Journal of Finance & Economics
Volume 1, Issue 1 (2013), 10-26
ISSN 2291-4951 E-ISSN 2291-496X
Published by Science and Education Centre of North America

Pure Portfolio Approach to Money Supply Determination in Nigeria: A Generalized Method of Moments Approach

Ernest Simeon O. Odior[1*]

[1]Department of Economics, Faculty of Social Sciences, University of Lagos, Akoka, Lagos Nigeria.

*Correspondence: Dr. Ernest Simeon O. Odior, Department of Economics, Faculty of Social Sciences, University of Lagos, Akoka, Lagos Nigeria. Email: odiorsimerny@yahoo.com, eodior@unilag.edu.ng.

Abstract: This study analyses broad money supply in Nigeria using a pure portfolio approach in order to establish an econometric framework which forecasts the Nigerian money multiplier with great precision. Methodologically, the Generalized Method of Moments (GMM) model was modeled to analysis the nature of the framework, where broad money supply is presumed to depend upon changes in various indicators of supply of money and a list of instrumental variables (IV) which were estimated over the period 1970-2010. Integral to this process is to determine if there exist a stable relationship between various measures of money supply, the monetary base and the instrumental variables, given a switch by the Central Bank from a direct to an indirect policy regime. In the results, it was found that there exist partial stable relations between these measures of money supply: the broad money and base money despite regime shifts over the sample period. However, a stable money multiplier was not found. This approach produced a scientific framework that could be used to predict the money multiplier derived from the broad money and could be used to forecast on an annual basis with reasonable accuracy at least in the medium term and projections in the monetary programme.

JEL Classifications: B23, E52

Keywords: Pure Portfolio, Money Supply, Nigeria, Generalized Method of Moments

1. Introduction

There is a widespread disagreement among economists on money supply determination. Jhingan (2008) identified three alternative views on this issue. The most common view which is the subject of this paper is associated with the orthodox monetary macroeconomists and the Keynesian thinking. It stresses the medium of exchange function of money that is, money supply defined as demand deposits (D) with commercial banks and currency in the hands of non-bank public. The second view, labelled “the pure loan demand approach” corresponds to the post Keynesian accommodationist view of endogenous money and associated with the modern quantity theorists headed by Friedman. The third view corresponds to the structuralists approach and is associated with Gurley and Shaw (1960).

Monetary policy refers to the specific actions taken by the Central Bank to regulate the value, supply and cost of money in the economy with a view to achieving Government’s macroeconomic objectives. For many countries, the objectives of monetary policy are explicitly stated in the laws establishing the central bank, while for others they are not. The objectives of monetary policy may vary from country to country but there are two main views. The first view calls for monetary policy

 © Science and Education Centre of North America

to achieve price stability, while the second view seeks to achieve price stability and other macroeconomic objectives.

Many Central Banks adopt the monetary targeting regime to stabilise the price level by directly controlling money supply, which is achieved by managing the quantity of central bank money (monetary base). The quantity of monetary base is the operational target while money supply is the intermediate target under a monetary targeting regime. Its success depends heavily on the controllability of money supply and the monetary base. However, there is very little reason to rely on the stability of the money multiplier and the controllability of the monetary base by the monetary authorities (Khan, 2010 ; Goodhart, 1989). For example, a reduction in money supply affects the ability of banks to create new money through giving loans to their customers. In this way, the central bank could be said to be pursuing a contractionary monetary policy. When investors cannot get new loans to expand their investments, it reduces the level of total output in the economy. A reduction in output affects the level of employment and prices as less money is available for purchasing goods. In this way, prices remain stable or fall. The central bank can also pursue an expansionary monetary policy when it reduces the cash reserve ratio and buy securities from the open market. In this case, the reverse of our analysis above holds.

In Nigeria, the Central Bank defines money supply as comprising narrow and broad money. The broad money (M2) includes narrow money plus savings and time deposits, as well as foreign denominated deposits. The broad money measures the total volume of money supply in the economy. Thus, excess money supply (or liquidity) may arise in the economy when the amount of broad money is over and above the level of total output in the economy. The Central Bank of Nigeria (CBN), like other central banks in developing countries, achieves the monetary policy goal through the amount of money supplied. The need to regulate money supply is based on the knowledge that there is a stable relationship between the quantity of money supply and economic activity and that if its supply is not limited to what is required to support productive activities; it will result in undesirable effects such as high prices or inflation. Thus, monetary policy in the Nigerian context refers to the actions of the Central Bank of Nigeria to regulate the money supply, so as to achieve the ultimate macroeconomic objectives of government. Several factors influence the money supply, some of which are within the control of the central bank, while others are outside its control.

When the CBN changes the level of money supply, it does so through the control of the base money. Base money is made up of currency and coins outside the banking system plus the deposits of banks with the central bank in the form of reserves. For example, If the central bank perceives that there is too much money in circulation and prices are rising (or there is potential pressure for prices to rise), it may reduce money supply by reducing the base money. To reduce the base money, the central bank sells financial securities to banks and the no-bank public so as to reduce the ability of deposit money banks to create new money. The central bank can reduce the money supply by also raising the cash reserve deposits that banks are required to hold with the central bank. The larger the deposit balances on bank balance sheets, the higher their ability to create more money. Central bank monetary policy, therefore, targets the growth in those deposit balances so as to control the expansion in money supply which could precipitate price distortions.

Also, the CBN controls the money supply through changes in bank reserves (R) and currency in the bands of non-bank public. This can then influence the multiplier in the desired direction. Although currency/deposit ratio(c) is a function of the cash preferences of economic agents, it may be sensitive to interest rate movements, while bank reserves to deposit ratio(r) may be influenced by the CBN through the use of reserve requirements. The CBN leverage on the money supply depends on a large degree of substitutability between cash per se and bills on the part of the non-bank public and a small degree of substitutability on the part of the banks. This is due to the fact that in the process of portfolio adjustment the short-term interest rate plays an important part. Any rigidity in asset portfolio implies that large changes in the interest rates are needed to induce asset holders to change their portfolio. Hence, the money supply depends on the portfolio choices of agents through demands for currency, time deposit and excess reserve.

