The Role of Central Bank of Nigeria's Analytical Balance Sheet and Monetary Survey in Monetary Policy Implementation

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This paper discusses the significance of Central Bank of Nigeria's (CBN) monetary aggregates in the implementation of monetary policy. The Analytical Balance Sheet and monetary survey are shown to be useful tools in the analysis of monetary and credit developments in the economy. It also discusses the role of the aggregates in monetary policy implementation through the adjusted money multiplier, which explains how policy actions of the CBN influence the broad money supply. Finally, the paper attempts to estimate the Taylor-type monetary policy reaction function for Nigeria using the monetary policy rate and reserve money since December 2006 when the monetary policy rate was first introduced by the Bank. The paper finds that the reaction function fits the actual policy performance of real monetary policy rate and reserve money as the implied paths of the reaction functions fit the actual paths of the policy variables rather closely.

1.0   Introduction

Policy makers in the field of monetary policy are deeply dependent on the availability of timely, relevant and reliable data provided by statisticians. Central Bank's analytical balance sheet and monetary survey are among the required information supplied to monetary policy committee for effective decision making on interest rates. Alongside the more traditional role of collecting data and assisting in the correct interpretation of data, statisticians also need to be more involved in communicating the results to the markets, media and wider public.

The Central Bank of Nigeria's (CBN) assessment of liquidity pressures influences the setting of monetary policy rate (MPR)[2]. This assessment of the

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[2] MPR replaced MRR on December 8, 2006 as the cornerstone of monetary policy implementation.

economy and the resulting MPR decision is the most important stage of monetary policy. The CBN then announces the stance of policy – the MPR decision and the associated Monetary Policy Statement – and executes operations in the financial market which are consistent with this decision.

Ultimately, the objectives of monetary policy is to ensure that the liquidity within the system is in tandem with the objective of price stability, maintenance of balance of payment equilibrium, promotion of employment, output growth and sustainable development. Though, all these objectives are necessary for the attainment of internal and external balance and promotion of long run economic growth, price stability remains the overriding objective of monetary policy.

Monetary policy in Nigeria relies on the CBN's influence on short-term interest rates because it is through these rates that household and corporate spending decisions are affected. In the present monetary policy regime, standing facilities[3] are some of the instruments employed to gauge the effectiveness of the policy. The CBN can either use symmetric or asymmetric corridor around the MPR. It is the duty of the Monetary Policy Committee (MPC) to set both the MPR and its symmetric or asymmetric corridor during the MPC meetings.

The Bank is always willing to supply overnight funds to banks at the prescribed standing lending facility rate and pay interest on banks' overnight deposits with the Bank at the prescribed standing deposit facility rate. The rates on these two facilities are meant to influence the overnight rates in the financial market to fall within the prescribed path (corridor) of the MPR. This paper, therefore, highlights the role and importance of the CBN analytical balance sheet and the monetary survey in monetary policy strategy and implementation.

For ease of exposition, the rest of the paper is structured as follows: section two discusses the Central Bank analytical balance sheet and the Central Bank survey. Section three presents the deposit money banks analytical balance

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[3] The CBN standing facilities was introduced on December 11, 2006 to effectively manage liquidity and avoid interest rate volatility in the banking system. The two rates on these facilities provide the interest rate corridor – the lower band is the standing deposit facility rate prescribed as some basis points below the MPR, while the upper band of the corridor is the standing lending facility rate which is also prescribed as some basis points above the MPR.

sheets and the monetary survey. While section four discusses monetary policy strategy and implementation, section five concludes the paper.

2.0   Structure of Central Bank Analytical Balance Sheet and Central Bank Survey

2.1   Structure of Central Bank Analytical Balance Sheet

Whereas every central bank's balance sheet is dissimilar, showing both history and the peculiar operational structure in that economy, they can usually be explained using the same categories as presented in Table 1.

