DEMAND FOR MONEY IN A DEBT-CONSTRAINED ECONOMY: A CASE STUDY OF NIGERIA

By

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Studies in Nigeria on the demand for money had often centred around finding a stable function using variables such as income, interest rate, inflation, exchange rate or foreign interest rate. This study considers the impact of debt (external sector variable) on demand for money. In particular, the debt service ratio has been shown empirically to influence demand for money. Our model, estimated with debt service taken into account, was found to be very stable. Hence, on the basis of this empirical finding, it is recommended that debt-service be considered an appropriate policy tool of monetary control. The two measures of exchange rate, parallel and official, showed no significant difference in the two models the study relied on, but model 1 was found to encompass model 2.

1. INTRODUCTION

The subject of demand for money has over the years generated much interest among researchers and has increasingly become a focus of economic analyses. This focus is attributed to the fact that monetary policy will only be effective if the demand for money function is stable. Stability of demand for money is crucial in understanding the behaviour of critical macroeconomic variables. Keynes' (1936) had a great impact on the theory of demand for money function. Prior to this, theories on the demand for money were variants of the quantity theory of money that David Hume advanced as early as 1752 to explain the balance-of-payments adjustment mechanism. Irving Fisher (1911), also contributed to the development of modern quantity theory. Subsequent studies recognised that demand for money was not only a function of the rate of interest but also of several other variables. After the second world war, when attention began to be focused on the problems of developing countries, it became necessary to develop a framework for explaining the role of money in economic development process. It was felt that expanding money supply and lowering interest rates might be good policy for investment, growth and development. Consequently, there has been a focus on issues such as the relationship between financial intermediation and economic growth, the sensitivity of savings to changes in real interest rates, relationship between demand for money and income, interest rate and expected rate of inflation.

Attempts to demonstrate the determinants of and stability in the demand for money in Nigeria dates back to the early 1970s. Tomori (1972) generated a lot of debate (in what is

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now known as the "TATOO DEBATE" on the subject matter and consequently, led to further empirical investigations of the issue. But there is no known study in Nigeria which has looked at the effect of debt burden on the conduct of monetary policy. The debt burden occasioned by heavy debt service ratio is bound to affect the demand for money function via the Monetary Approach to Balance of Payment (MABP).

Debt repayment inevitably imposes constraints on a debtor country's growth prospects since it involves the transfer of resources to other countries. In order to adequately appreciate the problem of indebtedness, it is essential to relate debt and its repayments to some income resources generated by the debtor out of which the repayments could be made. A number of macroeconomic aggregates and ratios are often used to assess the debt burden of a country which are based on (i) total debt outstanding and disbursed (DOD); (ii) total debt service, i.e, interest plus principal repayments; and (iii) interest payments. The burden from these are often compared with export earnings and either gross domestic product (GDP) or gross national products (GNP) to yield the following ratios; debt-service/export, interest/export, total debt/export, debt-service/GDP, interest/GDP, and total debt/GDP. The higher the ratios, the greater the burden. Of all the ratios, movement in the ratio of debt service payments to exports of goods and services (debt-service ratio) and total debt service to income (GNP) are the most important indices used to assess the debt burden. This is because debt service ratio or the debt-GNP ratio are indices of liquidity solvency. Lack of liquidity occurs when a country does not have enough cash on hand to pay for current obligations (Cline, 1985; Eaton and Taylor, 1986). The solvency problem relates to whether the value of a country's liability exceeds the ability to pay at any time. A country is insolvent when it is incapable of servicing its debt in the long run (Ajayi, 1991). Regarding the debt-service ratio, it is clear that Nigeria has been confronted with liquidity difficulties since the early 1980s' and that its ability to remain solvent has been impaired.

The pertinent question to ask is, what is the relevance of debt to money demand in a debt constrained economy like Nigeria?. Put differently, can the money demand function in Nigeria be said to be correctly specified without considering the debt factor?.

Nigeria, with a debt-export ratio of 292.1% (CBN, 1994) cannot be said to be debt-distressed considering the threshold of 200% between credit worthiness and the lack of it (Carios, 1985). We shall consider a country to be debt constrained if it is experiencing the pang of debt-burden but its export base is able to sustain its capacity to service this debt. In Nigeria, the main export base is oil with favourable prices and reserves are created then she would not be considered distressed as her export earning would continue to expand to meet her debt service obligations. Thus, the Nigerian economy could be described as a 'Debt Constrained' economy.

The general objective of this study is to empirically examine, the nature of the demand for money function in Nigeria (a debt-constrained economy) using cointegration and error correction technique. Specifically, the study would attempt:

(i) to establish the demand for money function in Nigeria within the context of a debt constrained economy.

(ii) to test the stability of the model.

(iii) and from the results obtained in (i) make policy recommendations towards putting in place an effective and efficient monetary policy.

The paper is divided into five sections. Section 1 introduces the concept and gives a background to the problem. Section 2 examines some relevant literature with a view to providing the background for the theoretic and conceptual framework. Methodological issues are discussed in section 3 together with model specification. In section 4, results are presented and discussed while section five contains policy recommendations and conclusion.