Over the years, the CBN has conducted its monetary policy towards achieving these objectives but these objectives are yet to meet the ultimate goal. More recently, the bank has refocused on achieving price stability, while at the same time balancing it with other macroeconomic objectives of the Government. Viewing the background of this study issues, there is a prior set of research questions that this study seeks to address, this include: (1) Does monetary base have great impact on broad money supply in Nigeria? (2) Does monetary base have a long run impact with broad money supply in Nigeria? (3) How stable is broad money multiplier for Nigeria?

Hence, the broad objective of this paper is to identify, within an empirical framework, the proportionality relationship between money supply and monetary base (the money multiplier) with a view to enhancing the Bank's ability to accurately forecast the money multiplier in Nigeria between 1970 and 2010, which is explained by variations in control variables given in this study and some sets of instrumental variables. Thus, the structure of the paper is as follows. After the introduction part, section 2 provides a brief review of the literature on money supply while, section 3 establish theoretical framework of the study, while estimation strategy and model specification are describe in section 4. Section 5 discusses the empirical results in the study and section 6 is the conclusions and policy implication.

2. Review of Literature

Traditionally, the supply of money has been regarded as exogenous. Within orthodox monetary macroeconomics, the determination of money supply is widely viewed as unproblematic. Macroeconomists either believe money supply to be endogenous, or believe it can be controlled. However, the facts seem to lie somewhere between these positions (Goyal & Dash, 2000). The Post Keynesian (PK) economists have seriously questioned the validity of the above general perception. On the basis of historical events and empirical evidences, researchers have strongly maintained that money supply is determined endogenously. This has been regarded as Post Keynesian invention. Money has always been endogenous, irrespective of the historical period. Money is endogenous irrespective of the central bank, the specific stage of development of the banking sector, financial innovations, or other institutional changes (Rochon & Rossi, 2006). In this Section, we review literature of the money multiplier approach, new view models, Post Keynesian economics and some empirical literature.

Generally, two conflicting views of money supply can be found in the literature. The older one is the money multiplier approach (Friedman and Schwartz, 1963). The other view is the so-called "New View" **(**Holtemöller, 2002; Papademos & Modigliani, 1990; Santomero, 1984; Klein, 1971).

The money multiplier approach is the "old view" of money supply. Money stock is determined by the money multiplier and the monetary base is controlled by the monetary authority. Money stock is exogenous and controllable by the monetary authority. The exogeneity or controllability assumption of the money multiplier approach forms the basis of the monetary policy strategy of monetary targeting. Three factors are considered as proximate determinants of money supply as suggested by Friedman and Schwartz (1963), which are: a) the stock of high-powered money; b) the ratio of deposit to reserve; c) the ratio of deposit to currency.

The variations in money multiplier depend on the currency in circulation, demand deposits, time deposits and bank reserves. Variations in these factors may dominate in the money stock in the short-run and become stable and predictable over the long-run. The non-monetarist has

 © Science and Education Centre of North America

pointed out that these factors are determined by the portfolio behaviour of agents and are sensitive to changes in relative rates of return, risk, innovations in the financial markets, income and preferences of the market participants.

However, the money multiplier approach does not necessarily imply exogeneity of the money stock (Holtemöller, 2002). If the money multiplier exhibits unpredictable and endogenous variations, the money stock is endogenous. With the increasing role of market forces in the financial transactions and continuous improvements in asset-liability management, there is very little reason to be reliant on the stability of the money multiplier and the controllability of the monetary base by monetary authorities (Goodhart, 1989) and Jha and Prasad Rath (2001) argues that an endogenous money multiplier framework is best suited for analysing the money supply process in India and finds instability on the part of both narrow and broad money multipliers, implying the uncontrollability and endogeneity of money.

The new view model stresses the importance of commercial banks in the money supply process. According to this view, money stock and the monetary base are endogenous, resulting from the optimizing behaviour of commercial banks and the public given the monetary reaction function set by the monetary authority. The central bank is not able to control the money stock (Holtemöller, 2002). With some additional assumptions that the New View models could be employed to analyse the macroeconomic implications of imperfect competition in credit markets (Joshi & Bhattacharyya, 2003).

In a modern financial system, Papademos and Modigliani (1990) recognise the central bank cannot control money supply directly but only indirectly by influencing the behaviour of financial intermediation (notably banks). They describe the money supply mechanism as a structural model of money stock determination. The determination of money supply relies on an explicit specification of a structural model of bank behaviour which describes the determinants of the supply of deposits by banks as well as their demands for earning assets and free reserves. The model of bank behaviour is then combined with equations describing the determinants of the demands for currency, bank deposits and bank loans by the public to obtain a complete model of the money market determining the stock of money and one or more interest rates. The main advantage of this approach is that it explicitly specifies the mechanism through which the interaction of the public's demands for assets, the banks' behaviour and the central bank's actions determine the stock of money. The multiplier approach, even when it allows for interest rate effects, leads to a money supply specification which is a hybrid of elements of public demand and bank behaviour, a kind of semi-reduced form rather than a money supply specification. It does not provide a theoretical analysis of the process through which banks' behaviour influences the supply of bank deposits.

According to Georg and Pasche (2008) endogenous money theory is one of the main cornerstones of Post Keynesian (PK) economics and a widely discussed topic, especially in New and PK macroeconomics (Fontana, 2003); Endogenous money represents a mainstay of PK macroeconomics. In Post Keynesian economics, money is endogenous by its nature. The PK theory of endogenous money constitutes a significant contribution to macroeconomic theory. Analytically, it provides a critical link connecting the financial and real sectors. PK endogenous money theory emphasises that this linkage runs predominantly from credit to money to economic activity. The important feature is that credit is placed at the beginning of this sequence. This contrasts with conventional representations that place money first, as reflected in the standard textbook money multiplier story where bank deposits are said to create loans. The origins of PK endogenous money lie directly opposite that of monetarism. Whereas neo-Keynesian economics challenged monetarism by focusing on the optimality of money supply versus interest rate targets, PK theory challenged monetarism's description of the money supply process (Palley, 2008).