Table 1: The Central Bank Analytical Balance Sheet

TOTAL ASSETS	TOTAL LIABILITIES
FOREIGN ASSETS	**RESERVE MONEY**
Gold	**Currency in Circulation**
IMF Reserve Tranche	Head Office
Foreign Currencies	**Deposit Money Banks' Deposits:**
Demand Deposits at Foreign Banks	Commercial Banks
Of which: Domicillary Accounts	Commercial Banks Demand Deposits
Treasury Bills of Foreign Governments	Commercial Banks Special Deposits
SDR Holdings	Commercial Banks Required Reserves
Attached Assets	Merchant Banks
Regional Monetary Cooperation Funds	Merchant Banks Demand Deposits
Other Foreign Assets	Merchant Banks Required Reserves
Claims on Trade Debt Prom Notes/Attached Assets	Non Interest Bank
CLAIMS ON FEDERAL GOVERNMENT	Non Interest Bank Demand Deposit
Treasury Bills & TB Rediscounts	Non Interest Bank Required Reservet
Treasury Bills	
Treasury Bills Rediscounts	**CBN SECURITIES**
Nigerian Converted Bonds	CBN Bills
Treasury Bond Stock	
Treasury Bonds Sinking Funds Overdrawn Account	**PRIVATE SECTOR DEPOSITS**
Treasury Bonds Interest	Non-Financial Public Enterprises (Parastatals):
Overdrafts to Federal Government	Federal Government Parastatals 1/
Overdraft on Budgetary Accounts	Private Sector Corporations Deposit
Federal Government(Ways & means)	State and Local Government Deposits and Parastatals
Development Stocks	State Government Parastatals
Development Stocks Account	State Government Deposits
Development Stocks Sinking Funds Overdrawn Account	Local Government Deposits
Development Stocks Interest	Other Financial Institutions Deposits
Treasury Certificates	Development Banks
Other Claims on Federal Government	Other Financial Institutions
Claims on Federation & Mirror Accounts	
	SHORT-TERM FOREIGN LIABILITIES
CLAIMS ON STATE AND LOCAL GOVERNMENT	**Non-Resident Deposits of:**
Overdrafts to States & Local Governments:	Foreign DMBs (Current Accounts)
Overdrafts to State Governments	Foreign Central Banks
Overdrafts to Local Governments	Other Foreign Financial Institutions
Claims on State & Local Govt.(Branch Position)	Other Foreign Customers
	Liabilities to Foreign Monetary Authorities:
CLAIMS ON NONFINANCIAL PUBLIC ENTERPRISES	Treasury Bills Held by Foreign Monetray Authorities
Overdrafts to Non-Financial Public:	**SME World Bank Loan A/C**
Overdrafts to Federal Parastatals	**SME Drawdown Account**
Overdrafts to State Parastatals	**Other Foreign Liabilities**
other Claims on Non-fin. Publ. Ent.	
	LONG-TERM FOREIGN LIABILITIES
CLAIMS ON (NON-FINANCIAL) PRIVATE SECTOR	**Long-Term Liabilities**
	Trade Debt Promissory Notes A/C
CLAIMS ON DEPOSIT MONEY BANKS	
Loan to Deposit Money Banks	**FEDERAL GOVERNMENT DEPOSITS**
(Overdrafts to) Merchant Banks	Budgetary Accounts
Other Claims on DMBs	Deposits on Nigerian Converted Bonds
	Deposits on Development Stocks
CLAIMS ON OTHER FINANCIAL INSTITUTIONS (OFI's)	Deposits on Treasury Certificates
Development Banks	Other Federal Govt Deposit
Other Claims on OFI's:	**Federation & Mirror Accounts**
of which AMCON Bonds	*Of which*
Loans to OFIs	**Federal Government (Excess Crude)**
Investment in OFI's	**Subnationals Government (Excess Crude)**
Miscellaneous Claims on OFIs	**Sovereign Wealth Fund (SWF)**
UNCLASSIFIED ASSETS	**CAPITAL ACCOUNTS**
Participation in International Organisations	Capital
IMF Currency Subscriptions:	Reserves
IMF Local Currency Subscription (CBN Accounting Records)	Provisions
IMF Non-Negotiable Interest Bearing A/C (CBN acc. records)	Undisbursed Profits
IMF Securities Account (CBN acc. records)	Revaluation Accounts
IMF Accounts Valuation Adjustments	Foreign Assets Revaluation A/C
SDR Allocation #1 (rev. descrepancy)	Fixed Assets Revaluation
IMF Gold Tranche A/C (CBN Accounting Records)	
Holdings of SDRs (CBN Accounting Records)	**UNCLASSIFIED LIABILITIES**
IBRD Subscriptions	Inter Bank Clearing
Total Receivables	Income
Receivables	Expense
Income Receivable:	Impersonal Accounts
Accrued Earnings	Liabilities to IMF
Impersonal Accounts	IBRD
Interest Receivables	SDR Allocation (CBN Rec)
Other Income Receivable	Other Unclassified Liabilities
Exchange Difference on Promisory Notes	Other Miscellanoues unclassified Liabilities
Foreign Assets Revaluation Accounts	
Fixed Assets Revaluation	
Inter Banks Clearing	
Non-Financial Assets	
Miscellanoues unclassified Assets	
Expenses	

The central bank analytical balance sheet (CBN-ABS) is a gross basis functional classification of all accounts that are being operated in the CBN, for the purpose of analyzing reserve money and its determinants. The source of the CBN ABS is the statistics module in Oracle ERP (Corporate book of the Bank[4]) linked to the trial balance and the accounts are driven by analytical codes. These analytical codes which are set of alpha-numeric combination of values from a coding list prepared by the Statistics Department are meant to classify the accounts by residency, institutional sectors and instruments. Each account in the general ledger is assigned a pair of both asset and liability code that will be driven by the *balance it carries* as at when the ABS is generated.

The CBN ABS is prepared in both detailed and summary formats. The CBN ABS showing the list of all the accounts having the same codes and closing with the same form of balance, that is, asset or liability balance is the "Detailed CBN ABS", while the one showing only the total balances of each parent categories without listing the accounts that constituted the balances is called the "Summary CBN ABS". The summary CBN ABS is an abridged version of the detailed.

TABLE 2: Central Bank Survey Outline

Foreign Assets (Net)
  Foreign Assets
  Long-Term Foreign Liabilities
  Short-Term Foreign Liabilities
Net Credit to Government
  Claims On Fed. Govt
  Fed Govt Deposits
Net Credit to Private Sector
  Claims on Private Sector
  Private Sector Deposits
Net Claims on DMBs
  Claims on DMBs
  CBN Securities
Other Assets Net
  Other Assets
  Other Liabilities

Reserve Money
  Currency in Circulation
  DMBs Deposits
    Required Reserves
    Current Account balances

2.2   Central Bank Survey

The central bank survey is derived from the summary CBN-ABS depicting both the determinants and components of Reserve Money**.** The reserve money (also referred to as high powered money, base money or monetary base) is the

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[4] In this paper, the word "Bank" refers to the Central Bank of Nigeria.

main component on the liability side of the central bank analytical balance sheet. It plays a key role in monetary analysis and policy formulation. If the quantity of money, rather than price, is the focus of monetary policy implementation, then the aggregate amount of the central bank account holders is mostly important.

At a minimum, reserve money should include currency in circulation and legal reserves. In many countries, holdings of central bank securities used for liquidity management are not included in reserve money, ostensibly because central banks would like to see the impact of liquidity management instruments on reserve money. Central bank securities held by deposit money banks can only be included in reserve money, if the securities could be used to satisfy reserve requirements. However, practice varies from country to country, but typically reserve money includes currency issued by the central bank [whether held by deposit money banks (vault cash) or by nonbank public (currency outside banks)], required reserves and transaction balances of operating deposit money banks with the central bank.

