Monetary Aggregate Targeting and Inflation In Nigeria

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The linkage between monetary aggregates and the pursuit of minimal inflation objective has been influenced by the axiom that says 'you can only make use of what you have to influence what you want'. The central bank, in any economy, has the sole responsibility of controlling monetary aggregates to pursue its macroeconomic objectives. Knowing fully well that fiscal operations of the economy are in most cases outside their control, they often rely on the use of monetary aggregates to influence the ultimate objectives/targets of growth of output, employment, balance of payment conditions and inflation. Most developing countries are faced with the problem of indirect linkage between monetary policy instruments and the ultimate targets. A strategy for obviating this problem is the targeting of such intermediate variables as the money supply, credit, short-term interest rates and perhaps exchange rate. The use of money supply as an intermediate target variable assumes greater significance where the interest rate channel of monetary policy is weak and where the exchange rate market is mostly driven by speculations with high level of instability like that of Nigeria. Particularly, maintaining relative price stability in the face of fiscal recklessness of government has become a daunting challenge for many developing countries. This, among others, has made most central banks in developing to play the role of 'leaning against the wind' by using what they have, given the weaknesses of other intermediate

targets, to counter or accommodate the fiscal behaviours of government with a view to controlling inflation.

Many other arguments have been advanced for using monetary aggregates to influence the behaviours of prices in many countries. The presumption for the use of monetary aggregate in targeting inflation is that it provides useful information about the current stance of monetary policy and the future course of economic conditions (Yue and Fluri, 1991). Given the corroborative and incremental information money contains on inflationary conditions, most countries use monetary targets as a means of providing a nominal anchor to tie down inflation[2] expectations and to limit the extent to which the public finances can be monetised. In this respect, the average growth rate of the monetary stock has been viewed as a decisive determinant of overall price trends in the long run (Meier, Florey and Stauffer, 2002). It also suggests a satisfactory relationship between monetary aggregates and some key macroeconomic variables such as inflation and nominal gross domestic product. In addition, it underscores the notion that aggregate money supply is strongly and directly controllable by the monetary authority. Mishkin (1999), in trying to point out the strengths and limitations between monetary and inflation targeting, points out that the monetary growth rates are more closely related to instruments of monetary

policy than inflation targeting while monetary targeting can be adjudged to be more transparent than its inflation counterpart because it is usually associated with one indicator. It allows for almost rule-based adjustments that are devoid of political control and influence[1].

For effective monetary aggregate targeting, some prerequisites need to be established. The first is the stability and predictability of money velocity as espoused by the classical quantity theorists. Second, there should be stable relationship between nominal incomes in the short run and monetary aggregates and prices in the long run (Lindsey, 1991 and Goodhart, 1991).

In spite of the significant role of monetary aggregates for targeting inflation, the literature is replete with the conclusion that monetary targeting is inherently difficult to master because of domestic and international sources of instability. This violates the general reason for its adoption: the long run stability of its relationship with the nominal GDP. Several factors could impair the stability assumption of the multiplier. Such factors include rapid changes in the financial system and credit relationship with real activities. The experience in transition economies has shown that they better serve as constraints on public finances and inflationary expectations than a very good instrument for targeting inflation. Despite this, many countries still use monetary aggregates as a nominal anchor for targeting inflation. Does it show the continued relevance of this framework in many other

countries? The continued reliance on the use of monetary aggregates for targeting inflation in Nigeria tends to suggest its relevance. This then raises the question of how relevant is monetary aggregate targeting to inflation expectations in the country? The need to answer this question underscores this paper.

To address this objective, the rest of the paper has been structured into five different parts. Following the introduction is part II that examines monetary targeting in Nigeria while part III highlights the theoretical issues in monetary aggregate targeting. Methodology and literature are reviewed in part IV. Part V presents the data and analyses the results while part VI concludes the paper.

II MONETARY AGGREGATES TARGETING IN NIGERIA: WHAT DO DATA SAY?

One of the primary responsibilities of the Central Bank of Nigeria, as explicitly stated in its Enabling Act is the promotion and sustenance of monetary stability and a sound financial system. Thus, the task of formulating and implementing monetary policy in the country rests squarely on the Central Bank. Saddled with this responsibility, the evolving monetary policy framework has shifted emphasis on its developmental functions[2] that were stressed in the 1970s and 1980s to the maintenance of price stability through the instrumentality of monetary aggregates targeting. Monetary aggregates are the liabilities of the banking system and represent the counterpart of the economy's assets, namely the

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[1] The lags in monetary policy transmission are, however, making monetary policy authorities particularly those in developed countries to shift attention to inflation targeting. Albeit, this presumes a relatively well developed financial system and a good knowledge of the forces behind price formation process.