PK's essence is that the stock of money in an economy is determined by the demand for bank credit, and the latter is causally dependent upon the economic variables that affect the level of output. Why does money exist and what does money do? Why do economic agents hold money and to what ends? How do economic agents use money and for what purpose? All these questions have stimulated several studies and led to the development of a variety of PK models and assumptions. Holtemöller (2002) also describes that both the money stock and the monetary base are determined endogenously by the optimising behaviour of commercial banks and private agents like households and firms.

Endogenous money has been given kudos for proposing a variety of perspectives from which the above questions could be answered. It can be taken as a common conviction that individual behaviour regarding credit demand and supply as well as holding currency and deposits, has an impact on the money creation process. These issues are often neglected in Neoclassical and Monetarist type models. There are, however, very different approaches on how endogeneity of money originate. New Keynesian economics is dominated by the "New Consensus" where the exogenously determined money supply of the central bank (LM curve) is replaced by the Taylor rule. The monetary policy targets inflation and output gap by controlling the real interest rate, while there is no explicit theory about the creation of credit and money (Georg & Pasche, 2008).

Pollin (1991) and Palley (1993, 2008), describes three competing models of the money supply process. The first model is the pure portfolio approach, corresponds to the orthodox description of the money supply process. The second model is the pure loan demand approach, corresponds to the PK accommodationist view of endogenous money. The third model, the mixed portfolio loan demand approach, corresponds to the PK structuralist view of endogenous money. This third model is very much in the spirit of the earlier "New View" developed in the 1960's. However, the model explicitly focuses on the money supply implications of the banking system's response to expansionary shifts of loan demand. The earlier New View theorists emphasised asset substitutability, and focused on changes in asset prices. This was consistent with their interest in the monetary transmission mechanism, but they took money supply to be exogenous. PK focuses on the implications of asset substitutabilities for money supply, and the capacity of the banking system to underwrite economic activity. What accommodationist and structuralist schools have in common is that the money creation process is determined by the behaviour of commercial banks and non-banks in the credit market. The process starts with credit demand, and credit creating deposits.

The critical difference between the "pure loan demand" and "mixed portfolio- loan demand" models concerns the significance ascribed to the private initiatives of banks in accommodating increases in loan demand. In the pure loan demand model, accommodation depends exclusively on the stance of the monetary authority, and its willingness to meet the reserve pressures generated by increased bank lending. However, mixed model accommodation depends on both the stance of the monetary authority, and the private initiatives of banks. These initiatives are independent of the monetary authority, and are therefore suggestive of the structurally endogenous nature of "finance capital".

The accommodationist argues that an increase in credit demand leads to a need for additional reserves. In order to ensure the liquidity of the banking sector, the central bank has to respond by increasing the monetary base and hence to accommodate the credit demand. In this view, the microeconomic considerations of the commercial banking sector play a minor role. The accommodationist believes the behaviour of financial institutions is unconstrained by the availability of liquidity (reserves) provided by the central bank and the supply- price of finance to banks is fixed at a price set by the central bank. Accommodationist can be divided into those having "strong" and "weak" positions. The strong position holds that the bank loan supply

 © Science and Education Centre of North America

schedule is horizontal and interest rates are unaffected by lending. On the other hand, the weak position states that interest rates may rise with lending if borrower quality deteriorates.

In contrast, the structuralist approach argues that commercial banks respond to an increase in credit demand with structural changes of their portfolio on the asset and liability side. This may lead to a change in the demand for reserves and hence in the interaction with the central bank. structuralists believe that liquidity pressures matter and the supply price of finance to banks can increase endogenously (Georg & Pasche, 2008).

The core of endogenous money theory is that the supply of money in modern economies is determined by the demand for credit (bank loans) and that this, in turn, responds to the need for financing production or speculative purchases. Beyond a widespread agreement over the idea that 'loans create deposits' and 'deposits make reserves', there is much controversy (Fontana, 2003). At the heart of the debate between what have now been labelled the accommodationist approach and the structuralist approach to endogenous money are the issues of the slope of the supply curves of reserves and of credit money, respectively (Fontana, 2003). The PK debate has been useful in articulating the mechanics of the money supply process, but inadequate attention has been paid to the implications of endogenous money for interest rate determination, the business cycle and economic growth.

There are some empirical studies regarding money supply issues**,** Badarudin et, al (2009) show that money supply is endogenous in five economies, namely China, the Czech Republic, India, Malaysia and Turkey while exogenous in Mexico. There was no causality found in Indonesia, Russia and Chinese Taipei. Thailand showed endogeneity in the long-run causality

Ho Dong Ching (2001) develops a structural monetary base model to show that an important feature of the approach is that the model combines three parts of the determinants of the monetary base. The three parts are the commercial bank, the public and the central bank. Bank behaviour relies on an explicit specification of a maximum profit-seeking and risk-averse model which describes the determinants of the supply of deposits by banks as well as their demands for earning assets and (free) reserves. The behaviours of the public and central bank are set up exogeneously. Accordingly, the monetary base equation is derived which is determined by various financial and real variables endogenously.

Palley (1993) examines the three competing approaches to the determination of the money supply. The first approach is labelled the pure portfolio approach, and corresponds to the orthodox approach to the money supply. He concludes that the critical theoretical difference between the latter two models is identified in terms of the importance of the private initiatives of banks in accommodating expansions of loan demand. The paper then provides Granger-causality evidence on the three approaches, and concludes in favour of the mixed portfolio-loan demand approach.

White (2006) seeks to establish an econometric framework which forecasts the Jamaican money multiplier and the existence of a stable long run cointegrating relation between various measures of money supply and the monetary base, applying a residual based cointegration test. It was found that there were stable long run relations between different measures of money supply, (broad money (M3) and M2) and base money, despite regime shifts over the sample period. However, a long run relation between narrow money (M1) and base money was not found. For robustness, components of the money multiplier derived from M2 were modelled simultaneously on select explanatory variables in a VAR framework.