Table 3: Deposit Money Banks Consolidated Analytical Balance Sheet

TOTAL ASSETS:	TOTAL LIABILITIES:
RESERVES	**DEMAND DEPOSITS**
Currency	Private Sector Deposits
Deposits with CBN:	State Government Deposits
[i] Reserve Requirements	Local Government Deposits
[ii] Current Accounts	
	TIME & SAVINGS DEPOSITS 2/
CLAIMS ON CENTRAL BANK	Time Deposits:
[i] CBN Bills	Private Sector Deposits
[ii] Stabilization Securities	State Government Deposits
[iii] Shortfall/excess credit/others	Local Government Deposits
	Savings Deposits:
FOREIGN ASSETS	Private Sector Deposits
Claims on Non-resident Banks:	State Government Deposits
[i] Balances held with banks outside Nigeria	Local Government Deposits
[ii] Balances held with offices and branches outside Nigeria	
[iii] Loans & Advances to Banks outside Nigeria	**FOREIGN CURRENCY DEPOSITS**
Bills Discounted Payable outside Nigeria	Domiciliary Accounts
CLAIMS ON CENTRAL GOVERNMENT	
Treasury Bills / Treasury Bills Rediscounted	**MONEY MARKET INSTRUMENTS:**
Treasury Certificates	Certificate of Deposit Issued
FGN Bonds	Notes & Deposit (Cash) certificates
Loans & Advances to Central Government	
Bankers Unit Fund	**BONDS**
	Debentures
CLAIMS ON STATE & LOCAL GOVERNMENT	
Loans & Advances to State Government	**FOREIGN LIABILITIES:**
Loans & Advances to Local Government	Balance Held for offices and branches Abroad
	Balance held for banks outside Nigeria
CLAIMS ON OTHER PRIVATE SECTOR	Money at call with foreign banks
Loans & Advances to Other Customers (Gross)	Loans & Advances from other banks outside Nigeria
Loans & Advances to Nigeria Banks Subsidiaries	
Bills Discounted from non-bank sources	**CENTRAL GOVERNMENT DEPOSITS**
Investments:	Federal Government Time Deposits
[i] Ordinary Shares	Federal Government Demand Deposits
[ii] Preference Shares	Federal Government Savings Deposits
[iii] Debentures	
[iv] Subsidiaries	**LIABILITIES TO CENTRAL BANK**
[v] Other investments	Loans & Advances from CBN
Commercial papers	CBN Overdrafts to banks
Bankers Acceptances	
Factored Debt	**CAPITAL ACCOUNTS:**
Advances under Lease	Capital
	Reserve Fund
CLAIMS ON OTHER FINANCIAL INSTITUTIONS	Reserves for Depreciation & non-performing assets
Placement with Discount Houses	Loans & Advances from Federal and State Government
	Total Loans/Lease Loss Provision
UNCLASSIFIED ASSETS	
Fixed Assets	**UNCLASSIFIED LIABILITIES:**
Domestic Inter-Bank Claims	Inter-bank liabilities
Money at call outside banks	Loans & Advances from Other creditors
Certificates of Deposit	Letters of Credit
Placement with Discount Houses	Takings from Discount Houses
Other Assets:	Other Liabilities:
Miscellaneous(others)	Miscellaneous

3.0   Structure of DMBs Analytical Balance Sheet and Monetary Survey

3.1   Structure of DMBs Analytical Balance Sheet

By the CBN Act, all deposit money banks (DMBs) are required to electronically submit their balance sheets to the Central Bank of Nigeria on monthly basis. The submitted financial balance sheet is consolidated by the electronic Financial Analysis and Surveillance System (e-FASS). The consolidated financial balance sheet, which is on net basis, is transformed into the analytical form by mapping each line on the balance sheet into its analytical position to produce the aggregated deposit money banks' analytical balance sheet. The DMBs-ABS is also on gross basis as the CBN-ABS (see Table 3).

3.2   Monetary Survey

In 2010, the CBN introduced a new banking model which categorized deposit money banks into commercial, merchant and specialized banks. Nigeria's monetary survey now comprises of the balance sheets of the CBN, Commercial Banks, Merchant Bank and Non-Interest Bank. The monetary survey is an aggregate balance sheet of the entire banking system in a given country comprising the central bank and the deposit taking institutions. The methodology of compilation is unified at the international level within the framework of the IMF member countries.

Table 4: Basic Monetary Survey Format

- ASSETS
  - Net Foreign Assets (NFA)
  - Net Domestic Assets (NDA)
    - Domestic credit (Net) (NDC)
      - Claims on Government (net) (NCG)
        - Memo: Claims on Federal Government less FMA
        - Memo: Federation and Mirror Accounts (FMA)
      - Claims on Private Sectors (CPS)
        - Claims on State and Local Governments (CSLG)
        - Claims on Non-Financial Public Enterprises (CNFP)
        - Claims on other Private Sectors (COPS)
    - Other items (net) (OIN)
- LIABILITIES
  - Broad Money (M_2)
    - Narrow Money (M_1)
    - Quasi Money (QM)

The basic framework of the monetary survey includes two levels of data compilation and presentation. In the first level, the financial balance sheets of individual DMB from the e-FASS are aggregated into analytical format (DMBs-ABS). Analytical reporting aims at providing data classified by residency, sector and instruments on gross basis. In the second level, the DMBs-ABS and CBN-ABS are consolidated into a monetary survey based on the IMF Money and Banking Statistics Manual.

It is pertinent to note that the monetary survey is the main source of monetary statistics and contains a lot of important indicators necessary for macroeconomic analysis. The process of compiling monetary survey for the central bank is premised on the reclassification of the balance sheet into the broad categories of aggregates indicated in Table 4. This reclassification of the banking system balance sheet could be illustrated using the balance sheet identity as follows;

$$M_2 = NFA + NDC + OAN \qquad (1)$$

And

$$NDC = NCG + CPS \qquad (2)$$

Where:
$\quad M_2 \quad = \quad$ Broad Money
$\quad NFA \quad = \quad$ Net Foreign assets
$\quad NDC \quad = \quad$ Net Domestic Credit
$\quad NCG \quad = \quad$ Net credit to Government
$\quad CPS \quad = \quad$ Credit to Private sector
$\quad OAN \quad = \quad$ Other assets net

Thus,

$$M_2 = NFA + NCG + CPS + OAN \qquad (3)$$

In terms of flow, that is changes in stock, the identity can be rewritten as:

$$\Delta M_2 = \Delta NFA + \Delta NCG + \Delta CPS + \Delta OAN \qquad (4)$$

Therefore,

$$\Delta M_2 = \Delta NFA + \Delta NDA \qquad (5)$$

where net domestic assets (NDA) is the sum of aggregate domestic credit (net) and other assets (net). Following the balance sheet identity that assets must equal liabilities, it can be seen that changes in money supply (M_2), that is, the left hand side of (5) reflects changes in the assets side of the balance sheet, that is, the right hand side of (5). For instance, an increase in external assets, which is reflected in foreign assets of the banking system, is mirrored by an increase in the level of money supply via monetization. The same applies to

changes in domestic assets of the banking system. Therefore, the analysis of the monetary survey is key to understanding the process of monetary policy implementation.

