has been used by the CBN to influence the level and direction of other interest rates. The changes in the rate indicate whether the monetary authorities wish to adopt a policy of monetary tightening or otherwise. The rate was 16.5 in December 2002, 15 percent in June 2004, 13 percent in December 2005 and 10 percent in December 2006.

In recent times, the CBN has been committed to ensuring price and exchange rate stability through restrictive monetary policy stance. This it has done with the introduction of the Wholesale Dutch Auction System (WDAS) and non-discountable Special Nigerian Treasury Bills (NTBs). In 2006, the CBN also introduced a new interest-rate determination scheme which establishes an interest-rate spread of three percentage points and above and below a short-term Monetary Policy Rate (MPR replaced MRR and became effective 11th December, 2006). The MPR

fixed at 10 percent in 2006 was reduced and retained at 8.0 percent in August 2007. Consequently, the annual headline inflation rate which averaged 17.9 percent in 2005 stood at 8.4 percent in 2006. Inflation stayed within single-digit of 6.4 percent in the first half of 2007. The exchange rate on the other hand has also faired well relatively. Apart from a drop in the market premium in the first week of 2006 June 2006 from N24 to N9.00, the naira exchange rate appreciated from US$1/₦151 in March 2006 to US$1/ ₦126.88 at end-March 2007 and appreciated to US$1/ ₦126.05 at end-June, 2007 (Central Bank of Nigeria Communiqué of the Monetary Policy Committee: *various issues*). Other policies of this period include recapitalization and consolidation of banks. The period 2006-2008, referred to as the period of post-banking consolidation is characterized by the gradual rundown of the Central Bank of Nigeria (CBN) holding of treasury bills (TBs), zero tolerance on ways and means advances and a frequent adjustment of the MPR[2]. With policy shifting to use of MPR coupled with a deregulated money market; will the money demand function still be stable?

4. The Gregory-Hansen Methodology

Gregory and Hansen (1996a) made an important contribution in the existing literature on cointegration by proposing residual-based tests of the null of no cointegration for the listed variables with I(1) order in the presence of structural breaks against the alternative cointegration. The Gregory-Hansen (G-H henceforth) methodology is an extension of the Engle-Granger (1987) cointegration analysis and can be viewed as a multivariate extension of the endogenous break test for univariate series The test allows testing for presence of cointegration among the variables of interest given the variables to be difference stationary or integrated of order one (Singh and Pandey, 2009). G-H proposes three models with different assumptions about structural breaks in the cointegrating relationship. These are, level shift, denoted as *C*; level shift with trend, denoted as *C/T*; and regime shift (both level shift and slope coefficients can change), this can be denoted as *C/S* (Gregory and Hansen, 1996b). The single break date in these models is assumed to be endogenously determined. Using a two-variable specification, the three models can be stated as follows:

$$Y_t = \alpha_1 + \alpha_2 D_{tk} + \beta_1 X_t + \varepsilon_t \tag{1}$$

$$Y_t = \alpha_1 + \alpha_2 D_{tk} + \delta t + \beta_1 X_t + \varepsilon_t \tag{2}$$

$$Y_t = \alpha_1 + \alpha_2 D_{tk} + \beta_1 X_t + \beta_2 X_t D_{tk} + \varepsilon_t \tag{3}$$

where Y is the dependent variable and X is the independent variable, t is a time trend, parameters α_1 and α_2 measure respectively the intercept before the break in $_k$ and the shift occurred after the break, β_1 and δ are slope coefficients attached to the cointegrating vector and time trend respectively, β_2 measures the change in the cointegrating vector after the regime shift, $_t$ is a time subscript, ε is an error term, k is the break date, and D_{tk} is a dummy variable defined as

$$D_{tk} = \begin{cases} 0 \text{ if } t \leq k \\ 0 \text{ if } t > k \end{cases} \tag{4}$$

with k denoting the point at which the break occurs. These models can easily be extended to more than one explanatory variable. As further explained by Cook (2006:1381), the residuals obtained from the above cointegrating regressions are then employed in the Dickey- Fuller test to provide a modified Engle-Granger (1987) test which allows for structural change in the cointegrating relationship:

$$\Delta\hat{\varepsilon}_t = p\hat{e}_{t-1} + \mu_t \tag{5}$$

where Δ denotes the difference operator such that $\Delta\hat{\varepsilon}_t - \widehat{\varepsilon_{t-1}}$. When determining the point at which to impose a break, Cook (2006: 1318) noted Gregory and Hansen (1996) suggestion of the use of a grid search procedure, with values in the central 70% of the sample being considered for k. That for each of the models (Equations 1-3), the Dickey-Fuller (DF) test of Equation 5 is estimated, with value employed as a resulting test statistic being the minimum value obtained for t-ratio of $\hat{\rho}$.