3. Theoretical Framework

3.1 Pure Portfolio Approach Model in Money Supply Determination

Traditionally, the supply of money has been regarded as exogenous. Within orthodox monetary macroeconomics, the determination of money supply is widely viewed as unproblematic. In this study we limit ourselves to the model, of the "pure portfolio approach", corresponds to the orthodox description of the money supply process. In a theoretical process, Palley (1993) describes, the portfolio choice money multiplier model, corresponds to the orthodox description of the money supply multiplier model process. The orthodox money multiplier model given by

$$Hs = NBR + max\,[0\,, BR(i - id)\,] \quad (1)$$

$$Dd = D(i, y) \quad (2)$$

$$Cd = C(i, y) \quad (3)$$

$$Td = T(i, y) \quad (4)$$

$$Rd = k1Dd + k2Td \quad (5)$$

$$Ed = E(i, id) \quad (6)$$

$$Hd = Rd + Cd + Ed \quad (7)$$

$$Hs = Hd \quad (8)$$

$$M = Cd + Dd \quad (9)$$

Where Hs = supply of base , NBR = non-borrowed reserves, BR = borrowed reserves, id = discount rate, Dd = demand for checkable (demand) deposits, Cd = demand for currency, Td = demand for time deposits/bank certificates of deposit, Rd = required reserves, Ed = demand for excess reserves, Hd = demand for base, i = nominal interest rate, y = nominal income, k1 = required reserve ratio for demand deposits, k2 = required reserve ratio for time deposits and M = M1 money supply

Equation (1) describes the base supply function, which consists of non-borrowed and borrowed reserves. The level of discount window borrowing is a positive function of the gap between market interest rates and the discount rate. Equations (2) and (3) describe the demands for checkable (demand) deposits and currency, which are both negative functions of the interest rate, and positive functions of income. Equation (4) describes the demand for time deposits, which is a positive function of the interest rate because time deposits are interest bearing bank liabilities. Equation (5) is the demand for required reserves, while equation (6) is the demand for excess reserves. This latter demand is a negative function of the interest rate because this represents the opportunity cost to banks of holding funds: it is a positive function of the discount rate since this represents the cost of substitute emergency funds. Equation (7) defines the total demand for reserves, and it is assumed that this demand is a negative function of the market interest rate. Equation (8) is the base market clearing condition, while equation (9) is the definition of the money supply.

Equilibrium in the federal funds market is determined by the intersection of the base demand and supply schedules. Since the demand for base derives from the demand for checkable deposits, equilibrium in the market for base determines the level of demand deposits. Equilibrium is achieved through interest rate adjustment, which serves to reconcile direct (currency) and indirect (derived) demands for base with the supply of base. This adjustment rests on the standard liquidity preference mechanism: if the interest rate were greater than i*, the nonbank public would be unwilling to hold D* of demand deposits and would seek to purchase bonds, which would drive up bond prices and reduce interest rates until the interest rate had fallen to i*.

This description of adjustment means that the interest rate is identified with the bond rate.

 © Science and Education Centre of North America

This orthodox model is illuminating both for what it includes and what it omits. First, the model emphasizes the supply of base as a constraint on the money supply. Fractional reserve banking means that base is needed to support deposits, so that the supply of base restricts the quantity of deposits that can be created. Second, bank lending creates inside balances, and in equilibrium these balances must be willingly held, or else agents will seek to spend those causing interest rate, output, or price level adjustments. Thus, equilibrium outcomes must lie on the money demand schedule. Third, the money supply depends on the portfolio choices of agents through the demands for currency, time deposits, and excess reserves. Shifts in any of these asset demands will change the money supply: thus, even the orthodox model exhibits some money supply endogeneity.

Palley (1993) viewed; the principal limitations of the orthodox model are its suppression of (i) the market for bank loans, and (ii) bank asset and liability management. The suppression of the loan market means that there is no requirement that the market for bank loans to clear: it also means that there is no channel through which loan demand can influence the issue of liabilities by banks. The suppression of bank asset and liability management decisions means that these are irrelevant for the money supply. Another weakness is confusion over the nature of the interest rate. The appropriate interest rate for choice of borrowed and excess reserves is the federal funds rate. Contrastingly, the appropriate interest rate for the non-bank public's demand for currency and demand deposits is the bond rate.

Yet, in the model there is only one interest rate, so that it is implicitly assumed that there is a fixed relation between the federal funds rate and the bond rate. It transpires that such a relationship can be economically justified by introducing bank portfolio behaviour, but this increases the significance of banks. Finally, the model is revealing of the conceptual difficulties of even talking about a money supply function. This is because the money supply is an aggregate of different financial liabilities, the respective quantities of which are determined by the choices of agents. In a fractional reserve banking system, the supply of base sets an upper bound the M1 money supply given by $M+ = Hs/k1$. Actual M1 is then determined within this bound by portfolio preferences embodied in the demands for *C*, *T*, *D*, and *E*.

3.2 Money Multiplier Approach

The money supply multiplier approach, also referred to as “the monetary base model”, is one of two main theories of money supply determination. According to this approach, the level of money supply is seen as a multiple (m) of the monetary base with m usually referred to as the money supply multiplier. The monetary base model theory depends on three factors: (i) the banks’ cash reserve ratio (ii) the non-bank private sector cash ratio and (iii) the monetary base. The stock of money is determined only by the size of the money multiplier and an exogenously determined monetary base.

Following the conventional money multiplier approach theory which stated that, money supply is measured by currency in the non-bank public (currency in circulation) and bank deposits. There is a more general formulation of the money multiplier which allows for a decomposition of the money multiplier into the currency to demand deposits, savings deposits to demand deposits, time deposits to demand deposits and bank reserves to bank deposits ratios. This representation is necessary to capture portfolio shifts between the components of quasi-money and demand deposits. Further, it provides a more detailed perspective for the econometric explanation of the money multiplier components, in particular, the currency to demand deposits ratio, which is a fundamental measure of a country’s money supply process.