It should be noted that the CBN-ABS provides highlights on the monetary base and its determinant, while the monetary survey presents money supply and its determinants.

4.0   Monetary Policy Strategy and Implementation

Producing high quality CBN-ABS and monetary survey remain a core task of a central bank. It is a central input not only for our decision-making processes, but also for communicating our decisions, and thus, for the credibility of monetary policy actions. Distinction between the various type of monetary policy lies primarily with the set of instruments and targets/variables that are used by the monetary authority to achieve their goals as shown in table 5:

Table 5: Types of Monetary Policy Regimes

Monetary Policy	Target Market Variable	Long-Term Objective
Inflation Targeting	Interest on overnigt Debt	Inflation Rate
Monetary Aggregates	The growth in Money Supply	Inflation Rate
Fixed Exchange Rate	The Spot Price of the Currency	The Spot Price of the Currency
Gold Standard	The Spot Price of the Currency	Low inflation as measured by the Gold price
Mixed Policy	Usually Interest Rates	Usually Unemployment and Inflation Rate

In practice, to implement any type of monetary policy, the main tool used is modifying the amount of reserve money. Under the current implementation regime, monetary policy is implemented by changing the size of the reserve money, largely through open market operations (OMO)[5].

Interest rate is another vital tool in monetary policy implementation. For instance, the contraction of money supply can be achieved indirectly by increasing the monetary policy rate. In Nigeria, the CBN set the discount rate,

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[5] OMO was introduced by the CBN in March 1993 but commenced operation in June 1993 as a major tool of monetary control.

as well as achieve the desired monetary policy rate (MPR) by OMO. The plot of MPR and interest rates on overnight debt in Chart 1 reflects this assertion.
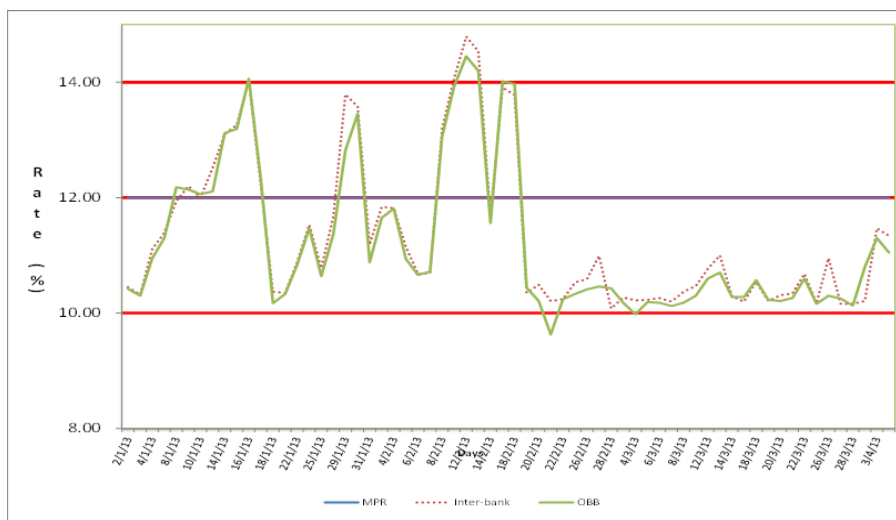

Chart 1: Plot of MPR, Inter-bank and OBB rates

4.1   The Role of RM and M_2 in Monetary Policy Implementation

The Multiplier model of M_2 originally developed by Brunner (1961) and Brunner and Meltzer (1964), has become the standard paradigm to explain how policy actions of central banks influence M_2. The framework of monetary control builds on the link between liquidity supplied by the Central Bank and the deposit and credit created by banks. Hence the supply of money is determined by the reserve money created by the CBN and the multiplier that relates reserve money and broad money. The multiplier model decomposes movements in M_2 into the part that is due directly to CBN policy actions (the adjusted reserve money) and the part that is due to changes in technology and/or the tastes and preferences of depository institutions and the public (the adjusted multiplier).

Under the indirect monetary control, M_2 would be expressed as the product of a money multiplier and the reserve money, with the latter as the main intermediate instrument of monetary management. For the reserve money to act as the main link to M_2, a priori expectation of the money multiplier is that it should be stable over time. Following Garfinkel and Thornton (1991), Doguwa (1994) examines the standard multiplier model of M_2 in the case of Nigeria. The results in Doguwa (1994) reveal that the CBN policy actions are

independent of the adjusted multiplier, indicating that the multiplier in Nigeria has been relatively stable over time, thus suggesting the appropriateness of using the adjusted reserve money as an indicator of the effects of the CBN policy action on the money stock (M_2)

The Broad money (M_2) is defined as

$$M_2 = C^p + DD^{ps} + DD^p + QM \tag{6}$$

Where C^p = currency held by the non - bank public
DD^{ps} = private sector demand deposits at deposit money banks
DD^p = other financial institutions deposits (private sector) at CBN
QM = private sector time and savings deposit at banks