For purpose of clarity, the potential confusion and difference between structural breaks and non-stationarity in the data is here reiterated. According to Adachi and Liu (2009), the Perron (1997) procedure which allows for a breaking trend in the conventional augmented Dickey-Fuller (ADF) unit root test should not be misunderstood with structural break with a lack of cointegration. Rather, Gregory and Hansen (1996) structural breaks technique is an extension of Engle and Granger's (1987) cointegration procedure which allows for a shift of parameters in the cointegration equation. In addition, the unit roots and cointegration with structural breaks are not only different conceptually, they have different critical values. Rao and Kumar (2007) have further observed that with regime shifts, the distribution theory used to evaluate the residual-based tests is different from the standard MacKinnon (1991) cointegration tests used in the Engle and Granger two-step procedure. Consequently, Gregory and Hansen (1996:109) provided

modified MacKinnon (1991) critical values for testing cointegration in the Engle and Granger method with unknown breaks. This is the methodology we follow in this study.

In the literature, the general specification of the long-run money demand takes the functional relationship for most emerging economies in the form:

$$\frac{M}{p} = \left(Y, r\right) \tag{6}$$

where *M/P*, the demand for real balances is a function of the chosen scale variable *(Y)* to represent economic activity and the opportunity cost of holding money *(r)*. *M* is the selected monetary aggregate in nominal term and *P*, the price level. As further stated in Akinlo (2006), there is a general consensus in the literature that the money demand function be estimated in log-linear form. Letting the monetary aggregates and the scale variables be in logarithms; the interest rates in levels[4], the demand for money in Nigeria can be specified as:

$$\ln M2_t = \gamma + \phi \ln Y_t + \psi r_t + \varepsilon_t \tag{7}$$

where M2 is broad money, *Y* is real GDP, its coefficient is expected to have positive sign, and *r* is the nominal interest rate (MPR), whose coefficient is expected to be negative. Although several studies on developing economies have used the narrow money measurement to reflect the underdeveloped nature of their financial markets, other studies on the demand for money in Nigeria have employed the broad money definition with satisfying results. The use of M2 also find favour in the argument of Hafer and Jansen (1991) and Laidler (1993) that the boundaries of narrow money demand shift over time to accommodate new financial instruments, thus making it plausible to apply M2 in money demand analyses. The implied specifications for the three G-H Equations (1-3) with structural breaks are stated as follow:

$$\ln M_t = \alpha_1 + \alpha_2 D_{tk} + \beta_1 \ln Y_t + \psi_1 r_t + \varepsilon_t \tag{8}$$

$$\ln M_t = \alpha_1 + \alpha_2 D_{tk} + \delta_t + \beta_1 \ln Y_t + \psi_1 r_t + \varepsilon_t \tag{9}$$

$$\ln M_t = \alpha_1 + \alpha_2 D_{tk} + \beta_1 \ln Y_t + \beta_2 \ln Y_t D_{tk} + \psi_1 r_t + \psi_2 r_t D_{tk} + \varepsilon_t \tag{10}$$

The estimable equations for which cointegration is tested for are (8), (9) and (10) respectively. These are denoted as G-H1, G-H2 and G-H3.

5. Empirical Results of the Break Date and Dynamic Specification

The paper uses annual data from 1960 to 2008. The source of data is the Central Bank of Nigeria: *Statistical Bulletin*, 50 years Special Anniversary Edition.