2. THEORETIC AND CONCEPTUAL FRAMEWORK

2.1. General Review

Attempts to demonstrate the determinants and stability of demand for money function date back to David Hume (1752). However, Keynes' (1936) work had a great impact on the theory of demand for money function. Several studies have, thereafter, been conducted on this subject among which are Bolnick (1975), Pathak (1981) and Darret (1985). Pathak looked at stability of the functions as well as the function of money as a medium of exchange. Darrat demonstrated the long-run elasticities of real money demand (narrow money, M_1 and broad money, M_2). His study showed that real income elasticities of M_1 and M_2 were greater than unity and the function was stable.

Tomori (1972) found income, interest rate, real income to be the major determinants of demand for money in Nigeria. Owing to perceived shortcomings in Tomori's study, a spate of research was conducted. In what some regard as the 'TATOO' debate in the literature, Ajayi (1974), Teriba (1974), Ojo (1974a), and (1974b), and Odama (1974) reacted to the findings of Tomori. The debate centred around the choice of the money demand model (i.e the choice of the most appropriate proxies), interest rate, the role of inflation rate and monetary aggregates; stability and reliability of the elasticities of the demand for money function as well as the stability of the regression over the sample period (Ajayi, 1974 and Odama, 1974). In order to examine the adjustment mechanism, Tomori (1972) adopted the partial adjustment framework and found the speed of adjustment to be rapid. However, Ajayi (1974) and Teriba (1974) unanimously concluded that the speed of adjustment was slow.

One of the most crucial aspects in the debate was the policy relevance of empirical modeling (Odama, 1974 and Tomori, 1972 and 1974). For instance, Odama (1974) suggested that a model should be of sufficient generality to support a policy simulation experiment, showing for specific target levels, the implied values of the instruments (or vice versa). Since the 'TATOO' debate and the recent works by Oresotu and Mordi (1992) and Teriba (1992), other empirical studies on money demand have been conducted in Nigeria. Among, these are: Iyoha (1976), Akinifesi and Phillips (1978), Sahi and Sheikh (1979), Fakiyesi (1980), Fakiyesi and Darret (1986), Adejugbe (1988), Ajowole (1989) and the World Bank (1991). Of these studies only Oresotu and Mordi (1992) and Teriba

(1992) are examples of contributions to the policy aspect of the modeling of demand for money function in Nigeria. The present work seeks to build on the results of the efforts in modeling the demand for money function from Tomori (1972) to Teriba (1992) by addressing the transition from modeling and policy concepts in the light of the current debt burden the Nigerian economy is facing.

2.2. Choice of Variable

One of the uncertain aspect of the demand for money modeling in Nigeria has been the choice of appropriate proxies. Among the unsettled problem of choice is the choice of proxies for transaction, scale factor, and domestic and foreign opportunity costs e.t.c. For instance, for money stock, it is the thinking of Arrau and De Gregorio[1] (1991) that the use of broader monetary base that includes other financial instruments in modeling money demand in developing countries could be misleading as financial seetors in most developing countries are not well developed and components of broad definition of money are interest bearing. The Nigerian case is not very different from other developing countries' cases. Consequently, the narrow definition of money, M_1, is used in our model.

On the proxy for transaction medium, the standard choice has been gross national product (GNP) or gross domestie product (GDP). However, Teriba (1992) showed that the GDP-based model is superior to the GNP-based model. Also, Bomberger and Mackinon (1980) and Mankiw and Summers (1986) provided theoretical arguments as well as empirical evidence to establish the superiority of expenditure-based proxies for transaction to those based on production. Bomberger and Mackinon argued that the choice of the proxy for transactions should depend, among other things, upon the relative size and stability of money balances held by producers of goods and ultimate buyers. For an open economy, they argued that the impact of foreign trade on total domestic transactions and thus demand for local exchange media, is captured more accurately in an expenditure-based aggregate such as gross national income (derivable as the sum of GNP and term of trade adjustment). Arrau and De Gregorio (1991) however, warned that, while there is evidence that households in developed countries hold about two thirds of real balances, "the extrapolation of this conclusion to developing countries may be controversial as firms may have much less sophisticated cash management procedures". Adam (1992) also argued that as a consequence of the volatility in the terms of trade in the Kenyan economy, GDP may fail to capture adequately the demand for money. It (GDP) would therefore, not be an adequate measure of income. Laidler (1985) reviewed this choice of scale variable and came to the conclusion that since both GDP and GNP move together results obtained would not change significantly.

Regarding domestic opportunity costs, a wide range of interest rates exists in Nigeria and they all tend to move together. The issue thus reduces to seeking a more representative rate among those available. Teriba (1992) found that, while the use of either the three month treasury bill rate (TBR) and long term (over twenty years) development stock of the Federal Government (FGSR) produced cointegration when GDP was the scale variable, only the FGSR belonged to the cointegration vector when the GNP was used. GNP

encompassed the two GDP-based models in the non-nested tests, suggesting that the most appropriate interest rate for the longer sample period was the FGSR.