A mathematical representation of this view of the money multiplier is given by:

$$M2 = m*MB \qquad (10)$$

Where: $M2$ = *nominal money stock; m = money multiplier; MB = base money*
Now let *local currency bank deposits;*

$$BD = D + S + T \tag{11}$$

Where: D = *demand deposits*; S = *savings deposits;* T = *time deposits*
Since *MB* is currency in circulation plus total commercial bank reserves, and *M2* is the sum of currency in circulation and total local currency bank deposits we have,

$$MB = C + R \tag{12}$$

$$M2 = C + BD \tag{13}$$

Where: C = *currency in circulation;*
From equation (10);

$$m = \frac{M2}{MB} = \frac{C + BD}{C + R} \tag{14}$$

Note that total bank reserves, $R = RR + ER = kBD + ER$
Where: RR = Required Reserves;
ER= Excess Reserves *(Vault Cash + Current Account)*
k = statutorily determined required reserves to bank deposits ratio
Now if we substitute equation (13) into (14) and divide through by D we have,

$$m = (\left(\frac{C}{D}\right) + \frac{D + S + T}{D})/(\left(\frac{C}{D}\right) + \left(\frac{R}{D + S + T} * \frac{D + S + T}{D}\right) \tag{15}$$

$$m = \frac{c + 1 + s + t}{c + r(1 + s + t)} \tag{16}$$

c = currency in circulation to demand deposits ratio, s = savings deposits to demand deposits *ratio*, t = time deposits to demand deposits ratio, r = reserves to total local currency bank deposits ratio

The model formulation implies that increases in the currency to demand deposits ratio and the reserves to bank deposits ratio results in a reduction in the money multiplier. On the other hand, increases in the time deposits to demand deposits and savings deposits to demand deposits ratios lead to an expansion in the multiplier.

4. Estimation Strategy and Model Specification

What monetary variables are considered as potential determinants of broad money supply? The included variables are as follows: monetary base, narrow money, currency outside banks, reserves with the central bank, demand deposits, time deposits and m2 multiplier. To obtain some rough estimates of the magnitude of the effects of monetary variables on money grow in Nigeria. We empirically modeled the relationship between monetary variables and money growth using the Generalized Method of Moments (GMM). The GMM is a robust estimator in that, unlike maximum likelihood estimation, it does not require information of the exact distribution of the disturbances. This is to avoid the short comings of exact distribution of the disturbances in the variables. The

© Science and Education Centre of North America

theoretical relations that the parameters should satisfy are usually *orthogonality conditions* between some (possibly nonlinear) function of the parameters $f(\theta)$ and a set of instrumental variables Z_t:

$$\mathrm{E}\left(f(\theta)' Z\right) = 0, \tag{17}$$

Where θ are the parameters to be estimated. The GMM estimator selects parameter estimates so that the sample correlations between the instruments and the function f are as close to zero as possible, as defined by the criterion function:

$$J(\theta) = \left(m(\theta)\right)' Am(\theta), \tag{18}$$

Where $m(\theta) = f(\theta)' Z$ and is a weighting matrix. Any symmetric positive definite matrix will yield a consistent estimate of *q*. However, it can be shown that a necessary (but not sufficient) condition to obtain an (asymptotically) efficient estimate of *q* is to set *A* equal to the inverse of the covariance matrix of the sample moments *m.*

For the GMM estimator to be identified, there must be at least as many instrumental variables as there are parameters to estimate. The instrumental variables in the model included are as follows: foreign assets, domestic credit (net), gross domestic product, inflation, total loan and advance and nominal interest rate.

To estimate the hybrid model, we specified the model in the GMM form and list of instrumental variables as follow:

Equation specification: y c x (19)

$$\text{Logm2}_{1t} = \beta_1 + \beta_2\text{Logcr}_{2t} + \beta_3\text{logrs}_{3t} + \beta_4\text{logdd}_{4t} + \beta_5\text{logtd}_{5t} + \beta_6\text{k2}_{6t} + U_t \tag{20}$$

Instrument list: c z w; logfa_7t, logdc_{8t}, loggdp_{9t}, logtla_{10t}, inf_{11t}, int_{12t} (21)

The a-priori expectations for equation (22) are: $\beta_1 > 0$; $\beta_2 > 0$; $\beta_3 > 0$; $\beta_4 > 0$; $\beta_5 > 0$; $\beta_6 > 0$

Where (variable list),

Logm2_{1t} represents log of broad money (supply) growth

Logcr_{2t} represents log of currency outside banks

Logrs_{3t} represents log of reserves with the central bank

$\text{Logdd}_{4t\,t}$ represents log of demand deposits

Logtd_5 represents log of time deposits

L2_{6t} represents log of m2 multiplier

Logfa_{7t} represents log of foreign assets

Logdc_{8t} represents log of domestic credit (net)

Loggdp_{9t}, represents log of gross domestic product

Logtla_{10t} represents log of total loan and advance

Loginf_{11t}, represents inflation rate

Logint_{12t} represents nominal interest rate

And where:

mb = monetary base (cr + rs)

The orthogonality conditions given by

$$\sum\left(y_t - c(1) - c(2)x_t\right) = 0 \tag{22}$$

$$\sum\left(y_t - c(1) - c(2)x_t\right)z_t = 0 \tag{23}$$

$$\sum\left(y_t - c(1) - c(2)x_t\right)w_t = 0 \tag{24}$$

In testing the relationship between money grow and the monetary variables, the J-statistic is used to carry out hypothesis tests from GMM estimation; see Newey and West (1987a). A simple application of the J-statistic is to test the validity of over identifying restrictions when you have more instruments than parameters to estimate. In this paper, we have six instruments to estimate three parameters and so there are six over identifying restrictions. Under the null hypothesis that the over identifying restrictions are satisfied, the J-statistic times the number of regression observations is asymptotically with degrees of freedom equal to the number of over identifying restrictions.

In estimating the model we used the Time series (HAC) of Weighting Matrix and Coefficients with GMM estimates. These estimates are used to compute a coefficient covariance matrix that is robust to cross-section heteroskedasticity and autocorrelation of unknown form. For the HAC option, we specify the kernel type and bandwidth. The Kernel Options determine the functional form of the kernel used to weight the autocovariances in computing the weighting matrix. The overall relationship between the money supply and its explanatory variables are expected to be positive. We use annually data from the CBN bulletins (CBN, 2010).

To allow for shifts in the long run equilibrium at an unknown point, the structural break is modeled in the form of a shift in the intercept (β). Hence, in testing for cointegration, equation (20) in generally form, the money multiplier relation is usually written as;

$$MS_t = m(.)H_t \tag{25}$$

Where: MS_t = monetary aggregate stock, H_t = base money and $m(.)$ = mean of the money multiplier over the sample period. Taking logs we get:

$$ms_t = a + bh \tag{26}$$

Where; $ms = \log(MS)_t$, $h_t = \log(H)$, $a = \log(m(.))$

$b = 1$ implies that the proportionality relationship between money supply and base money holds.