5.1. Results of Unit Root and Cointegration Tests

It is important to check for the unit root properties of the individual series being time series in nature in order to avoid the problem of spurious regression. We examined the order of integration of the individual series using the Dickey-Fuller (DF) and Augmented Dickey-Fuller (ADF) tests of unit root with their results reported in Table 2. The DF and ADF tests indicate presence of unit root at level but all the series are stationary at first difference. It should be noted that we used constant and trend at levels but only constant at difference series since it is believed that differencing of the series takes away trend from the series (Singh and Pandey, 2009). The individual series of output, money supply, nominal interest rate and inflation rate used in the analysis are also respectively displayed graphically in Appendix A.

Table 2.

UNIT ROOT TEST RESULTS

Variables	Dickey-Fuller (DF) critical values		Augmented Dickey-Fuller (ADF) critical values	
	Level	First difference	Level	First difference
M	1.835	-4.254*	1.202	-3.545*
Y	-1.183	-6.164*	-1.172	-4.964*
r	-1.947	-8.932*	-1.506	-7.761*

*Indicate significance at 1% level of significance

Next we proceed to the estimate Equations 8-10 from 1960 to 2008. The results are presented in Table 3. The results of the estimations suggest that G-H2 is the most plausible model since its null is rejected at 1 per cent level; while G-H1 and G-H3 failed the tests as their null fall into the acceptance region, thus rejected as implausible. The endogenously determined break date of G-H2 is 1994. In this

model all estimated coefficients are significant at 1 per cent except the 1994 time trend which is weakly significant at about 11 per cent. The income elasticity coefficient of 0.51 though very low, is positively signed as expected *a priori*. Consequent upon this, we use the made residuals from G-H2 to estimate the short-run dynamic equation for the money demand with the error correction term in the spirit of Engle and Granger (1987). As earlier observed, the decade of the 1990 especially before mid-1990, can be described as a period of policy reversers and lost opportunities. First, the package of economic reforms embarked upon from the mid-1980s had its backlash effects on the real economy which were equally transmitted to the financial system. The experimentation with deregulation and liberalization was truncated in 1994 following the prolonged political crisis that chronicled into a *palace coup* led by the late Gen. Sanni Abacha. Second, the administration in a policy summersault re-regulated the economy, by capping exchange and interest rates in the spirit of guided deregulation. Thus in 1994, the GDP grew by 1.3 per cent while the inflation rate reached an all time highest of 57 per cent. Table 4 further present's average growth rates of some monetary indicators.

Table 3.

TESTS FOR COINTEGRATION WITH STRUCTURAL BREAKS, 1960-2008.

	Break date	GH test statistic	0.01 critical value	0.05 critical value	0.10 critical value	Reject H_0 of no cointegration
G-H1	1981	-3.899	-5.16	-4.92	-4.69	no
G-H2	1994	-5.551*	-5.51	-5.29	-5.03	yes
G-H3	1992	-4.625	-5.73	-5.73	-5.23	no

Source: Author's calculations. Asymptotic critical values obtained from Gregory and Hansen (1996:109).

Table 4.

COINTEGRATION EQUATION, 1960-2008

	G-H1	G-H2	G-H3
Intercept	5.03 (19.60)	5.26* (9.60)	5.06 (19.31)
Trend		0.01 (0.47)	
ln Y_t	0.53 (13.15)	0.51* (6.99)	0.52 (12.24)
r_t	-0.89 (6.43)	-0.92* (6.14)	-0.85 (5.78)
Dummy 1981	0.29 (2.30)		
Dummy 1992			-3.75 (0.32)
Dummy 1992*ln Y_t			-0.21 (0.25)
Dummy 1992*r_t			0.35 (0.46)
Dummy 1994		0.23 (1.65)**	

Notes: Absolute t-ratios are reported in parentheses. An asterisk points to significance at 1 per cent level of significance and indicated for only G-H2 being the Equation of interest.

Source: Author's calculations.