Inflation rate, another domestic opportunity cost of holding money has been suggested by conventional literature to replace domestic interest rate in a developing country where the financial system is not just rudimentary but also heavily repressed. The argument here is that in such a system, substitution between money and physical assets are more common place than substitution between money and non-monetary financial assets. However, Baba, Hendry and Starr (1992) have argued that the rate of inflation would enter the demand for money independently, just as interest rate, if it is imperfectly correlated with them, and showed empirically that the demand for money (M_1) in the US would be mispecified if inflation rate is excluded. Again Teriba (1992) confirmed empirically that in Nigeria there is low correlation between inflation rate and interest rate, reflecting the fact that interest rates were heavily controlled over much of his sample period (1960-1989). Consequently, he included inflation rate in his model and the empirical results justified its inclusion. With respect to foreign oppotunity cost, which measures the influence of foreign economic conditions on demand for money, Thomas (1985) and Gioviani and Turtelboom (1993) maintained that the inclusion of a representative foreign interest rate in addition to the domestic interest rate would capture the influence of capital mobility or substitutability between local money and foreign near monetary assets on the money holder's asset portfolio. There is also the need to consider the returns on foreign assets as an opportunity cost variable because economic agents in an open economy could hold either local or foreign financial assets rather than local cash balances (Hamburger, 1977). Djeto and Pourjerami (1990) provided evidence from Cote d'Ivoire to confirm that ignoring returns on foreign assets could lead to model mispecification.

The return on the holdings of foreign assests will be influenced by expectations of exchange rate movements. Depreciation of the domestic currency relative to foreign currencies would lead to a rise in the return on foreign assets to domestic holders. The converse holds true. Consequently, attempt should be made to capture the influence of exchange rate expectations on the return on foreign assets. This could be done by either adjusting the foreign interest rate for exchange rate expectations or by introducing the exchange rate expectations as a separate variable into the demand for money function to be able to identify the separate effects. Elbadawi (1992) suggested that the influence of the rate of change of parallel market exchange rate or its premium on the holdings of domestic currency vis-a-vis holdings of foreign exchange or other forms of durable assets could be strong enough to validate the use of the parallel market rate as the true opportunity cost variable. This study, however, uses exchange rate rather than foreign interest rate as a measure for currency substitution in the Nigerian economy. In particular, both the ₦/ US dollar official and parallel market rates are used.

As earlier mentioned, the ratio of debt service payment to export of goods and services (debt-service ratio) and total external debt to income (GNP) are the two most important indices used to assess the debt burden. However, in the present work, debt-service ratio is used as a measure of debt burden. This is based on Onwioduokit (1995) observation that for a monoculture economy which is also import-dependent, the use of debt-service ratio as a measure of debt burden is superior to the use of total debt to income. Also, the choice

of debt-service ratio is preferred in our present model as a way of getting around the possible problem of multicollinearity.

3. MODELING DEMAND FOR MONEY

3.1 The Model

A model of demand for real money balances would revolve around finding stable function (in the face of increasing debt burden) establishing a stable equilibrium relationship between the demand for money and the factors influencing them. Such stability would ensure that disequilibrium following a shock is transient. Also, the existence of a long run equilibrium would ensure that the model could be specified in a short run dynamic way via the error correction mechanism, while removing any spurious inferences.

Proceeding from a Keynesian framework, which finds explanation and asset theories for holding cash balances, we specify for the transaction and the precautionary motive;

$$(M/P)^d = L_1 (Y/P) \quad (1)$$

where,

L_1 is the transaction and precautionary elements, (Y/P) is the real income, (M/P) is the real money balance. For the return on assets which defines the speculative motive we specify;

$$(M/P)^d = L_2 (r) \quad (2)$$

where,

L_2 is the speculative element and r, the interest rate. Combining (1) and (2), we get

$$(M/P)^d = f(Y/P, r) \quad (3)$$

$$(M/P)/Y > 0 \text{ and } (M/P)/r < 0$$

The extension of the above model to include inflation (Brownson, 1989) would yield

$$(M/P)^d = f(Y/P, r, \Pi) \quad (4)$$

where, Π is the inflation rate or growth rate of consumer price index.

Thus, a typical demand for money would consist of a transaction medium, M_1, narrow money, a scale variable (GDP or GNP), an opportunity cost variable, which could be empirically chosen from several measures on return on assets (Teriba, 1974), a final opportunity cost of holding money, which is the inflation rate.

In an open economy such as Nigeria, the model is further extended to include the external sector, thus the need to include the return on foreign assets as an opportunity cost since economic units in the domestic economy could invest in high interest yielding assests abroad. It is expected that domestic currency return on foreign asset holding would increase with depreciation in exchange rate, and hence the need to include either exchange rate or foreign interest rate in the equation (Adam, 1991), depending on the goal of the study. This inclusion yields the specification,

$$(M/P)^d = f(Y/P, r_d, \Pi, r_f \text{ or } e) \quad (5)$$

where,

r_f is the foreign interest rate, and e is the exchange rate.

Following from above, the external sector becomes relevant in modeling the demand for money. For an economy that is feeling the burden of external debt and in order to relate demand for money with external debt, consider the external debt growth identity below:

$$(D_t - D_{t-1}) - (R_t - R_{t-1}) = iD_{t-1} - iR_{t-1} + X_t - M_t \qquad (6)$$

where,

D = year-end debt (both concessional Official Development Assistance (ODA) and non-concessional loans);

R = year-end external reserves;

i = average interest rate on debt and reserves (assumed for simplicity to be equal);

M = annual import of goods and services;

X = annual exports of goods and services (excluding interest on reserves); and

t = year.