[2] Such functions include issuance of legal tender currency, safeguarding the value of the domestic currency, serving as a banker and an adviser to governments, and providing specialised credit to priority sectors.

sum of foreign assets (estimated in local currency), domestic assets and net 'other' assets (Onyido, 2001 and Odusola,2002). Within this framework, the components of broad money are narrow money (currency outside banks, private sector demand deposits with the central bank and commercial banks), quasi money (savings and time deposits at commercial and merchant banks), net domestic credit, net foreign assets, and net 'other' assets.

To effectively discharge this role, several institutional and regulatory changes have taken place. A critical component of this is the shift away from direct monetary controls to indirect one with emphasis on market-based instruments to keep the operating variables within targets[3] . Such instruments include the open market operations, flexible and dynamic interest rate policy, proactive adjustments of the minimum rediscount rate as a barometer to gauge market conditions, reserve requirements (both cash and liquidity) and discounting window operations. The use of market-base techniques does not only enhance market competition and efficiency but also allows for flexibility in smoothening swings in bank reserves relative to demand to keep the inter-bank rate within the desired bound. The need to be more focused on this made the Bank to adopt broad money as the intermediate target of monetary policy.

Effective targeting cannot be undertaken without supportive operational and administrative environments. To this end, several amendments were made to the Central Bank of Nigeria Act of

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[3]The commencement of open market operations (OMO) in June 1993 ushered in OMO as the primary instrument of monetary management while the introduction of CBN Certificate in February 2001 was geared towards complementing the use of Nigeria's Treasury Bill as the intervention instrument. It was originally operated weekly before it was rescheduled to a bi-monthly operation.

1957 and subsequent amendments. To improve operational environment, the CBN Act No. 24 and the Bank and Other Financial Institutions Act No. 25, both of 1991, were enacted. The 1998 and 1999 amendments also conferred operational autonomy on the Bank. To further enthrone transparency and credibility in the conduct of monetary policy, the Monetary Policy Committee was established in January 1999.

Right from its inception in 1959, monetary targeting has been an anchor of monetary policy framework with either or both the narrow and broad money serving as intermediate targets. Following the rapid institutional changes in the Nigerian financial environment, narrow money has seized to be the intermediate targets from the late 1980s. When the narrow money (M1) was being used, merchant banks were not considered as a part of the institutions accounting for the economy's money stock. The rapid increase in the number of merchant banks after the liberalization of the financial system in July 1987 swell up the quantum of quasi money in the economy. The number of merchant banks, for instance, rose from 12 in 1985 through 1992 to 54 with the number of branches rising from 25 to 116 correspondingly. During the same period, quasi money rose from ₦10.55 billion to ₦53.11 billion representing 403.41 percent. This suggests that the activities of merchant banks can no more be ignored particularly given their increasing influence on the liquidity conditions. Prior to the inception of the indirect monetary policy, bank credit served as the operational target but subsequently changed to base money thereafter; with inflation control and economic growth serving as the ultimate policy goals.

To control the growth of money stock, attention has been focused on managing the banking system's liquidity. The secondary expansion of liquidity in

the economy brought about by fiscal surprises has also been managed through interest rate policy. It is important to note that monetary targeting cannot be effective without proper guidance to rational expectations and enthronement of transparency and accountability. To achieve this, attention has now been shifted away from annual targeting to medium term monetary policy framework since the beginning of 2002.

Monetary aggregate targets are always announced at the beginning of every year. Appropriate operating targets are then used to influence the expected course of monetary policy[4]. Since the inception of OMO in 1993, the use of base money as the operating target has been stressed. Using the base money as the operating target, the

difference between the optimal level of reserves and the actual becomes the target of OMO within the framework of liquidity management. The discounting window operation becomes the adjustment valve for meeting short-run reserve needs of the banking system. That is, it becomes the instrument of providing short-term liquidity obligations of the financial system.

To what extent has the Bank been effective in its targeting of monetary aggregates? Evidence from Table 1 and Figure 1 shows that monetary targeting has not been quite effective over the years. Both narrow and broad money targets were out-rightly off the track. Between 1993 and 2003, the actual broad money supply was far above the target levels. It was more than 100 percent above the targeted level in 5 out of 11 years and was as high as 21.5 percentage points in 1994 and 1999, 33.5 and 34 percentage points in 1993 and 2000, respectively. Narrow money was particularly volatile between 1998 and 2003 with the gap between the target and the actual hovering around 500 percent.