If ms_t and h_t are integrated of order one, then for equation (25) to represent a stable long run equilibrium relationship, the variables must be cointegrated.

$$ms_t = a_1 + a_2\phi_{t\tau} + bh_t + e_t, \qquad t = 1... n, \tag{27}$$

5. Estimation of Results

Our estimation technique consists of three steps procedure. First we test for variables stationarity this is in order to ensure stationarity of the data and all the variables are in terms of first differences of logarithms (growth rates) and none at level. Second, a GMM estimate, with a list of instrumental

 © Science and Education Centre of North America

variables is run over the sample period 1970-2010. This is done once the stationarity test was determined. The third part of the estimation provides the co-integrating relations among the variables under consideration (see Table 1-3).

The results in the Table 1 showed that there is an existence of unit root. This implies that all the series are non stationary at levels except. Therefore the null hypothesis (ρ = 1) is accepted at levels. From the results, the ADF - Choi Z- test statistic (-10.9099) and various probabilities values show that both the explanatory and instrumental variables were integrated at order one, that is I(1). This implies that all the variables were statistically significant at 1%, 5% and 10% critical values at first difference. In other words, they were stationary at first difference. Except for CR and K2 that were statistically significant at 5% and 10% critical values at first difference

The results for unit root test also show that the model residual is integrated of order of zero I(0). This is in conformity with the postulated theory, which stated that residuals of the estimated model must be significant at level. These are MacKinnon critical values for the rejection of hypothesis of a unit root. Next we look for the possible existence of a cointegrating relationship among the variables.

Table 1. Unit Root (Individual Unit Root Process)

Method			Statistic		Prob.**
ADF - Fisher Chi-square			178.562		0.0000
ADF - Choi Z-stat			-10.9099		0.0000
Intermediate ADF test results					
Series	Prob.	Order of integration	ADF T-Stat 1st diff	Max Lag	Obs
D(LOGM2)	0.0112	I(1)	-4.267903	1	39
D(LOGCR)*	0.0184	I(1)	-3.964020*	1	39
D(LOGRS)	0.0061	I(1)	-4.404611	1	39
D(LOGDD)	0.0030	I(1)	-4.675655	1	39
D(LOGTD)	0.0047	I(1)	-4.504147	1	39
D(K2)*	0.0172	I(1)	-3.992002*	1	39
D(LOGFA)	0.0003	I(1)	-5.556832	1	39
D(LOGDC)	0.0000	I(1)	-6.788258	1	39
D(LOGGDP)	0.0004	I(1)	-5.370271	1	39
D(LOGTLA)	0.0001	I(1)	-4.504147	1	39
D(INF)	0.0000	I(1)	-6.288270	1	38
D(INT)	0.0000	I(1)	-7.108415	1	38
RESIDO	0.0000	I(0)	-4.773753	1	39
Test critical values:	1% level		-4.211868		
	5% level		-3.529758		
	10% level		-3.196411		

Note: * denotes statistically significant at 5% and 10% critical values at first difference.

In Table 2 we GMM estimate (using Time series (HAC) of simultaneous weighting matrix for the five variables excluding the standard errors, with lists of six instrumental variables. Examination of these results indicates that currency outside banks (cr) (0.28%), reserves with the central bank (rs)

(0.01%), demand deposits (dd) (0.37%), time deposits (td) (0.34%), m2 multiplier (0.03%), all have positive effects on broad money supply. though all explanatory variables have positive effects, but the reserves with the central bank (rs) and m2 multiplier (k2) looking at their probability values (P-values) and their level of impacts, (0.01%) and (0.03%), respectively, it shows that they contribute less (insignificant) to broad money supply in the economy. Also Looking at the level of impacts of cr (0.37%), dd (0.37%) and td (0.34%), conformed to the economics theory of the definition of M2 and active in monetary policy issues given a coefficient of determination (R^2) of (97%). show that only 97% of variations in M2 are accounted for by the changes in the cr, rs, dd, td and k2.

Furthermore, an examination of the results shows a good fit in terms of apriori expectation and statistical significance of the explanatory variables and in terms of the standard error of the parameters. Though there seem to be a problem of multicollinearity, this cannot be ruled out for the fact the variables came from the same field. The Durbin-Watson (DW) test statistic *(d*)* shows the presence of positive serial correlation between the error terms in the m2 equation (22)

The J-statistic reported at the bottom of the table is the minimized value of the objective function. The J-statistic times the number of regression observations is asymptotically with degrees of freedom equal to the number of over identifying restrictions. In our model we have six instruments to estimate five parameters and so there are three variables under the money equation are significant in explaining money growth.

Table 2. Estimation Method: Generalized Method of Moments

Dependent Variable: LOGM2				
Method: Generalized Method of Moments				
Simultaneous weighting matrix & coefficient iteration				
Coefficient	Coefficient Values	Std. Error	t-Statistic	Prob.
β_1	1.014029	0.027807	36.46727	0.0000
β_2	0.276095	0.046706	5.911316	0.0000
β_3	0.011330	0.035235	0.321562	0.7497
β_4	0.370809	0.042847	8.654280	0.0000
β_5	0.344203	0.052739	6.526504	0.0000
β_6	0.030578	0.027122	1.127407	0.2672
J-statistic		0.001791		
Equation: $Logm2_{1t} = \beta_1 + \beta_2 Logcr_{2t} + \beta_3 logrs_{3t} + \beta_4 logdd_{4t} + \beta_5 logtd_{5t} + \beta_6 k2_{6t} + U_t$				
Substituted Coefficients: Logm2 = 1.014 + 0.276logcr + 0.011logrs + 0.371logdd + 0.344logtd + 0.031k2				
Instruments: Logfa, Logdc, Loggdp, Logtla, Inf, Int				
R-squared	0.969975	Mean dependent var		11.49354
Adjusted R-squared	0.959978	S.D. dependent var		2.772644
S.E. of regression	0.014864	Sum squared resid		0.007733
Durbin-Watson stat	1.793210			