This expression ignores capital flight, which could add to debt without any corresponding trade or interest payment deficits. Equation (6) states that the growth of external debt in relation to external reserves equals the difference between interest payments on external debt and interest earnings on external reserves plus the trade deficit (Obadan, 1995). This is simplified to give net debt as

$$D_t - D_{t-1} = iD_{t-1} + X_t - M_t \qquad (7)$$

Implying that,

$$D_t - D_{t-1} = i + X_t - M_t \qquad (8)$$

or

$$i = GD_t - (X_t - M_t) \qquad (9)$$

where GD_t is the growth in debt at time t.
thus,

$$\frac{i}{X_t} = \frac{GD_t}{X_t} + \frac{M_t}{X_t} - 1 \qquad (10)$$

or

$$DB_t = \frac{GD_t}{X_t} + R_{M_t/X_t} - 1 \qquad (11)$$

where,
DB = is a measure of debt burden defined as the ratio of interest payment to exports; and
$R_{M/Y}$ = ratio of imports to exports.
Also, consider the basic money supply function

$$M_s = mB \quad (12)$$

$$= m(D+R) \quad (13)$$

where,

M_s = Money supply

m = Money multiplier

B = Monetary Base

Thus, from (13) money supply, M_s, consists of the domestic credit creation (D) and an international component (R), i.e the domestic currency value of the monetary authorities' international reserves. If we then relate debt to reserves, and given that $Gd_t/X_t) < 1$ (see Annex C), equation (11) shows that a decrease in $R_{M/Y}$ reduces the debt burden which increases the country's external reserves, hence an increase in money supply and vice versa. This would seem to imply that an appropriate policy measure to reduce debt burden would be to increase money supply which could have inflationary consequences. This, however depends on the component of credit creation that is favoured in (13).

From equations (5) and (13), it could be shown that under condition of money market equilibrium,

$$\Delta D = \Delta (M/P)^d - \Delta R = f(Y/P, r_d, \Pi, r_f \text{ or } e) - \Delta R \quad (14)$$

i.e a change in domestic credit would be positive to the extent that the change in total money demand exceeds change in net international reserve. A necessary condition for disequilibrium would be changes in money demand and domestic credit creation, while adjustment mechanism to ensure equilibrium would vary with changes in reserve maintained by a reduction in the debt burden. Thus, in a debt constrained economy the issue of debt cannot be overlooked in modeling demand for money. Ajayi (1991) observed that the major macroeconomic goal of a country experiencing debt problems is to reduce its debt burden and increase its debt servicing capacity.

If we define the debt burden as ratio of debt service to exports, an increase in debt service constraints the ability of the economy to meet its domestic obligations.

3.2. Model Specification

Following from the above discussion, a measure of debt burden is introduced into the demand for money equation to yield the specification:

$$(M/P)^d = F[Y/P, R_d, \Pi, PAR, DS] \quad (15)$$

$$(M/P)^d = F[Y/P. R_d, \Pi, MKT, DS] \quad (16)$$

where,

M = transaction money demand (M1);

P = consumer price index (1985=100);

Y = aggregate income (Gross Domestic Product);

R_d = domestic interest rate (Discount Rate);

Π = inflation rate;
PAR/MKT = parallel/official exchange rate of the naira to the dollar; and
DS = debt service ratio.

Writing (13) and (14) in logarithmic form we have;

$$(m_t-p_t) = \alpha_0 + \alpha_1 (y_t-p_t) + \alpha_2 r_d + \alpha_3 \Pi + \alpha_4 e_p + \alpha_5 ds_t + u_t \quad (17)$$

$$(m_t-p_t) = \alpha_0 + \alpha_1 (y_t-p_t) + \alpha_2 r_d + \alpha_3 \Pi + \alpha_4 e_m + \alpha_5 ds_t + v_t \quad (18)$$

where the coefficients α_1, $\alpha_3 > 0$ and α_2, α_4, $\alpha_5 < 0$ are long run elasticities. Equation (15) uses the parallel market rate, e_p while (16) is a model with official market rate, e_m.

Adopting the Engel-Granger (1987) two-step approach we would first determine the order of integration of the variables in the regression using the Dickey Fuller (DF) and Augmented Dickey Fuller (to correct for autocorrelation in the error term) set of unit root test, with Sargan-Bhargava Durbin Watson test (SBDW)[2] as a confirmatory tests, and then proceed to search for the existence of a long run equilibrium relation between money demand and the factors effecting it as stipulated by our postulate. We would thus be led to determining its dynamic short run behaviour as specified by the error correction model. According to the Granger theorem: if a set of variables are cointegrated of order 1, then there exists a valid error correction representation of the data. Also, the converse is true in that cointegration is a necessary condition for error correction models to hold (Engel and Granger, 1991). The error eorrection specification is of the form;

$$\Delta y_t = \alpha_0 + \alpha_1 \Delta x_t + \alpha_2 (y_{t-1} - x_{t-1}) + \varepsilon_t \quad (19)$$

where,
x is a vector of explanatory variables and the specification assumes that the cointegrating vector is not known a priori.

3.3. Data And Their Sources

Data for this work are quarterly, spanning 1978 to 1994 and obtained from International Financial Statistics (various issues). However, data for debt service were obtained from International Economic Relations Department of the Central Bank of Nigeria (CBN), from 1984 to 1994. Quarterly data were generated from the annual ones for 1978 to 1983 using the method of ratio estimation (see Ajani, 1978).