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[4] The computation of the optimum money stock is based on the absorptive capacity of the economy. This is computed in tandem with assumed targets

**Table 1: Monetary Aggregates (Targets and Actuals), 1993 – 2003.**

		1993		1994		1995		1996		1997		1998	
		Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Actual
1.	Broad Money	20.0	54.0	14.8	36.3	10.1	18.8	16.8	19.1	15.0	16.8	15.6	21.2
2.	Narrow Money	18.0	57.5	21.4	46.7	9.4	15.4	14.5	18.0	13.5	10.6	10.2	17.2
3.	Aggregate Credit	17.5	62.7	9.4	34.3	11.3	22.0	12.0	-25.8	24.8	16.9	24.5	55.7
4.	Credit to Federal Govt.	14.5	89.1	0.0	21.6	5.6	7.7	0.0	-61.6	0.0	-32.5	0.0	199.3
5.	Credit to Private Sector	20.0	19.9	32.6	72.8	21.9	49.4	29.5	23.3	45.4	39.3	33.9	27.3
6.	Inflation	25.0	57.2	-	57.0	-	72.8	30.0	23.9	15.0	8.5	9.0	10.0

Table 1 Cont'd

		1999		2000		2001		2002		2003	
		Target	Actual	Target	Actual	Target	Actual	Target	Actual	Target	Act.
1.	Broad Money	10.0	31.6	14.6	48.1	12.2	27.0	15.3	21.5	15.0	21.2
2.	Narrow Money	4.1	18.0	9.8	62.2	4.3	28.1	12.4	15.9	13.8	19.8
3.	Aggregate Credit	18.3	30.0	27.8	-23.1	15.8	79.9	57.9	56.6	25.7	28.5
4.	Credit to Federal Govt.	10.2	32.0	37.8	-162.3	2.6	95.2	96.6	6,320.6	-	47.0
5.	Credit to Private Sector	19.9	29.2	21.9	30.9	22.8	43.5	34.9	11.8	23.3	11.5
6.	Inflation	9.0	6.6	9.0	6.9	7.0	18.9	9.3	12.9	-	10.1

Note: (I)   Government inflation target for 1995 was to significantly reduce the rate of inflation and hence did not indicate any figure.

      (ii)   Figures for 2003 are for January – June.

Source: CBN Annual Reports and Statement of Accounts (Various Issues).

Figurre 1: Monetary Aggregates Deviations from Targets (%) (1993 - 2003)
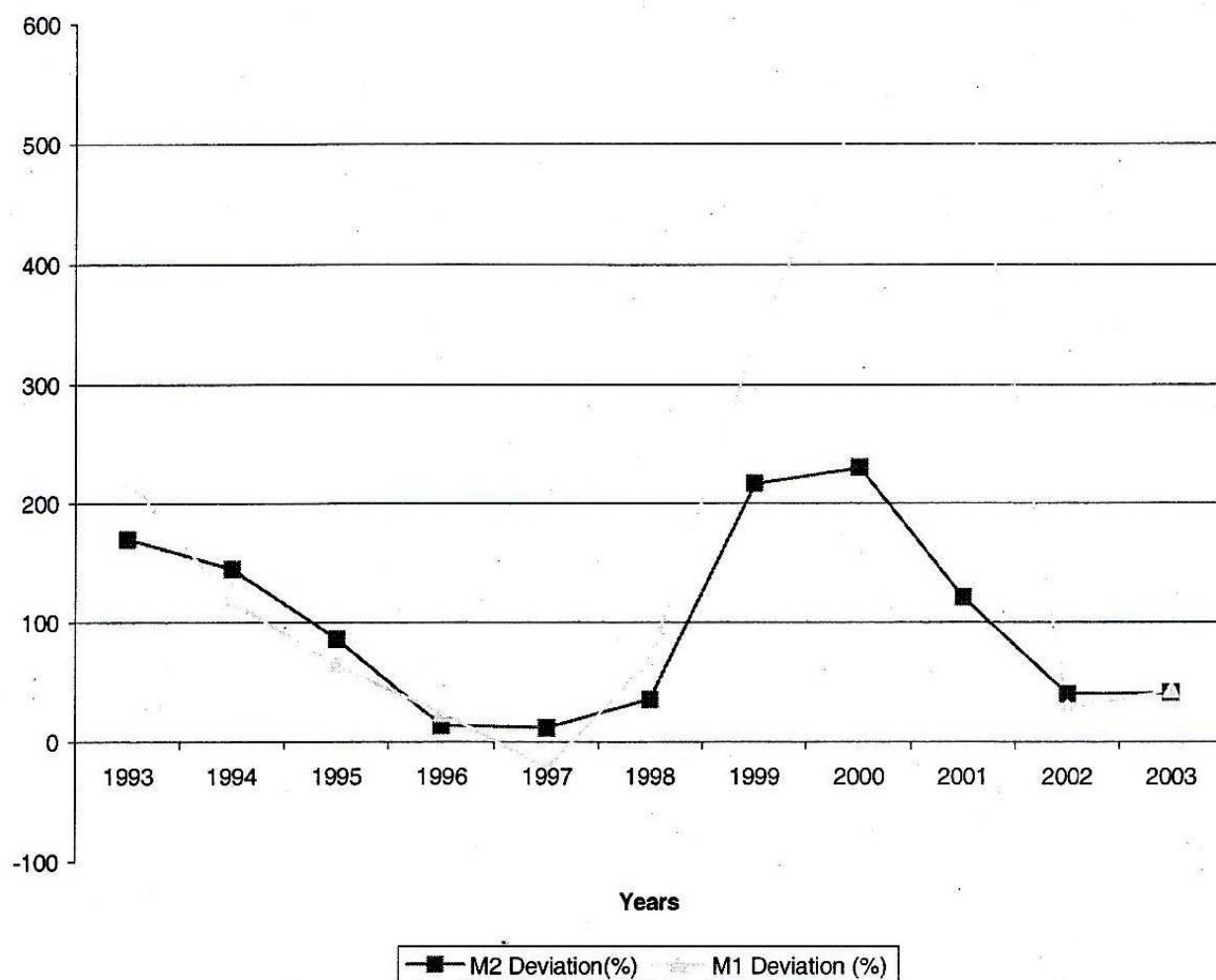
The supply of credit to the economy was very erratic during the period. Despite the adoption of the private sector as the engine of growth of the economy, credit to government was very dominant. In most cases, the actual credit was far above the targets. In fact, in some cases where zero public credit was targeted as high as 199.3 percent was experienced (Table 1). Out of the 11 years under consideration, the actual credit to the private sector was far below the targeted whereas actual credit to government was more than the target in 8 years.