The reserve money on the other hand is simply the sum of currency with non-bank public, C^p, cash at banks C^b and the balances of the banks at the CBN, comprising required reserves, RR and other reserves OR, that is,

$$RM = C^p + RR + OR \tag{7}$$

The sum of C^p and C^b provides currency in circulation. The other reserves comprises of vault cash of banks, current account balances and standing deposit facility at the CBN.
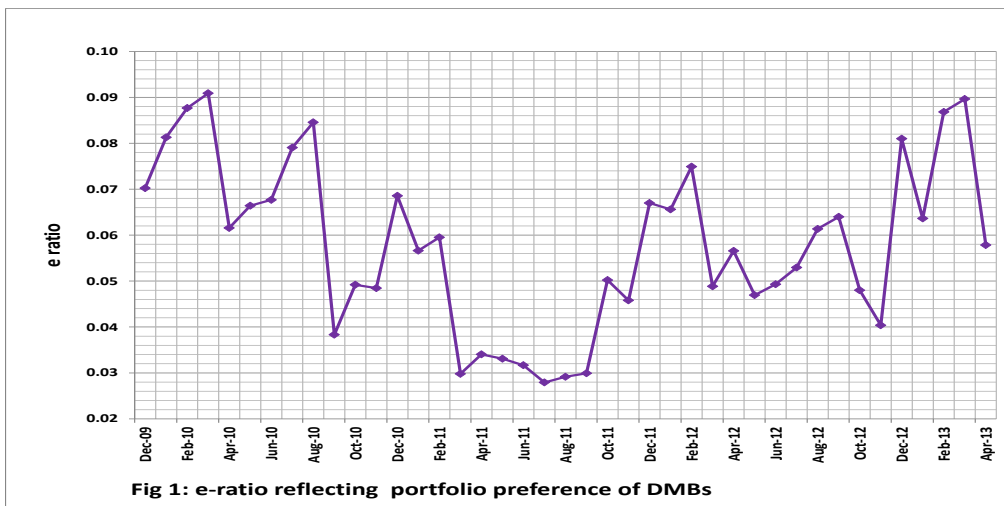

Fig 1: e-ratio reflecting portfolio preference of DMBs

The bank balances at CBN can be affected directly by the Bank sales or purchase of government debt instruments in the open market. The CBN has a

simple system of statutory reserve requirements, with required reserves, RR given by

$$RR = r(DD^p + QM) \qquad (8)$$

Where $0 < r < 1$ and r denotes the cash reserve requirement ratio. A change in r also would constitute a monetary policy action by the CBN.

Banks build up other reserves for purposes of clearing and other banking activities such as foreign exchange bidding and overnight investment in SDF at the CBN. Therefore OR can be expressed as,

$$OR = e(DD^p + QM) \qquad (9)$$

Where, e denotes the ratio of other reserves that are held against private sector demand, savings and time deposits at banks, and is expected to reflect the portfolio preference and/or behavior of the depository institutions (Fig 1).

Fig 2: k-ratio reflecting portfolio preference of non-bank public for currency
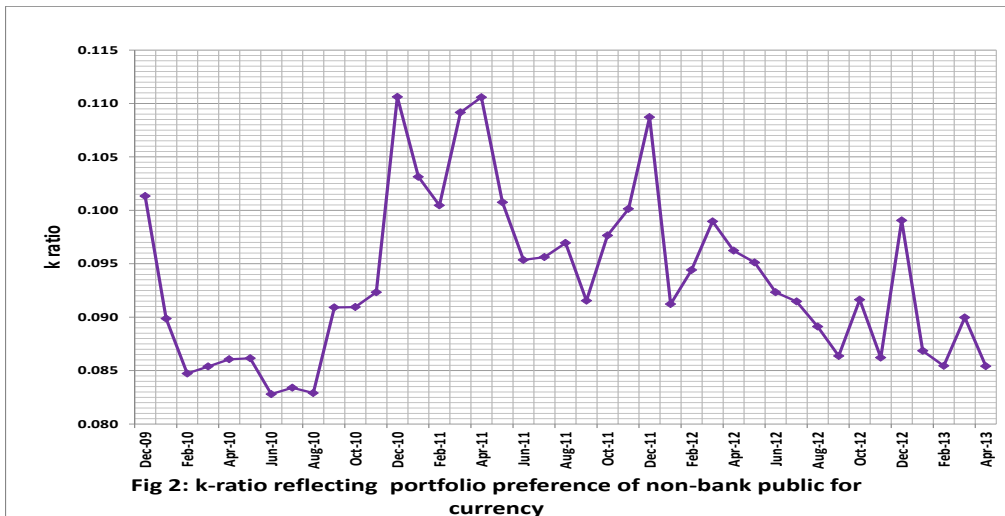
The model is completed by assuming that currency with non – bank public and other financial institutions deposits with CBN are held in some proportion k and p, respectively, of private sector demand deposits with banks and quasi money. The currency ratio k (Fig 2) reflects the portfolio preference of the non-bank public for currency. Thus

$$C^p = k(DD^p + QM) \qquad (11)$$

$$DD^{ps} = p(DD^p + QM) \qquad (12)$$

From equation (6), and (7);

$$M_2 = (1 + k + p)(DD^p + QM) \tag{13}$$
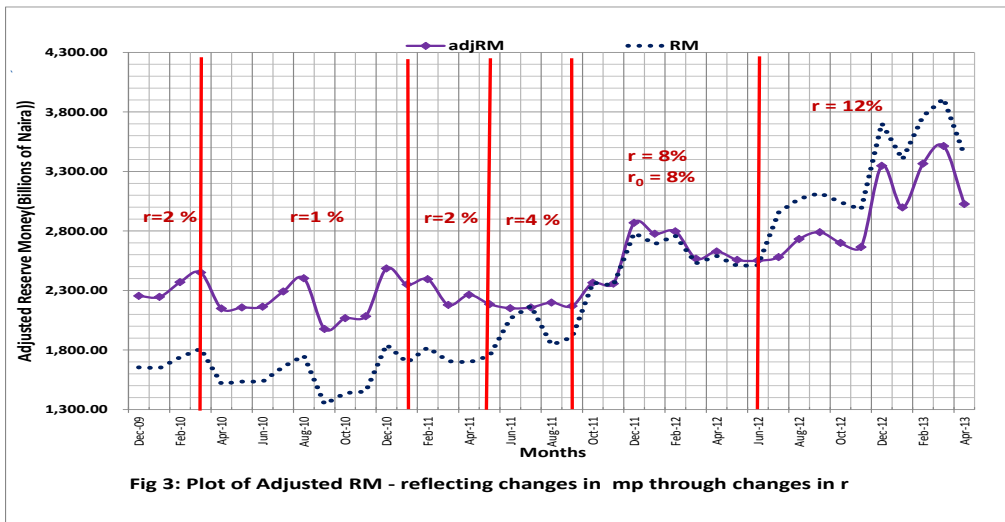
and

$$RM = (k + r + e)(DD^p + QM) \tag{14}$$

Therefore,

$$m_2 = \frac{(k + p + 1)}{(k + r + e)} \tag{15}$$

and

$$M_2 = m_2\, RM \tag{16}$$

where m_2 is the broad money multiplier.