The variables used in this study and their definitions are outlined below:

LRMI = Logarithm of Real money demand
LRGDP = Logarithm of Real Gross domestic product
LDIR = Logarithm of Treasury bills discount rate
LINF = Logarithm of Inflation rate
LDES = Logarithm of debt serve ratio
LFAR = Logarithm of parallel market rate
LMKT = Logarithm of official market rate
ECV = Error correction variable

4. EMPIRICAL RESULTS

4.1 Time Series Properties of Data

Table 1 shows the results for the DF and ADF class of unit root test and also the SBDW test. These tests conducted at the levels of the variables show that all variables except inflation rate are non-stationary. This findings suggests that they are I(1) variables as confirmed by a test on the first difference of the variables.

Table 1: Unit root test on quarterly data on variables

VARIABLE	DF	ADF Max. Lag =4	SBDW	ORDER
LRMI	3.0240 (-3.5908)	-1.8696 (-3.0514)	0.4466	1
LRGDP	-2.8435 (-2.8334)	-1.8359 (-1.6198)	0.7042	1
LDIR	-2.0112 (-1.9707)	-1.7401 (-1.5004)	0.0575	1
LPAR	0.41569 (-2.2542)	-0.12660 (-2.5448)	0.5189	1
LMKT	0.47620 (-2.2142)	-0.058782 (-2.5317)	0.0349	1
LINF	-5.049 (-6.3001)	-2.2826 (-3.5795)	1.1586	0
LDES	-2.29232 (-2.0028)	-2.5072 (-1.5779)	0.5547	1

The values in parenthesis are for unit root test with trend.
Sample size, n = 67.
SBDW tends to 2 for I(o) series. Low values indicates I(1)
H_o: Y_t is I(o)
DF Test is $Y_t = \propto + \rho y_{t-1} + U_t$; U_t (0,σ²), $y_o = 0$
ADF Test is $Y_t = \propto + \rho y_{t-1} + \Sigma r_j \Delta y_{t-j} + U_t$
H_o: $\rho = I$

Thus, a dynamic modeling using the variables at their levels such as the partial adjustment model would result in spurious regression as it is confirmed by the battery of diagnostic tests in the static regression as shown in table 2. Mainly, the table indicates low value for DW statistics, inherent serial correlation, and functional form mispecification for models 1 and 2.

4.2. Testing For Cointegration

Table 2. Results for static regression

Variable	Model 1	Model 2
CONS	5.8168 (0.000)	5.8358 (0.000)
LRGDP	0.26577 (0.004)	0.27042 (0.004)
LDIR	-0.92506 (0.000)	-0.94417 (0.000)
LDES	0.15828 (0.000)	0.16037 (0.000)
LPAR	0.10526 (0.005)	-
LMKT	-	0.11025 (0.003)
R^2	0.60	0.61
R^2 adjusted	0.57	0.58
F	23.65	24.23
DW	0.81	0.82
Serial Correlation	27.10 (0.000)	26.24 (0.000)
Functional Form	15.56 (0.000)	15.39 (0.000)
Normality	0.96 (0.619)	1.29 (0.525)
Heteroscedasticity	0.1065×10^{-7} (1.00)	0.018 (0.894)

Diagnostic test is LM version

Low R^2 in static regression may wrongly indicate that there is cointegration. However, we would take the residual from the static regression as a valid error correction term if it is stationary and hence conclude that the variables are cointegrated under the following conditions (according to Engel & Granger, 1991);

(i) all components of the vector of variables X_t are I(1)

(ii) there exists a cointegrating vector Φ such that

$Z_t = \Phi' X_t \sim I(d\text{-}b)$, $b>0$ if X_t is I (d)

Table 3. Residual Stationarity Test

Variables	DF	ADF Max lag = 4	SBDW	Order
ECV 1	-4.0260 (-3.9962)	-2.9614 (-2.9488)	0.7595	I(o)
ECV 2	-4.0806 (-4.0496)	-2.9923 (-2.9834)	0.7208	I(o)

Table 3 shows that there is no unit root in the residuals from both models. Thus the I(1) variables are all cointegrated. Inflation rate was I(o) and was dropped from the cointegration analysis. Table 2 also represents long-run specification of the interplay of real money demand and its determinants. Given that cointegration was developed to make the concept of long run equilibrium operational, we proceed to capture the dynamics of demand for real money balances as specified in the error correction model earlier stated

4.3. The Dynamics

Adopting a general to specific framework we proceed to the second step of specifying an overparametised autoregressive distributed lag (ADL) error correction model of the form

$$A(L)\, y_t = Y_0 + B(L)\, U_t \qquad (20)$$

in first difference. This enables us to identify the nature of the main dynamic patterns in the long run solution of the model and ensure that this dynamics is not constrained by a lag that is too short. A lag of 4 period is considered an appropriate maximum (Hendry and Mizon, 1984). Thus for the model using parallel market rate, denoted model 1, we have:

$$\Delta lrml = \alpha_o + \alpha_{1i} \sum_{i=1}^{4} \Delta lrml_{t-i} + \alpha_{2i} \sum_{i=0}^{4} \Delta lrgdp_{t-i} + \alpha_{3i} \sum_{i=0}^{4} \Delta ldir_{t-i} + \alpha_{4i} \sum_{i=0}^{4} \Delta ldes_{t-i}$$
$$+ \alpha_{5i} \sum_{i=1}^{4} \Delta lpar_{t-i} + \alpha_6 ecvl_{t-i} \qquad (21)$$

$$\Delta lrml = \alpha_o + \alpha_{1i} \sum_{i=1}^{4} \Delta lrml_{t-i} + \alpha_{2i} \sum_{i=0}^{4} \Delta lrgdp_{t-i} + \alpha_{3i} \sum_{i=0}^{4} \Delta ldir_{t-i} + \alpha_{4i} \sum_{i=0}^{4} \Delta ldes_{t-i}$$
$$+ \alpha_{5i} \sum_{i=1}^{4} \Delta lmkt_{t-i} + \alpha_6 ecv2_{t-i} \qquad (22)$$