The inability to pursue the targeted monetary aggregates as expected led to the gyration of money supply and consequently inflation. As indicated in the upper panel of Figure 2, broad money supply was very volatile. It was particularly volatile between 1993 and 1997. The associated monetary lag of the fiscal deficit of 1998 and the over-bloated spending of the first half of 1999 weakened the efficacy of monetary management in the country. The implications of these developments on inflation can be gleaned from the upper panel of Figure 2. Evidence from the figure further reiterates the claim of the monetary authorities that monetary policy actions affect the ultimate objectives with substantial lags (CBN, 2002:1). The gyration of the monetary aggregates away from

the targeted level is an indication of monetary authorities limited control over the fiscal recklessness of the government. It will be very difficult to achieve any meaningful success in monetary policy management in an environment characterised by extra budgetary spending and poor macro-economic co-ordination (between the government and the Central Bank and within the constituent parts of the Nigerian federal structure). The swiftness at which oil windfall is often monetised and subsequently shared among the three tiers of government defiles macroeconomic management reasoning thereby affecting the ultimate objectives of the monetary authorities. This again underscores the challenges of monetary-fiscal policy coordination in a federal set up. The recognition of the problem of time inconsistency and over-reactions to temporary shocks informed the shift from annual targeting to medium term monetary policy framework in the beginning of 2002.

III   A BRIEF REVIEW OF THE LITERATURE

This section provides a brief review of the empirical linkages between monetary aggregates and inflation with a view to putting the relevant issues in the appropriate context. Dewald (1988) examined the linkage between monetary aggregates and inflation and GNP movements in the United States in the 1960s and 1970s. Apart from providing the balance of the wide divergence between real GNP growth and fiscal deficit, monetary aggregates correlated with the movements in inflation and real income. Here, monetary policies performed the 'leaning against the wind' function through contractionary and expansionary frameworks during periods of business booms or recessions. For the monetary authorities to clearly distinguish between the wind it is leaning against and thrust of its own actions, it is important to use long term monetary aggregates as an anchor for preventing undesirable inflation.

Evidence from Bullard (1994) tends to suggest that the strength of the linkage depends on the measure of money used and the time horizon covered in the investigation. Broader aggregates produce striking results while narrow ones mimic the equi-proportional relationship posited by the quantity theory. Extension of sample size, particularly when series of monetary innovations took place could have some significant bearing on the outcomes.