Fig 3: Plot of Adjusted RM - reflecting changes in mp through changes in r

In the RM multiplier representation, policy actions are reflected not only in RM through changes in RR, but also in m_2 through changes in r. With a simple adjustment of RM, the effects of the policy actions on M_2 can be isolated in one measure. This alternative measure of the Reserve Money called the adjusted RM, RM_{adj}, (see Fig 3) reflects both changes in RR and r. Thus,

$$RM_{adj} = RM + RAM \tag{17}$$

where the reserve adjustment magnitude, RAM is defined as

$$RAM = (r_0 - r)(DD^p + QM) \qquad (18)$$

The adjustment magnitude measures the amount of required reserves released or absorbed by changes in r relative to r_0 – the required reserve ratio during a chosen base period. In the base period RAM = 0, and RM_{adj} equals RM. A decrease in r from its base period level r_0 releases reserves into the banking system and thereby increases RAM and RM_{adj}. Conversely, an increase in r reflects the reserve drain on the banking system by reducing RAM and RM_{adj}.
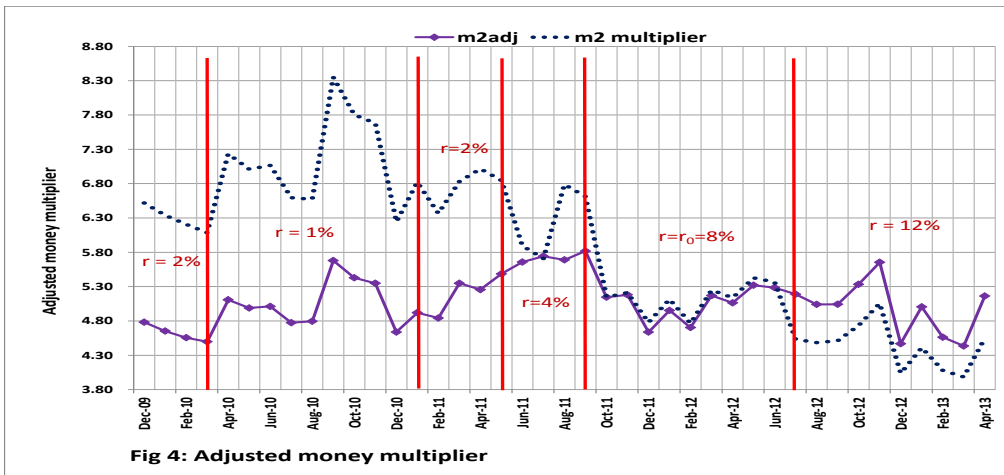

Fig 4: Adjusted money multiplier

From equation (13) and (16) we have

$$RM_{adj} = (k + r_0 + e)(DD^p + QM) \qquad (19)$$

and

$$M_2 = m_{2adj} RM_{adj} \qquad (20)$$

$$m_{2adj} = \left.(k + p + 1)\middle/(k + r_0 + e)\right. \qquad (21)$$

In this characterization of M_2, all changes in monetary policy, through changes in r are expected to be reflected in the RM_{adj}. However, changes in the adjusted multiplier reflects only changes in the portfolio preferences of the depository institutions and the non – bank public. Thus the adjusted multiplier is supposed to be independent of policy, since it is not directly influenced by the policy actions of the CBN (see Fig 4).

4.2   Monetary Authorities Reaction Function

The Monetary authorities reaction function, which summarizes how the monetary authorities alter monetary policy in response to economic developments, helps in predicting actual policy actions, thereby serving as a benchmark for assessing the current stance and the future direction of monetary policy. Also in macroeconomic models, the reaction function is central in evaluating the monetary authorities' policy and determining the effects of other macro policies or economic shocks.

A recent interest in monetary policy reaction functions has been motivated mainly by the work of Taylor (1993) – who proposes his rule in terms of the instrument actually used by central banks. Thus, the Taylor rule-like monetary policy is designed to keep inflation low and to do what little it can to stabilize real output fluctuations. In the spirit of Judd and Rudebusch (1998), Sanchez-Fung (2000) and Doguwa (2002), we estimate a Taylor-type monetary policy reaction function by paying particular attention to the specification, stability and dynamics of such a relation. Our version of the modified Taylor's rule to be estimated can be written as:

$$\kappa_t = \gamma_0 + \beta \pi_t + \rho DG_t + \lambda DE_t + e_t \qquad (22)$$

and

$$\eta_t = \gamma_0 + \beta \pi_t + \rho DG_t + \lambda DE_t + \mu_t \qquad (23)$$

where
$$DG = log\{GDP|P\_GDP\}$$
$$DE = log\{BDC\ Rate|Wdas\ Rate\}$$

and κ is the log of RM, η is the real monetary policy rate, π is the year on year CPI inflation, DG is the percentage deviation of real GDP from its potential P_GDP created using the Holt-Winters multiplicative three parameter method which is appropriate for series with a linear time trend and multiplicative seasonal variation. DE is the exchange rate premium between Bureau De Change rate and the official wDAS rate. The error terms μ_t and e_t are the well-behaved disturbance terms. The parameters γ_0, β, ρ and λ are the constant term and coefficients to be estimated empirically. Both equations (22) and (23) can be seen as a 'feedback' rule in which κ and η react to expected inflation, exchange rate premium and the output gap.