Table 4. Modeling ΔLRM1 using OLS

Variables	Coefficient (Model 1)	t-Value (Model 1)	Coefficient (Model 2)	t-value (Model 2)
Lrml 1	.1619046	1.00353	.1536049	0.96741
Lrml 2	.1933226	1.21899	.1629932	1.04180
Lrml 3	.3382530	2.20402	.3199096	2.07566
Lrml 4	.0105702	.06451	-.0007848	-.00462
CONSTANT	.0194460	.91301	.0304429	1.14876
Lrgdp	.1133892	1.17514	.1375752	1.37070
Lrgdp 1	-.0661310	-.59044	-.0836994	-.72780
Lrgdp 2	-.2520662	-2.10537	-.1663572	-1.34398
Lrgdp 3	-.2493609	-2.08587	-.2526986	-2.07113
Lrgdp 4	-.1112393	-1.01347	-.0820380	-.68761
Ldir	-.8536483	-4.34823	-.8947740	-4.44990
Ldir 1	.1267094	.55099	.1649383	.71221
Ldir 2	.5720877	2.50983	.5135888	2.25669
Ldir 3	.3592828	1.52052	.3963037	1.67738
Ldir 4	-.5359992	-2.05391	-.5640207	-2.19366
Ldes	.0065928	.29178	-.0322987	-.36553
Ldes 1	-.0461932	-1.71291	.0201109	.20112
Ldes 2	-.0008986	-.03248	-.0984732	-.97817
Ldes 3	-.0098875	-.38284	-.0448640	-.45733
Ldes 4	-.0223424	-.99182	-.0758468	-.89461
Lpar	-.0009514	-.05502	.0116800	.52633
Lpar 1	-.0213048	-.93404	-.0485431	-1.78521
Lpar 2	-.0112791	-.46581	.0030199	.10566
Lpar 3	-.0150954	-.97401	-.0127053	-.47574
Lpar 4	-.0176243	-.65332	-.0194238	-.83454
ecv 1	-.4735820	-3.23337	-.4223953	-2.99725

Model 1: $R^2 = 0.67$ $F(25, 37) = 3.06$ [.0010] I = .1277694 DW = 1.89
RSS = 0.60 Information Criteria: SC = -2.937408; HQ = -3.474010;
FPE = .023062 R^2 Relative to DIFFERENCE + SEASONALS = .82803

Model 2: $R^2 = .683516$ $F(25, 37) = 3.20$ [.0007] I = .1259206 DW = 2.0
RSS = .5866721209 Information Criteria: SC = -2.966559; HQ = -3.503161;
FPE = .022400 R^2 Relative to DIFFERENCE+SEASONALS = .83297

Having identified the main dynamic patterns in the model, a search for parsimony proceeded along three directions:

(a) Statistical significance of the coefficients in the ADL model. This allowed us to accept the hypothesis that

(i) $\propto_{11} = 0$ for models 1 & 2

(ii) $\propto_{21} = 0$ for model 1 and $\propto_{21} = \propto_{24} = 0$ for model 2

(iii) $\propto_{31} = 0$ for both models

(iv) $\propto_{40} = \propto_{42} = \propto_{43} = \propto_{44} = 0$ for both models

(v) $\propto_{50} = \propto_{52} = \propto_{53} = \propto_{54} = 0$ for model 1 and $\propto_{50} = \propto_{51} = \propto_{53} = 0$, using the t-statistics.

(b) Statistical significance of lags. This consisted of a series of F-test of the information contained in each lag. From table 5 more information were contained in the fourth lag. This would be an ideal expectation for a model of quarterly demand for money.

Table 5. Test on the Significance of Each Lag

LAG	F[NUM, DEMON]	Probability (Model 1)	Probability (Model 2)
4	F[5, 37]	.145	.114
3	F[5, 37]	.152	.188
2	F[5, 37]	.181	.247
1	F[5, 37]	.550	.550

(c) Maximization of goodness of fit. Here the Schwarz Criteria was a guide. A reduction in the Schwarz Criteria is an indication of parsimony. These three criteria ensured data admissibility and theory consistency.

Finally, Akaike Information criteria (AIC) given as

$$AIC\ (M1 : M2) = MLL_1 - MLL_2 - (k_1 - k_2) \qquad (23)$$

and the Schwarz Bayesian Information Criteria (SBIC) given as;

$$SBIC\ [\ (M1 : M2) = MLL_1 - MLL_2 - 0.5(k_1 - k_2)]\ \log\ (n) \qquad (24)$$

where

MLL_1 and MLL_2 are the maximum of Log-likelihood for model 1 and 2, respectively, k_1 and k_2 denote the number of parameters estimated in models 1 and 2, n is the number of observations, was used for an encompassing test on the models.