Figurre 2: Money Supply and Inflation in Nigeria (1970 - 2001)
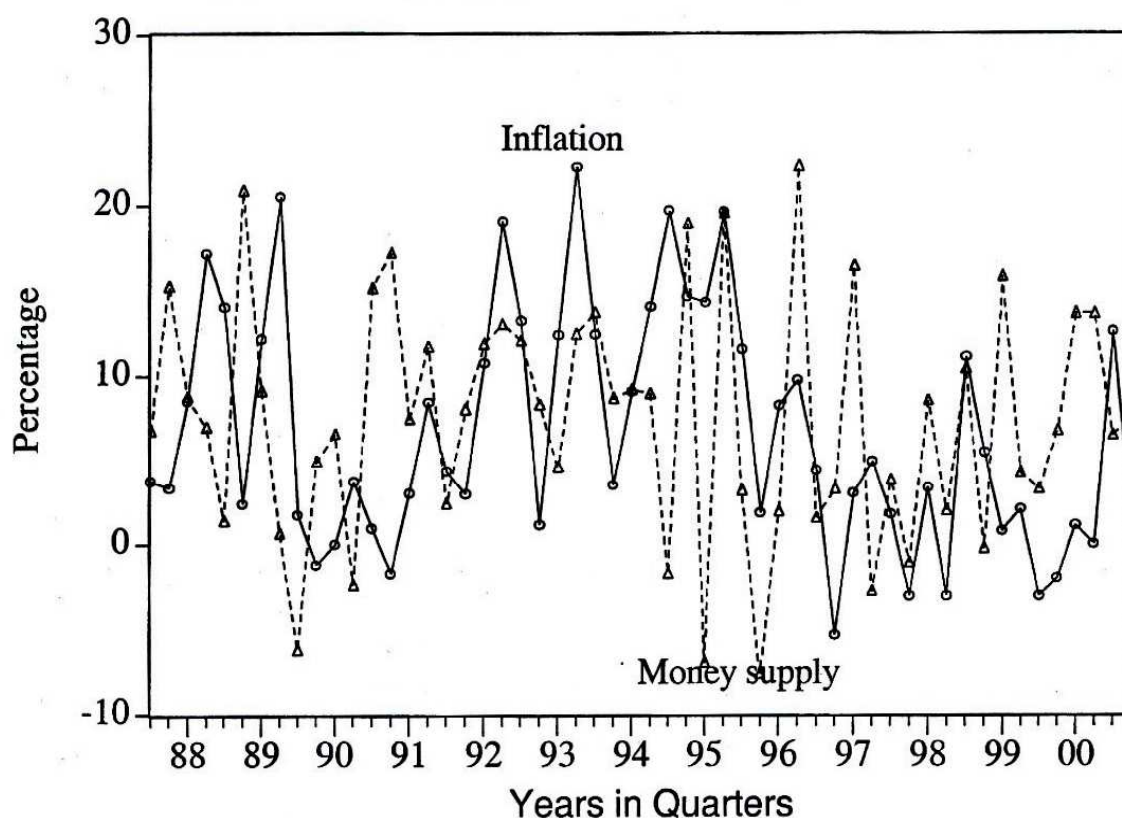
Empirical evidences from cross-country data have also shown that inflation and money growth rates are typically averaged over many years (e.g., Dwyer and Hafer, 1988; Duck, 1993). This is a good indication that monetary aggregate can be a veritable policy target for managing inflation.

Morande and Schmidt (2002) examine the role of inflation targeting in achieving price stability in Chile using vector autoregressive models. The VARs models use six endogenous variables (interest rates, wages, GDP, consumer price index, money supply, and nominal exchange rate) and two exogenous variables (the terms of trade and the US consumer price index). The empirical evidence reveals that announcement of an explicit inflation target and adoption of a supportive monetary policy and a floating exchange rate regime that lend

credibility to that target were instrumental to achieving price stability.

The experience from Peru as espoused by Dorich and Triveno (2001) shows that the behaviour of the monetary policy, as reflected in the monetary base, causes higher variability in the country's observed inflation. Other variables of interest are the interest rate and exchange rate depreciation. Similarly, Boschen and Talbot (1987) observe that outside money growth is the dominant monetary factor causing inflation in the United States. The evidence from inside money is relatively very weak.

The role of monetary aggregates in price movements in Nigeria was also stressed by Akinlo and Odusola (1994) using simultaneous models. Given the focus of the paper, they see inflation as a

structural phenomenon with the monetary variables playing some ancillary role. In a more dynamic form, Odusola and Akinlo (2001) and, Akinlo and Odusola (2003) extricate the influence of money supply on the behaviours of prices in Nigeria. Emphasis was placed on the nexus of linkages among output, inflation and exchange rate depreciation. They did not, however, pay attention to how monetary targeting can be used as a veritable weapon for controlling inflation.

The foregoing points to the fact that monetary aggregates can be a good intermediate target depending on the measure of money used, the extent of innovation within the financial system, the supportive role of the exchange rate regime, and the credibility of the monetary authorities, among other factors.