 © Science and Education Centre of North America

Table 3. Unrestricted Cointegration Rank Test (Trace)

Trend assumption: Linear deterministic trend (restricted)				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.998702	889.0203	374.9076	0.0000
At most 1 *	0.974346	629.7956	322.0692	0.0000
At most 2 *	0.973221	486.9363	273.1889	0.0000
At most 3 *	0.933872	345.7516	228.2979	0.0001
At most 4 *	0.812383	239.8214	187.4701	0.0000
At most 5 *	0.685055	174.5607	150.5585	0.0011
At most 6 *	0.655044	129.5018	117.7082	0.0073
At most 7	0.530975	87.99261	88.80380	0.0572
At most 8	0.408362	58.46573	63.87610	0.1311
At most 9	0.353628	37.99616	42.91525	0.1424
At most 10	0.314383	20.97735	25.87211	0.1804
At most 11	0.148235	6.257320	12.51798	0.4283
Trace test indicates 7 cointegrating equations at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegrating Coefficients (normalized by b'*S_{11}*b=I):				

LOGM2	LOGCR	LOGRS	LOGDD	LOGTD	K2	LOGFA	LOGDC	LOGGDP	LOGTLA	INF	INT	@TREND(71)
49.824	-8.4434	3.1491	-14.234	-33.414	2.4904	-2.0142	-0.3621	0.0025	0.0784	0.0437	-0.2295	1.4525
79.817	-23.868	-4.9111	-20.398	-25.687	-3.5311	-1.8969	-1.0022	3.5178	3.6250	-0.0368	0.4773	-2.2398
-52.208	22.794	3.8498	15.156	2.8033	6.9832	-1.3548	-1.2704	1.5189	4.5031	-0.0358	-0.0388	1.0604
51.261	-25.270	-5.1411	-17.061	-2.0459	-7.5080	0.0674	4.2353	3.2467	-3.3632	-0.0578	-0.2091	-1.2531
65.234	-17.749	-10.669	-14.107	-11.435	-7.0948	-0.1292	-1.6249	4.6138	-4.8608	-0.0209	-0.0056	-1.9051
-143.12	33.348	-2.4169	48.917	63.123	2.5709	0.6660	2.8352	9.9656	-2.5576	0.0128	0.0650	-2.4187
49.434	-17.515	-3.2396	-12.172	-4.4477	-2.7038	-3.7165	-4.1314	8.0313	-3.4166	-0.0616	0.2502	-1.8880
-8.8285	-8.0442	-2.6958	-2.8146	14.493	-6.4833	1.6959	1.1334	-3.0681	11.444	0.0522	0.0125	-0.9990
-12.273	6.1188	-4.0700	-2.0649	12.618	-0.2213	3.1769	1.1117	-2.9356	4.2376	0.0632	0.0134	-1.4665
-18.118	17.981	8.0497	-0.5709	-5.2835	6.7935	1.3752	-0.3339	-9.1794	1.7123	-0.0166	-0.2369	0.9877
-38.032	19.483	10.664	2.6569	2.5626	10.625	-0.7417	-0.7928	4.5040	-2.2350	-0.0146	0.0625	0.3661
-7.0412	0.3570	6.8129	1.6366	-9.8506	5.0506	0.7252	1.2774	-0.4280	-1.4617	0.0036	-0.0888	1.7237

The unrestricted estimate of Johansen' cointegration rank test establishes whether there exists linear long-run economic relationship among the variables, with an assumption of none linear deterministic trend in data. The summary of the Johansen' cointegration tests are presented below in Table 3.

The table showed the estimation of the Johansen co-integration relation among the variables. The Trace test indicates 7 cointegrating equations at the 0.05 level of the Johansen co-integration relation among the variables. The second part of the outputs provides estimates of the co-integrating relationsβ. As is well known, the co-integrating vector β is not identified unless we impose some arbitrary normalization. The first block reports estimates of β and based on the normalization $\beta^* S_{11}^* \beta = I$, where S_{11}, where is defined in Johansen (1995a). Note that the transpose of β is reported under unnormalized co-integrating coefficients so that the first *row* is the first co-integrating vector, the second *row* is the second co-integrating vector, and so on.

By imposing one normalization restrictions on the model the cointegration equations exactly identifies the system. The estimate of Johansen's log likelihood (degree of probability) subject to exactly identifying restriction at most 11 for the model, with the positively log likelihoods and at the order of integration of I(1), the test results show that all the variables are pair-wise cointegrated, but with weak evidence that we do have a cointegrating relation and the presence of linear long run equilibrium among the variables.

6. Conclusion and Policy Implication

The broad focus of this study was to identify, within an empirical framework, the proportionality relationship between money supply, monetary base and the money multiplier with a view to enhancing the bank's ability to accurately forecast the money growth and in order to better target the real factors determining the broad money supply and to achieve higher economic growth in Nigeria. Due to policy regime shift in monetary policy regime from 1986 which could have been attributed to a number of institutional changes that were implemented in the financial sector by the authorities according to the recommendations of the Structural Adjustment Programme, there was an unstable impact relation between broad money (M2) and the monetary base (MB).

In a monetary targeting regime, the stability of the long run relation between money supply and base money is very important for effective control of money supply by the Central Bank. However, the Central Bank is always able to achieve its announced monetary target. One reason for not achieving the announced target, on rare occasions, could be that money is endogenous. In a modern open economy with a sophisticated profit-maximising banking system, a non-banking financial sector, dynamic currency in circulation affecting the supply of bank reserves and rapid international capital flows, it is at least questionable whether money is exogenous.

The elimination of reserve requirements on some non-transaction accounts and the extension of Central Bank reserve requirements to all depository institutions have greatly increased the association between checkable deposits and reserves. These changes have increased significantly the association between changes in monetary policy actions and changes in the multiplier. That the multiplier is affected by policy actions suggests that money stock control using the multiplier model would be enhanced by taking the effect of policy actions on the multiplier into account.

This study provided evidence showing that the monetary base (which includes currency in circulation and reserves with the central bank), bank demand deposits, time deposits, the multiplier and with interplay of some instrumental variables are important factors for determine broad money supply in Nigeria. And the trends of required bank deposits, time deposits and the multiplier and the monetary base seem to be in the same direction. The deductions from these empirical findings are predicted on the sizes and magnitude of the slope coefficient. Looking at above results, it shows less significance relationship between money supply, the reserves with the central bank and money multipliers.