Based on the criteria stated above the parsimonious error correction models are presented in tables 6 and 7

Table 6: The parsimonious error correction model (Model 1)

Variables	Coefficient	STD Error	H.C.S.E.	t-Value
Lrml 3	.3018804	.11753 a	.00000	2.56865
CONSTANT	.0186508	.01697	.00000	1.09893
Lrgdp	.1238813	.07412 b	.00000	1.67140
Lrgdp 2	-.1915964	.08403 a	.00000	-2.27996
Lrgdp 3	-.2302037	.09731 a	.00000	-2.36563
Lrgdp 4	-.1187214	.08486	.00000	-1.39897
Ldes 1	-.0435608	.01683 a	.00000	-2.58787
Ldir	-.9226221	.15467 a	.00000	-5.96528
Ldir 2	.3760112	.14046 a	.00000	2.67709
Ldir 3	.3964501	.19186 a	.00000	2.06636
Ldir 4	-.4613667	.19817 a	.00000	-2.32809
Lpar 1	-.0140271	.01208	.00000	-1.16121
ecvl 1	-.3648588	.09273 a	.00000	-3.93481

a = significance at 5%, b = significance at 10%, R^2 = .642365
F(12, 50) = 7.48 [.0000], I = .1151480 DW = 1.89, RSS = .662952
Maximum log-likelihood = 50.9723, Information Criteria: SC = -3.699254;
HQ = -3.967555; FPE = .015995 R^2 Relative to DIFFERENCE+SEASONALS = .81126

Table 7: The parsimonious error correction model (Model 2)

Variables	Coefficient	STD Error	H.C.S.E.	t-Value
Lrml 3	.2787381	.11776 a	.00000	2.36700
CONSTANT	.0309092	.01749 b	.00000	1.76708
Lrgdp	.1319422	.07324 b	.00000	1.80149
Lrgdp 2	-.1250955	.08292	.00000	-1.50862
Lrgdp 3	-.1989059	.08658 a	.00000	-2.29747
Ldir	-.9328481	.15521 a	.00000	-6.01005
Ldir 2	.3246136	.14008 a	.00000	2.31738
Ldir 3	.3802634	.18629 a	.00000	2.04121
Ldir 4	-.5161435	.19380 a	.00000	-2.66322
Lmkt 2	-.0830670	.06409	.00000	-1.29606
Lmkt 4	-.0793593	.06102	.00000	-1.30063
Ldes 1	-.0476262	.01690 a	.00000	-2.81777
ecv2 1	-.3285193	.08937 a	.00000	-3.67602

a = significance at 5%, b = significance at 10% R^2 = .649125
F(12, 50) = 7.71 [.0000], I = .1140546 DW = 1.92, RSS = .6504230343
Maximum log-likelihood = 49. 9184, Information Criteria: SC = -3.718334;
HQ = -3.986636; FPE = .015693 R^2 Relative to DIFFERENCE + SEASONALS = .81482

4.4. Major Findings of The Study

An examination of the results for the parsimonious error correction model (Tables 6 & 7) shows that the a priori expectations about the signs of all the parameter estimates were met. Other observations about the results include:

(i) Real money demand was highly significant at the 3rd quarter lag and had a positive relationship with its unlagged value. Thus an increase in real money balances in the third quarter by 1% would lead to a 30% and 28% increase in money demand, respectively.

(ii) The coefficient of real income at its current value showed a positive relationship with money demand and was significant at 10%. The short-run income elasticity was 0.12 & 0.13, respectively. Previous real income was highly significant. This shows that it is more relevant in explaining current demand for money in Nigeria. The negative sign however, confirms the findings of Essien et al (1995), that for the SAP to post SAP period, the policy thrust was mostly restrictive. Though the real income was not generally negative, the rate of growth of GDP was declining during this period.

(iii) Discount rate on treasury bills was highly significant in explaining demand for money. In the current period, demand for real money decreased by 92% and 93%, respectively for every 1% increase in discount rate. Real narrow money is non interest bearing, thus this finding confirms that in a country with less developed money market, demand for money would react sharply with a slight increase in discount rate as economic units strive to hold the only highly liquid interest bearing asset.

(iv) The results so far have shown that there is no significant difference between models 1 & 2. According to Adam (1991), in an economy where the exchange rate premium is constant this observation is expected. In Nigeria, the policy thrust had ensured that this premium was kept fairly constant over the various exchange rate regimes. The fact that the parallel market rate was near significant at 1st quarter, while that of the official rate was better at the 2nd and 4th quarters shows that the official rate is always tracking the parallel rate and thus the latter could be regarded as the true rate during the period of study. Also from the value of the coefficient of the exchange rate, currency substitution effect was found to be insignificant.

(v) The result confirmed our earlier hypothesis that there could not be any meaningful discussions on demand for real money without considering the debt burden, particularly as measured by the debt service ratio. For instance, the coefficient of debt service in our parsimonious model was highly significant and had the expected sign. The short-run debt service elasticity of demand for money in the period lagged 1 was 0.04 & 0.05, respectively. Hence, for a 1% increase in debt service, money demanded would grow by 4 & 5%, respectively. That the impact of debt is not felt in the current period conforms with theoretical expectations.