IV THEORETICAL FRAMEWORK AND METHODS OF ESTIMATION

4.1 Theoretical Framework

The theoretical underpinning of the linkage between monetary aggregates and price level originated from the crude quantity theory of money. The theory assumes that the *price level will change proportionately with changes in quantity of money.* This belief is often summed up in the phrase, 'money is long run-neutral". The rate of money creation is reflected in the rate of inflation in the long run. It further posits the existence of the classical dichotomy between relative and absolute prices determination. The crude quantity theorists, focusing on long run relationship, posit that the theory of value explains the relative prices (because they are determined in the real sector) while monetary theory explains absolute prices. A change in quantity of money will only change the general

level of absolute prices; it will not affect outputs, or relative prices (Lucket, 1980). While the proposition of the traditional proportionate relationships between absolute prices and monetary aggregates are upheld, it is however objected to the classical equality between money and income (Struthers and Speight, 1986).

The empirical validations of Milton Friedman between 1956 and late 1970s provide a dynamic linkage between changes in money stock, prices and nominal income. His empirical findings show that changes in money stock have effects on prices and nominal income. These changes are brought about by expected prices and expected output. He argues that changes in money supply do not bring about any changes in the first six months, except possibly on interest rates. After the first six to nine months, the rate of growth of GNP will increase. Some eighteen months after, the whole effects will have shifted to prices. After about one year or so, the rate of growth of output will fall back to, or below, it's natural level and in the long run prices will rise faster than the nominal income. Friedman finds a close relationship between changes in the quantity of money and changes in nominal income, admit that the price level is the joint outcome of the monetary forces determining nominal income and the real forces determining real income. The empirical validations of Friedman lead to a common dictum that inflation is always and everywhere a monetary phenomenon and that lags are long and variable (Dewald, 1988).

The main contention is whether the use of monetary aggregates in controlling inflation should be a long or short-term issue. As argued by Dewald (1988), the main pre-occupation of the monetary authorities should be that of long run price stability and not offsetting the short-term movements. The central banks only know enough to keep inflation

within bound, but not to fully stabilize the price level. As such it is a long run phenomenon as oppose to the short run perspective of Friedman. The poor performance of the short run model of Friedman in the 1980s further makes this approach less desirable.

The theoretical inspiration for monetary aggregate targeting of inflation, as earlier mentioned, comes from the equation of exchange as proposed by the crude quantity theory. It makes use of an identity equating the product of money supply and velocity of money with the product of average price of transaction and total number of transactions. The identity formulation is expressed thus:

$$MV = PT \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad \ldots \quad (1)$$

In equation (1), M=money, V=velocity, P= average price level and T=transactions. The transaction measure typically used is real output so that MV=PY. As it is, the equation is tautological hence it is not operational. It nevertheless permits the development of a theory of the role of money in the economy through the behavioural explanations of the four variables. The insertion of some sequence of cause and effect makes the classical theory to see the quantity of money as the prime mover in the equation. That is, changes in M initiate the changes in MV and PT. Within the propositions of the proponents of the quantity theory, the quantity of money can be used effectively to influence macroeconomic aggregates, particularly inflation (Humphrey, 1986). For the equation to be turned into a theory, it is also

assumed that the growth rate of V is constant[5]: velocity is reasonably stable and predictable; and that output movements are not correlated with changes in the quantity of money.

The theoretical formulations of these propositions and assumptions can be expressed by taking the logarithm of both sides of the equation of exchange (MV=PY) and differentiating with respect to time as expressed in equation (2).

$$1/P(dP/dt) = \alpha + 1/M(dM/dt) - 1/Y(dY/dt) \; \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \; (2)$$

Equation (2) posits that inflation rate is equal to the constant velocity growth rate (α), plus the money growth rate less the growth rate of output. If, for convenience, we replace $(1/x)(dx/dt)$ by Δx, equation (2) can be reformulated as expressed in equation (3) below:

$$\Delta P_t = \alpha + \Delta M_t - \Delta Y_t \quad \ldots \quad \ldots \quad (3)$$

Equation (3) provides the basis for using monetary stock to influence the changes in price movements. This is particularly so since it is the only monetary stock the monetary authority can easily control. And within the classical framework, changes in income are determined in the real markets. As argued by

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[5] Irving Fisher assumed that two principal factors affect the average rate at which people spend their money: the payment mechanism and the spending habit. By experience, both of them do not change very often. Other factors include population density and physical means of transporting money (Odusola, 2002).