5.2. Basic Estimates of the Error-Correction Model of Real M2 Money Demand

The next stage is application of the general-to-specific modeling framework to develop the short term ECM model. To obtain model of the error correction mechanism, we regressed differenced series of money demand (M) on its own lags, the differenced terms of real GDP, interest rate, and their lagged terms, and the one-period lagged residuals from the cointegrating vector of Gregory and Hansen (G-H2). This over- parameterized model had lags up to four periods except for the ECM. By applying the LSE Hendry methodology, the numbers of the right-hand side variables were reduced until we obtained the most parsimonious model reported in Table 5. The absolute t-ratios are in parentheses and * and ** indicate significance at the 5% and 10 % respectively. All estimated coefficients are significant at the conventional levels of 5% and 10% except the interest rate coefficient, though rightly signed, it is statistically not significant. The poor behaviour of the interest rate in the estimated model may be a reason why the CBN relies more on open market operations (OMO) in the manipulation of monetary policy. The one period lagged error correction term (ECM_{t-1}) has the expected sign implying negative feedback mechanism and statistically significant at 5 per cent. The relative small size of the coefficient (-0.233) signifies smooth adjustment towards equilibrium. Thus if there are departure from equilibrium in the period, the

departure is reduced by about 23 per cent. From the battery of tests, the residuals are neither autocorrelated nor heteroscedastic.

Table 5.

PARSIMONIOUS RESULTS WITH DEPENDENT VARIABLE = $\Delta LN\ M_t$

Explanatory Variable	Coefficients (absolute t-ratio)	Test Statistic
$\Delta \ln M_{t-1}$	0.483* (3.311)	$R^{-2} = 0.123$
$\Delta \ln Y_t$	0.127** (1.74)	D-W = 2.08, χ^2_{ac} =1.46 (0.18)
Δr_{t-4}	-0.039 (0.300)	SER = 0.159
ΔECM_{t-1}	-0.232** (2.329)	χ^2_{hs} = 1.08 (0.14)

Source: Author's calculations.

5.3. Test for Structural Stability

In order to test the stability of the function, we applied both the CUSUM and CUSUM of squares tests (Brown, Durbin, and Evans, 1975). The CUSUM test is based on the cumulative sum of the recursive residuals which plots the cumulative sum together with the 5 per cent critical lines. The test finds parameter instability if the cumulative sum goes outside the area between the two critical lines. The CUSUM of squares test is like the CUSUM test, with movement outside the critical lines suggestive of parameter or variance instability. Both plots are shown in Figures 1 and 2 respectively. Both plots did not report any sign of instability; thus implying that the demand for money is temporarily stable in Nigeria. According to Poole (1970) as cited in Rao and Kumar (2009), it can be inferred from by these results that money supply is the appropriate monetary policy instrument of the Central Bank of Nigeria.

5.4. Effectiveness of Monetary Policy

The structural stability test indicate a stable demand for money in Nigeria but there was a regime shift in 1994, which caused a sharp increase in the demand for money of about 39.54 per cent. The implication is that the average stock of real money was 39.54 per cent higher during 1994-2007 than in earlier period[5].

Did the Central Bank of Nigeria use monetary policy effectively to achieve its objectives, particularly price stability? To answer this question, we followed Rao Kumar (2007) lead by computing the real excess supply of money (EXCMS) using the point estimate of 0.506 (see Table 4) as the income elasticity of demand for money.

The computation of the excess money supply values are presented in Table 6. The entire period (1960-2008) was broken down into four sub-periods judging with inflationary trend behavior of the economy. In the entire period of analysis (1960-2008), EXCMS is small and positive. We can deduce that the CBN may have maintained monetary equilibrium in the money market although average inflationary rate was high. The period 1973-1995, Nigeria experienced an unprecedented threshold inflation rate (27.24 per cent) and this followed with a relatively moderate inflation (11.95 per cent). During the high inflation period, EXCMS was negative (-0.723 per cent) implying the CBN's policy assisted in dampening the high inflation expectation occasioned by the oil price shocks of the 1970s and high budget deficits primarily financed by the Central Bank of Nigeria (CBN). The success of the restrictive monetary policy of the CBN is seen in the reduction in the inflationary rate in the period 1996-2008. This is not to say that the increased excess money supply did not have some inflationary impact. It did from the price change.

The monetary expansion also resulted in output falling from its 1973-1995 level of 1.8 percent to 0.52 per cent in 1996-1998. However, the fall in output as a result of the excess money supply of 1996-2008 is less than the proportionate fall in inflation due to negative excess money supply of the previous period (1973-1995).

Table 6.