(vi) The error correction variable (ECV) was highly significant and had appropriate sign. The disequilibrium error from the long run elasticity of demand for money was 33% and 36%, respectively. The strong significance of the ECV is an indication of the existence of a long run equilibrium relationship between demand for real money balance and the factors affecting it. It is also a confirmation that, indeed, debt service ratio and money demand are cointegrated. A necessary condition for the achievement of this equilibrium would be a well articulated debt payment policy.

(vii) The diagnostic tests show that:

(a) the variation in demand for real money as explained by the linear influence of its determinants was 65 and 67%, respectively for both models which is quite significant;

(b) the overall regression was significant with no evidence of serial correlation;

(c) the information criteria that led us to parsimony was also indicated; and

(d) on the choice of model, the result from the Akaike Information Criteria (AIC) and Schwarz Bayesian Information Criteria (SBIC) shows that model 1 is preferred.

4.5 Stability Of The Model

The period of this analyses, 1977-1994, clearly coincides with the period when external borrowing became pronounced and sustained. Recall that the concept of cointegration borders on the fact that if the short run disequilibrium is stationary, then the series would have a long run relationship. The residual from the cointegration regression would be of a lower order than those of the variables in the relationship. The implication of this is that the acceptance of cointegration is equivalent to the acceptance of stability in the long run demand for real money balances. We would therefore, test for stability properties of the short run model using the method of recursive regression. In the absence of any structural break, the forecast errors would be expected to be close to zero, and 95% of such error should lie within the band bounded by two estimated standard errors ($\pm 2\sigma$). This would imply that there is no instability problem in the behaviour of demand for real money balances in a debt constrained economy such as Nigeria. Our analysis showed that our model is stable as 98% of the residuals from our recursive regression lie within the confidence band. Hence, there is no reason to accord instability to the behaviour of the demand for real money balances in a debt constrained economy as Nigeria.

5. POLICY IMPLICATIONS AND CONCLUDING REMARKS

In Nigeria, monetary policy to control the demand and supply of money had centred around direct credit control and interest rate fixing. Deregulation saw to the emergence of Open market Operations and reduced use of stabilization security during SAP. Recent reversal in policy meant, among other things, that the interest rate was again stylistically fixed. As a result of inconsistencies in policies over the review period, the control of monetary

expansion by way of interest rate manipulation, stabilization security and open market operation had limited relevance.

The use of stabilisation securities affected the liquidity in the banking system as the determination of the desired liquidity in the system at any point in time was a matter of educated guess. Consequently, we saw the need to seek for a policy instrument for monetary control that would be in the direct control of government without even affecting the type of monetary regime adopted, whether direct or indirect monetary control. Our result showed that debt-service ratio fits into the description of such a variable. Theoretically, it was shown to have an impact on money demand, empirically it has been confirmed to be very significant. The inclusion of a debt-burden variable in our specification seems therefore, appropriate. Accordingly, we strongly recommend it as a policy instrument for effective control of money demand. The beauty of it is that since it is directly under the control of the central government it would be more convenient to manipulate.

Thus, the determination of the desirable level of monetary expansion could be enhanced given the proportion of our export earning that would be used to service our debt as specified in the model. The issue then reduces to knowing inter alia, the short run debt-burden elasticity of demand for money.

A proper manipulation of debt-service ratio would create the desired impact on demand for money unlike interest rate, stabilisation security and OMO in the light of our undeveloped financial system. Thus, the use of debt service ratio is recommended as a more convenient tool of monetary control which would not have any adverse impact on the other relevant economic variables normally employed for the purpose.

ANNEX

A. CRITICAL VALUES AT 5% FOR REJECTING NULL IN FABOUR OF $\rho<1$

	without trend	with trend
DF	-2.9048	-3.4769
ADF	-2.9077	-3.4812

Source: Microfit 286

B. CRITICAL VALUES AT 5% FOR SBDW (Banjeree et al 1992)

Sample Size	Critical Value
50	0.78
100	0.39

C. CALCULATED DEBT AND TRADE RATIOS

Year	GD	GD/EXP	IMP/EXP	DB
1979	1,930.3	0.11	0.59	-0.30
1980	706.6	0.03	0.64	-0.33
1981	1540.3	0.09	1.14	0.23
1982	8149.7	0.67	1.23	0.90
1983	1501.5	0.14	0.87	0.02
1984	4396.5	0.37	0.49	-0.14
1985	340.5	0.03	0.49	-0.48
1986	1169.6	0.26	0.66	-0.08
1987	4570.0	0.62	0.53	0.15
1988	4442.5	0.65	0.58	0.23
1989	2946.6	0.38	0.53	-0.09
1990	4677.5	0.34	0.42	-0.24
1991	-4046.5	-0.33	0.74	-0.59
1992	-1644.9	-0.14	0.70	-0.44
1993	-2530.6	-0.25	0.76	-0.50
1994	715.9	0.08	0.78	-0.14

GD = Growth in Debt
GD/EXP = Ratio of Growth in Debt to Exports
IMP/EXP = Ratio of Imports to Exports
DB = Ratio of Interest Payments on Debt to Exports

D. FOOTNOTE

1. Arrau, P. and J. De Gregorio, (1991) "Financial Innovation and Money Demand: Theory and Empirical Implementation" Pre-Working Paper, WPS 859, The World Bank, February.

2. The rational for using the DF and SBDW tests together is that the null hypothesis of one is the same as the alternative hypothesis of the other and hence it serves as a cross-check.

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