the proponents, money and prices tend to move together in the same direction and that the primary changes in the price level are brought about by changes in the quantity of money in the economy. To them, the quantity of money can be used to cure the ills of the economy - inflation. Since inflation is very vital in economic agents decision-making, they often monitor inflation through monetary authorities policy changes. Their ability to capture this depends on how well-defined the transitory dynamics are (Bullard, 1994). The main problem confronting the econometrician observing such an economic behaviour is to separate the long run relationship from the noise introduced by the transitory learning dynamics. The need to integrate these two issues has generated some debates: high frequency data (e.g., monthly and quarterly) only address the dynamics and the associated noise with limited attention to the long run attributes of the proposition while low frequency data focuses on the latter at the expense of the former. To benefit from the synergy of both the dynamic and long run attributes, the framework adopted here integrates the two issues.

4.2   Methods of Estimation

A common approach to estimating the linkage between monetary targeting and inflation is the polynomial distributed lags (PDLs) (Batten and Thornton, 1983; Yue and Fluri, 1991). A major limitation of this approach is the possible existence of the significant serial correlation in the PDLs framework. One limitation, as pointed out by Lucas (1980) is determining which monetary aggregate to use. Theoretically, all variants of monetary aggregates are plausible, but the relevance of each to a particular economy is an empirical and a policy issue.

The econometric limitation associated with carrying out the long run neutrality of monetary aggregates on inflation on a single country data often informed the preponderance of cross country evidence. Lucas (1980) obviated this problem by introducing filter to capture the long run movements, which are often referred to as 'Lucas filter procedure'. The filter extracts the long run data from the time series data. The restricted parameter for generating the filter was not modelled. On the other hand, it is also affected by serial correlations associated with PDLs. This unobservable filter may be cumbersome to compute. Monetary targeting poses some communication problems when the relationship between money growth and inflation is affected by shocks.

An interesting development in modelling monetary policy targeting, in recent times, is the emphasis on the use of vector autoregressive models (VARs). This is based on its ability to provide comprehensive information about the dynamics of the interactions without losing the desired long run attributes. Also since shocks are common phenomena of the operations of the financial markets, earlier models like the PDLs and Lucas procedure have not been able to threat this very explicitly. Shocks, through the instrumentality of innovations have been imbedded into the VAR framework. The relevance of the framework has informed its applications to monetary and inflation targeting (Morande and Schmidt-Hebbel, 2002; Landerietcha, Morande and Schmidt-Hebbel, 2000).

A framework that minimises these limitations of the foregoing approaches is the vector error correction mechanism; it combines the dynamic

attributes with the long run characteristics. It also accounts for possibility of shocks. This paper thus adopts this framework of analysis. Following a standard vector autoregressive model framework where Z_t is an $n \times 1$ vector of the variables of interest observed at time t, whose joint behaviour we intend to examine. As indicated in equation (3) above, the dynamic behaviour of Z_t is governed by the following structural model:

$$Z_t = \sum_{i\text{-}0}^{m} \beta_i \ Z_{t\text{-}i} + A u_t \quad \text{...............} (4)$$

The dimensionality of Z_t is three namely: real income (y), inflation or prices(p) and money supply (m). The variables are in logarithmic transformation. The β_i are a sequence of nxn matrix of coefficients while μ_t is an nx1 vector of disturbances to the system and it is assumed to be serially uncorrelated. $E(\mu_t \ \mu_t{}')=\Sigma$ a diagonal matrix. A is an nxn matrix of coefficients relating the disturbances to the Z vector.

The estimation of the standard VARs takes the reduced form of equation (4) as expressed in equation (5) below (Odusola, 2001):

$$Z_t = \sum_{i=1}^{m} C_i \ Z_{t\text{-}i} + e_t \quad \text{..............} (5)$$

Such that $C_t =(I\text{-}\beta_0)^{\text{-}1}\beta_i; \ e_t=E\mu_t$ and $E=(I\text{-}\beta_0)^{\text{-}1}A.$

The absence of any cointegrating relationships among the variables of interest suggests the need to use the standard VARs. The existence of cointegration vector(s), however, connotes the use of a vector error correction (VEC) model following Johansen (1991) and Odusola (2001). Since equation (5) is a reduced form, and as often argued in the literature (e.g. Rasche, 1993), it provides limited information about the impacts of money shocks or any other relevant policy shocks that are of interest to economists. To provide this information, the VARs are supplemented with some identifying restrictions that are derived from some economic model. Such restrictions define the economic structure that provides the needed information on the impacts of monetary shocks on inflation and real output as proposed by the classical economists.