Also, this study has examined closely the standard multiplier model of the money supply process, specifically questioning the view that the adjusted monetary base multiplier is independent of the

 © Science and Education Centre of North America

policy actions of the central bank. Because the demand for currency depends on a number of factors that are unrelated to the demand for checkable deposits (and vice versa) and because the stock of checkable deposits has been more closely tied to the quantity of reserves supplied by the Central Bank, changes in monetary policy result in changes in the ratio of currency to checkable deposits and, consequently, changes in the multiplier. Hence, the Central Bank's monetary policy actions are reflected both in the adjusted monetary base and the money multiplier.

In fact, as repeatedly pointed out by if the central bank tried to run a system of monetary base control, it would fail". This sheds some light on the generalised preference for central bankers to adopt a monetary policy strategy based on a target for inflation rather than for a growth rate of a monetary aggregate such as M1, M2, or M3. And since the impact of changes in reserve requirements is difficult to estimate; because each change has the potential to affect thousands of financial institutions in different ways, depending on each institution's deposit base.The policy implication of this result is that it is possible for the money multiplier derived from M2 to be forecasted on an annual basis with reasonable accuracy in the long run, which could be used to enhance the medium term projections in the monetary programme. How much improvement can be expected with this modified approach and how effective alternative approaches to monetary control can be left as a topic for further research.

References

[1] Ajayi, S. I., & Ojo, O. O. (2006). *Money and Banking Analysis and Policy in the Nigeria Context*. Second Edition.

[2] Badarudin, Z. E., Khalid, A. M., & Ariff, M. (2009). Money Supply Behaviour in Emerging Economies: A Comparative Analysis. Journal of the Asia Pacific Economy, *14*(4), 331-350.

[3] Central Bank of Nigeria (2006). What is Monetary Policy?. *Monetary Policy Series, Series 01*. Monetary Policy Department.

[4] Central Bank of Nigeria (2006). How Does the Monetary Policy Decisions of the Central Bank of Nigeria Affect You?. *Monetary Policy Series, Series 02*. Monetary Policy Department.

[5] Ching, H. D. (2001). *Endogenous Money –A Structural Model of Monetary Base*. The South East Asian Central Banks (SEACEN), Research and Training Centre (The SEACEN Centre), Kuala Lumpur, Malaysia. *Occasional Paper*, No. 52.

[6] Fontana, G. (2003). Post Keynesian Approaches to Endogenous Money: A Time Framework Explanation. *Review of Political Economy*, *15*(3), 291-314.

[7] Friedman, M., & Schwartz, A. J. (1963). *Money and Business Cycles*. Review of Econometrics and Statistics.

[8] Georg, Co-Pierre & Pasche, Mark (2008). Endogenous money: onbanking behaviour in new and post keynesian models. *Jena economic research papers*, No. 2008, 065. http://hdl.handle.net/10419/31770.

[9] Goodhart, C. A. E. (1989). The Conduct of Monetary Policy. *Economic Journal, 99,* 293-346.

[10] Goyal, A., & Dash, S. (2000). The Money Supply Process in India: Identification, Analysis and Estimation. *MPRA Paper*, No. 24632, July. University Library of Munich, Germany.

[11] Gurley, J. G., & Shaw, E. S. (1960). *Money in a Theory of Finance*. Brookings Institution, Washington D.C.

[12] Holtemöller, O. (2002). *Money and Banks: Some Theory and Empirical Evidence for Germany*. A chapter author's doctoral dissertation.

© Science and Education Centre of North America

[13] Jha, R., & Prasad Rath, D. (2001). *On the Endogeneity of the Money Multiplier in India*. Departmental Working Papers. Australian National University, Arndt-Corden Department of Economics.

[14] Jhingan, M. L. (2008). *Money, Banking, International Trade and Public Finance* (8th ed.). Vrinda Publications (P) ltd. Delhi.

[15] Joshi, H., & Bhattacharyya, I. (2003). The Dynamics of Money Supply Process in India: An Alternative Empirical Framework. In A. Vasudevan (Ed.), *Money and Banking: Select Research Papers by the Economists of Reserve Bank of India*. Academic Foundation.

[16] Khan, M. A. (2010). Testing of Money Multiplier Model for Pakistan: Does Monetary Base Carry Any Information? *Economic Analysis Working Papers (EAWP).* Colexio de Economistas de A Coruña, Spain and Fundación Una Galicia Moderna, *9*, 1-20.

[17] Klein, M. A. (1971). A Theory of the Banking Firm. *Journal of Money, Credit, and Banking*, *3*, 205–218.

[18] Palley, T. I. (1993). *Competing Views of the Money Supply Process: Theory and Evidence*. Dept. of Economics New School for Social Research New York, NY 10003 Revised July.

[19] Palley, T. I. (1994). Competing Views of the Money Supply Process: Theory and Evidence. *Metroeconomica*, *45*(1), 67-88.

[20] Palley, T. I. (2008). Endogenous Money: Implications for the Money Supply Process, Interest Rates, and Macroeconomics. *PERI Working Paper Series*, No. 178.

[21] Papademos, L., & Modigliani, F. (1990). The Supply of Money and the Control of Nominal Income. In B. M. Friedman & F. H. Hahn (Eds.), *Handbook of Monetary Economics* (Vol. 1), Amsterdam: North Holland.

[22] Pollin, R. (1991). Two Theories of Money Supply Endogeneity: Some Empirical Evidence. *Journal of Post Keynesian Economics*, *13*, 366 - 396.

[23] Rochon, L. P., & Rossi, S. (2006). Endogenous Money: The Evolutionary versus Revolutionary Views. *Working Paper*. No.14, Gennaio.

[24] Santomero, A. M. (1984). Modelling the Banking Firm. *Journal of Money, Credit, and Banking*, *16*, 576–602.

[25] White, O. (2006). Forecasting the Jamaican Money Multiplier. *Working Paper*. Monetary Analysis and Programming Department, Research and Economic Programming Division, Bank of Jamaica.

 © Science and Education Centre of North America