EXCESS MONEY SUPPLY

	EXCMS	Δ ln y	Δ ln p
1961 – 2008	0.156	1.179	17.216
1961 – 1972	0.655	0.703	4.928
1973 – 1995	-0.723	1.800	27.244
1996 – 2008	1.253	0.520	11.955

Source: Author's calculations

6. Concluding Remarks

This study addresses three basic questions on the money demand function of Nigeria for the period 1960-2008. What is the endogenously determined structural break date in the cointegrating equation of the money demand function of Nigeria? Is the Nigerian money demand function stable over the period 1960-2008? And finally, did the Central Bank of Nigeria use monetary policy effectively to achieve its objectives during the period of analysis? To address the first question comprehensively, Table 4 presents the findings using the Gregory and Hansen procedures to test for an endogenously structural break date. The endogenously break date is 1994. This year is characterized by various policy shifts and a reversal among them is the truncation of the liberalisation and deregulation policy by the then new government led by the late Gen. Sanni Abacha.

The second question- stability of the demand for money in Nigeria. The plots of Figures 1 and 2 did not report any sign of instability. This implies that the demand for money is at least temporarily stable in Nigeria. Thus, money supply is an appropriate monetary policy instrument of the Central Bank of Nigeria. This also adds support to similar studies that have affirmed this.

Finally, did the Central Bank of Nigeria achieve the objective for which monetary policy was formulated? We used three sub-periods to examine the effectiveness of monetary policy in Nigeria. During the period of high inflation, 1973-1995, monetary policy was highly restrictive and helped to reduce inflation rate by dampening inflationary expectations. To answer in the affirmative, the CBN uses money supply as a monetary policy instrument effectively. Table 6 reports the details of the estimations. It should however be noted that the effectiveness of monetary policy can only be sustained by strong and transparent institutions among them the monetary authorities which is expected to be policy and instrument independent.

Endnotes

1. This section is extracted from an earlier paper by Omotor (2010), *processed*.
2. See various decisions of the CBN, Monetary Policy Committee Meeting. http://www.cenbank.org/monetary policy/decisions.asp [03/05/2010].
3. As noted in Singh and Pandey (2009), constant and trend were used at level but only constant at difference series while testing the null of a unit root with PP test, because differencing the series takes away trend from the series.

4. Some models have used the logarithm of interest rate.
5. Computed from raw data on money supply.
6. Country Report on Economic Practice and Trade of Nigeria (various issues). dosfan.lib.uic.edu/ERC/economics/trade_reports/1994/Nigeria.html [downloaded 02-06-2010].