Potential GDP is important because monetary policy makers use the difference between actual and potential GDP – the output gap to determine whether the economy needs more or less monetary stimulus. If the actual output is below the potential output, the policy makers would want to stimulate the economy by reducing monetary policy rate and/or reserve money. In contrast, the farthest above potential real GDP is, the higher the probability of overheating the economy, and the policy makers would respond by increasing monetary policy rate and/or reserve money. Therefore, the DG coefficient ρ in both equations (22) and (23) should be negative unless the authorities follow a "lean with the wind policy".

A constant growth rate of money stock, an informal policy of leaning against the wind, and an explicit quantitative policy of interest rate setting all will tend to generate positive responses of the policy rate to changes in expected inflation, exchange rate premium and output gap. The most straightforward application of equations (22) and (23) is to situations where the monetary authorities set short term interest rates in response to events in the economy, in which case, these equations are the central bank monetary policy reaction functions describing how the Bank takes actions in the money market that cause the interest rate to change in response to changes in inflation and real GDP.

If the Bank 'leaned against the wind' by easing money market conditions in response to lower inflation or declines in production; and tightening money market conditions in response to higher inflation or increases in production, then one would expect β and ρ in equations (22) and (23) to be negative. In contrast, if the Bank "leaned with the wind" by tightening money market conditions in response to lower inflation or declines in production; and easing the market conditions in response to higher inflation or increases in production, then one would expect the coefficients ρ and β in to be positive.

The coefficients of the exchange rate premium λ in the two equations should be negative, if the authorities are in the temperament to defend the official exchange rate. Such an outcome could be generated mainly by depletion of gross official reserves, but could also be paired with a reduction in net domestic assets in order to attempt to reduce liquidity, since less Naira with the bank and non-bank public would imply less demand for foreign currencies. The larger the exchange rate premium, the higher the probability that the official exchange rate regime could collapse. Under such

circumstances, therefore, it would be impossible to maintain an overvalued currency, given that the amount of gross international reserves is not unlimited.

Table 6: Long and Short Run Monetary Policy Reaction functions

	Long Run Estimates		Short Run Estimates	
	η_t	κ_t	$\Delta\eta_t$	$\Delta\kappa_t$
γ_0	2.2232[b] (0.9821)	-1.2947 (0.6274)	0.0142 (0.1430)	0.0098 (0.0118)
γ_1	0.8426[a] (0.1188)		0.8846[a] (0.2179)	
γ_2	0.2369[c] (0.1316)	0.4964[a] (0.1431)	0.1552 (0.0975)	0.2564 (0.1842)
γ_3	-0.1908[b] (0.0791)		-0.0744 (0.1232)	
γ_4		0.7302[a] (0.1764)		0.7298[a] (0.1580)
β_0	-0.7443[a] (0.0837)		-0.8112[a] (0.0949)	
β_1	0.562[a] (0.1071)		0.6059[a] (0.1902)	
β_2		-0.0152[b] (0.0063)		-0.01148[b] (0.0054)
β_3		-0.0081 (0.0066)		-0.0135[b] (0.0059)
ρ_0	1.1251[b] (0.4275)		0.3384[b] (0.3384)	
ρ_1		0.0450 (0.0278)		0.0304 (0.0254)
ρ_3	0.8080[b] (0.3305)		0.5077 (0.3172)	
λ_0	0.3132[b] (0.1453)		0.4143[a] (0.1074)	
λ_2	-0.4744[a] (0.1140)		-0.4022[a] (0.1191)	
λ_4		0.0061 (0.0081)		0.0046 (0.0081)
Θ			-1.0278[b] (0.3862)	-1.2344[a] (0.2680)
Adj R^2	0.9745	0.9109	0.9047	0.6547
BG LM Test	1.2314 [0.3292]	1.7577 [0.2110]	0.7325 [0.5073]	2.5388 [0.1240]
JB White Noise	0.5647 [0.7540]	1.2483 [0.5357]	2.1124 [0.3478]	0.6026 [0.7398]
ARCH Test	0.3857 [0.5416]	0.0010 [0.9747]	0.0265 [0.8724]	0.9607 [0.3400]

Heteroskedasticity Test: ARCH
Breusch-Godfrey Serial Correlation LM Test (BG LM test)
Standard errors in ( ), and Probability values in [ ]
Jarque-Bera White Noise test

The version of equations (22) and (23) to be empirically estimated can be written as:

$$\kappa_t = \gamma_0 + \sum_{i=1}^{4}\gamma_i\kappa_{t-i} + \sum_{r=0}^{4}\beta_r\pi_{t-r} + \sum_{j=0}^{4}\rho_j DG_{t-j} + \sum_{k=0}^{4}\lambda_k DE_{t-k} + \mu_t \qquad (25)$$

and

$$\eta_t = \gamma_0 + \sum_{i=1}^{4} \gamma_i \eta_{t-i} + \sum_{r=0}^{4} \beta_r \pi_{t-r} + \sum_{j=0}^{4} \rho_j DG_{t-j} + \sum_{k=0}^{4} \lambda_k DE_{t-k} + \varepsilon_t \qquad (26)$$

respectively. Equations (25) and (26) are autoregressive distributed lag specifications each of order four ARDL (4,4,4,4). It is chosen in order to account for the well-known problem of preliminary, as well as wrongly measured data.

Fig 5: Monetary policy reaction function
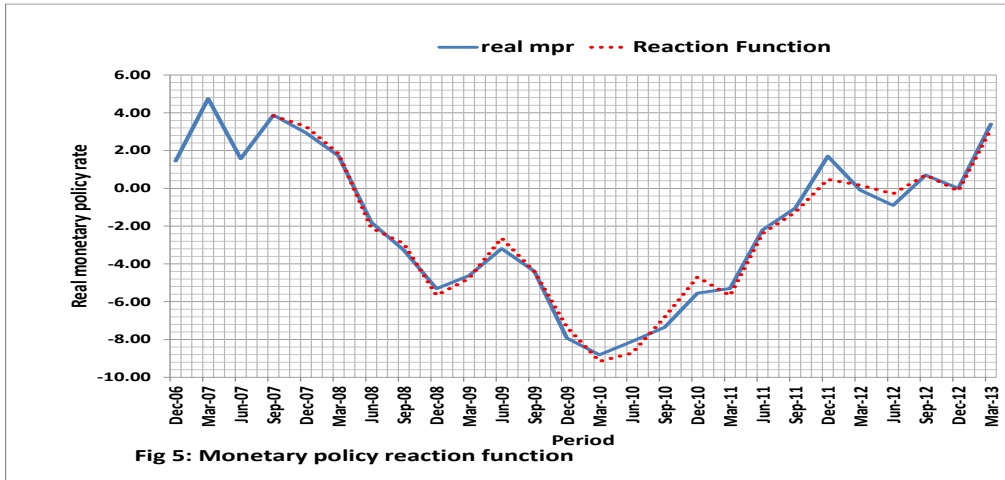
Equations (25) and (26) are estimated using quarterly data for the period 2006Q4 to 2013Q1 to coincide with the period when the new monetary management framework was introduced in CBN. The results of the estimation are shown in Table 6. The diagnostics suggest that both long-run and the short run equations are adequately determined by the data. During the estimation period, the negative coefficient of inflation in the η equation presented in the revealed that the monetary authorities "leaned against the wind" by easing money market conditions in response to lower inflation and tightening the money market conditions in response to higher inflation. The negative exchange rate coefficient in the η equation suggested that the monetary authorities defended the official exchange rate in the period.

Fig 5 and 6 presents the reaction functions which actually fit the actually policy performance of real monetary policy rate η and the log of the reserve money as the implied paths of the reaction functions (model 1 and 2) fit the actual paths of the policy variables rather closely.

It is interesting to find out how quick monetary authorities in Nigeria reacted to deviations from their 'implied rules' estimated in table 6. In order to do so,

short-run versions of (25) to (26) are estimated by using the rates of change of the variables, as well as the lagged saved residuals from such equations, or equilibrium corrections mechanisms (ECM), as explanatory variables. The coefficient of the ECM term θ is expected to provide information regarding the speed of adjustment to the steady state relation between the variables being modeled.

The short-run versions of equations (25) and (26) are given by:

$$\Delta\kappa_t = \gamma_0 + \sum_{i=1}^{4}\gamma_i\Delta\kappa_{t-i} + \sum_{r=0}^{4}\beta_r\Delta DI_{t-r} + \sum_{j=0}^{4}\rho_j\Delta DG_{t-j} + \sum_{k=0}^{4}\lambda_k\Delta DE_{t-k} + \theta\mu_{t-1} + \epsilon_t \quad (27)$$

and

$$\Delta\eta_t = \gamma_0 + \sum_{i=1}^{4}\gamma_i\Delta\eta_{t-i} + \sum_{r=0}^{4}\beta_r\Delta DI_{t-r} + \sum_{j=0}^{4}\rho_j\Delta DG_{t-j} + \sum_{k=0}^{4}\lambda_k\Delta DE_{t-k} + \theta\varepsilon_{t-1} + \epsilon_t \quad (28)$$

Equations (25) to (28) comply with all the diagnostic statistics reported. This suggest that the models are well fitted as all the equations error terms are not serially correlated and have stable variances (Table 6). The estimated parameter θ in both equations are statistically significant and imply that on average, all of the deviations from the estimated monetary policy reaction functions are made up in one quarter.

Fig 6: Monetary Policy Reaction Function
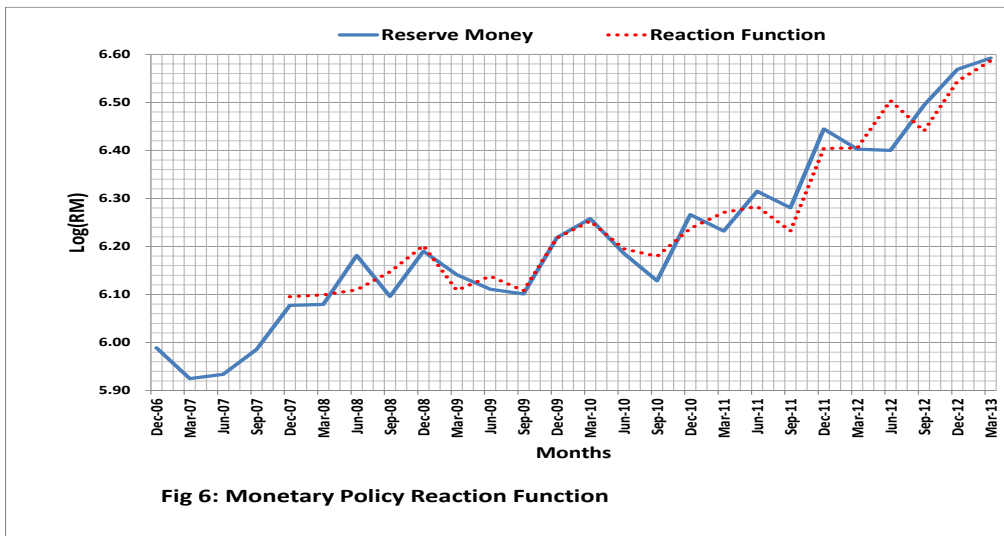
5.0   Concluding Remarks

This paper discusses the role of the Central Bank of Nigeria's Analytical Balance Sheet and monetary survey in monetary policy implementation. The

effective management of the banking system balance sheets is critical to the success of any monetary policy regime. As such an accurate and reliable balance sheet is central to a successful implementation of monetary policy.

The Monetary Policy Committee of the CBN currently base their decisions on many factors: leading indicators, forecasts, growth in monetary aggregates, etc. There is no reason why reaction functions such as the ones estimated in equations (25) and (26) could not be added to the list of factors to be considered. Furthermore, a quarter ahead forecast of the monetary policy rate implied by the reaction function under different assumptions (on expected inflation, output gap and exchange rate premium) could be provided as a possible guide to the MPC in taking their decisions.

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