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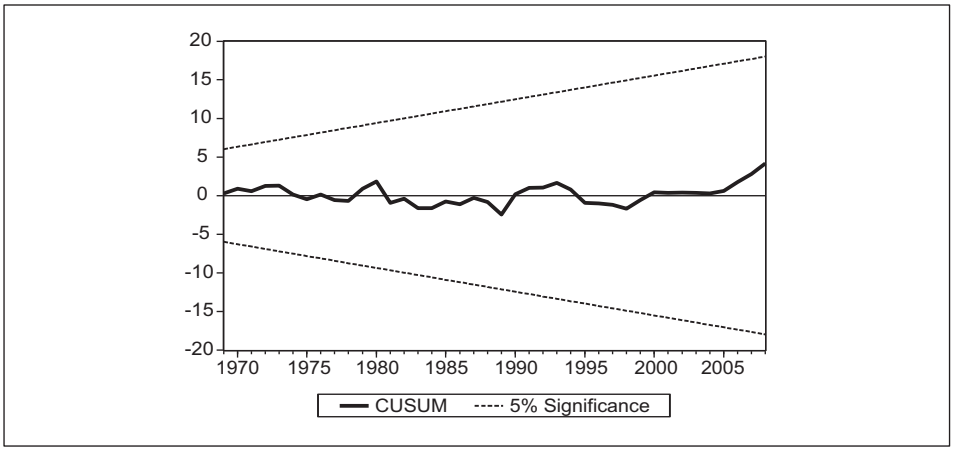
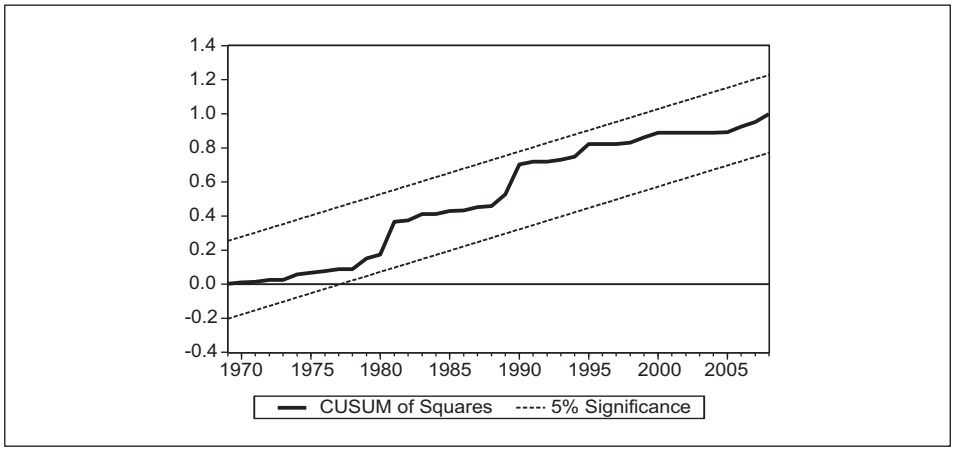
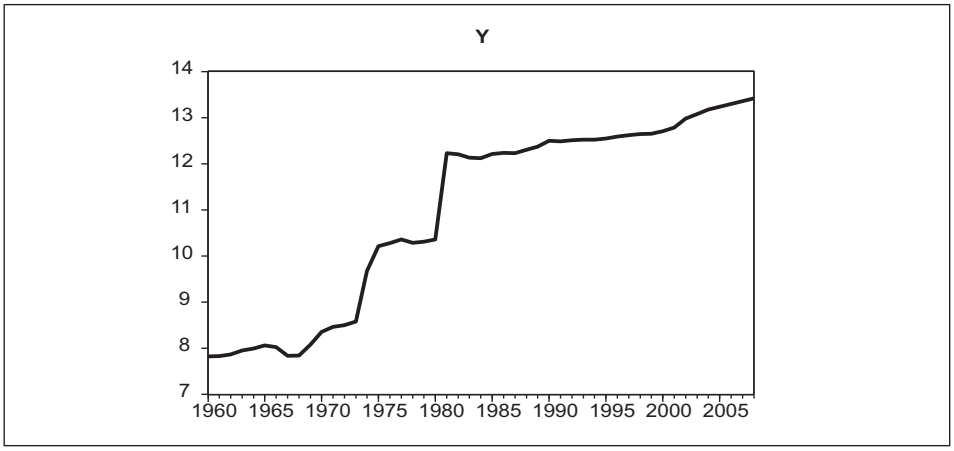
Figures 1 and 2:

PLOTS OF CUSUM AND CUSUM SQUARES





Appendix A.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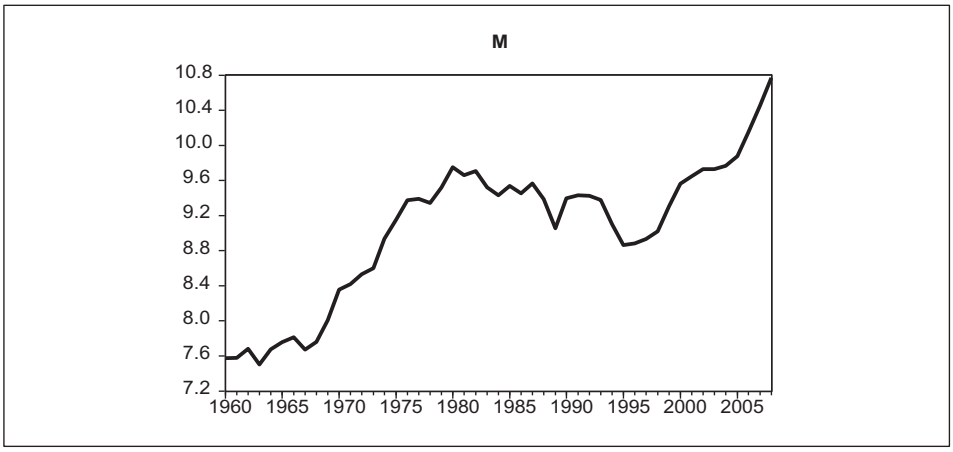
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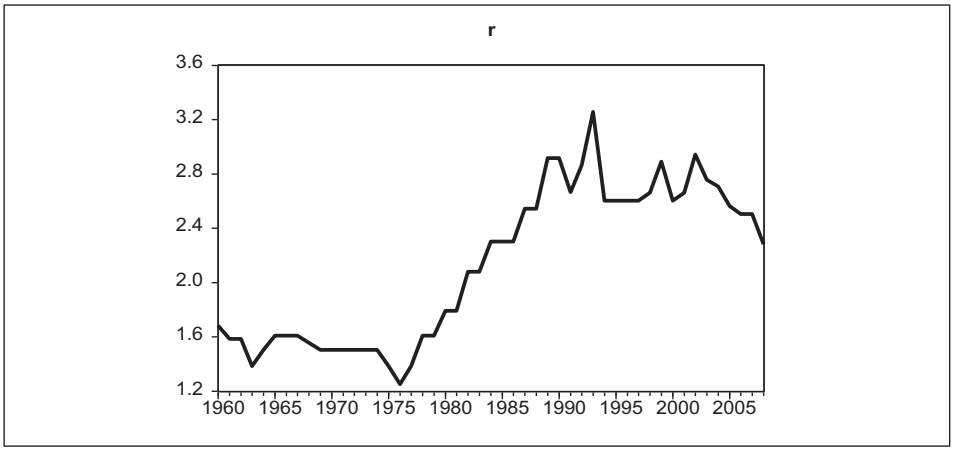
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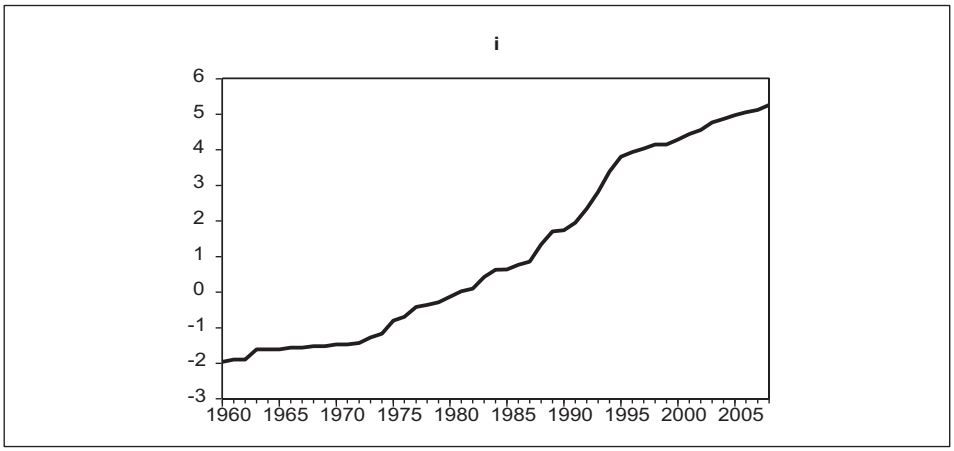

STRUKTURNI PREKIDI, POTRAŽNJA ZA NOVCEM I MONETARNA POLITIKA U NIGERIJI

Sažetak

U ovom se radu procjenjuje datum endogenog strukturnog prekida u funkciji potražnje za novcem u Nigeriji za razdoblje 1960.-2008. Koristeći se Gregory-Hansen metodom, za kointegracijsku jednadžbu potražnje za novcem određeno je da se endogeni prekid dogodio u 1994. Studija se nadovezuje na prethodne radove i potvrđuje stabilnost funkcije potražnje za novcem u Nigeriji. Povrh toga ustanovljeno je da je Središnja nigerijska banka uspješno upotrebljavala ponudu novca kao instrument monetarne politike.

Ključne riječi: potražnja za novcem, strukturni prekidi, monetarna politika, Nigerija