From equations (4) and (5), the obvious identifying restrictions are on , C_0 and Σ. The identifying restrictions here are that Σ should be diagonal, C_0 should be an identity while $\hat{a}_0$ should be lower triangular when variables are arranged according to causal priority. The triangular authogonalization has become a standard way of interpreting econometric models. The refinement of Bernanke (1986), Blanchard and Quah (1989), among others, have shown that the orthogonalisation does not necessarily need to be triangular; the non-zero elements could be interspersed outside the lower triangular matrix – a steady state macroeconomic models. Thus in line with Litterman and Weiss (1985), most of the dynamic

relationships among macroeconomic variables can best be explained as arising from an economic structure in which monetary phenomena do not affect real variables. By implication, inflation is purely a monetary phenomenon.

V   DATA AND ANALYSIS OF RESULTS

5.1   Data and Sources

The three-variable model uses the quarterly series of real income (y), prices (p) and broad money (m) over the period 1987:1 to 2001:4. The choice of broad money as opposed to narrow one was informed by the discontinuation of the narrow money as a target variable sequel to the liberalization and deregulation of the financial sector from July 1987. While data for prices and money are available on quarterly basis, GDP is only available annually. Following Bernanke (1986) and Akinlo and Odusola (2003), quarterly GDP was interpolated through the index of industrial production. In line with the proposition of the crude quantity theory, real GDP was used as opposed to nominal GDP. The nominal output was deflated by the composite consumer price index (CPI). The three variables were obtained from the various issues of the Central Bank of Nigeria's Statistical Bulletin. All the variables are in logarithmic form.

5.2   Analysis of the Results

The three variables – real income, prices and money- are integrated of order one and hence satisfy the condition for their inclusion in vector error correction methodology (VECM). Evidence from Table 2 shows the existence of cointegrating vectors in output and money. The use of VECM allows the long run attributes of the variables to converge to their cointegrating relationships while permitting a wide range of short run dynamics that characterise the operations of any financial system. Although the error terms of the three models are plausibly good, the coefficient of determination and F-statistics of money are rather low.

Evidences from Tables 3 and 4, and Figure 3 show the responses of income, prices and money to innovations and forecast error variance in any of the three variables. What does the evidence from the impulse response function show? The classical proposition that inflation is everywhere a monetary phenomenon seems to be evident in Table 3. Changes in money supply have a monotonically increasing relationship with prices but with some appreciable lags. Rather the relationship is of a long run one. Evidence from panel 2 of Figure 3 shows monetary aggregates as good predictor of price movements in Nigeria. Appreciable impacts become glaring from the third quarter and are stronger thereafter. The non-contemporaneous effects of money supply on inflation tends to confirm the general view within the monetary authorities that monetary policies are inconsistent with time due to undue lags in the transmission mechanism. The spontaneity of the response of the ultimate targets to the intermediate targets matters a lot in monetary policy management.

Table 2: Summary of the Vector Error Correction Model (VECM) Estimates, 1987:1-2001:4

	Output	Prices	Money
Cointegrating equation	-0.437 (-3.593)	-6.6 E –05 (-0.001)	0.158 (2.115)
Goodness of fit statistics Adjusted R^2 Standard error of equation F-statistic	0.482 0.109 8.845	0.317 0.052 4.922	0.012 0.067 1.105

Note: The cointegrating equation presents the cointegrating vectors from the three-variable model with the t-statistic in parenthesis.

Expectation appears to be very important in price formation process and not solely a monetary phenomenon as predicted by the quantity theorists. Expectation predominates the price formation process as evident in Table 3. Current inflation is incorporated into the future price formation process. This behaviour is even stronger as time horizon becomes longer. After the 6th quarter, for instance, more than 10 percent of the price level increase is accounted for by the cumulative effects of past inflation's expectation. The relationship between real income and inflation is hyperbolic. Increase in real income, in the short run, dampens inflation but due to wealth effect and the associated increase in purchasing power and enhanced demand, prices go up in the third quarter but latter tend to stabilize towards its long run value. This finding supports Milton Friedman validation of the empirical relevance of the crude quantity theory in the 1970s and 1980s.

Initial condition matters a lot in predicting future real income, the higher the income the higher the future income expectation, although with some declining influence later (Table 3). Inflation has a monotonically declining linkage with real income. The impulse generated by innovations in money supply is neutral contemporaneously, inverse in the first thee quarters and marginally positive as the horizon becomes longer. The noise often associated with monetary policy announcement could generate the negative influence in the short run. The impacts of the innovations generated in real income, prices and money on money supply are indicated in the fourth column of Table 3. While the impacts of the innovations in prices and money are stronger in the short run, the opposite is the case for real income on money supply. The response of money to the innovations from real income is stronger the longer the time horizon.

Table 3: Impulse Response Functions from the VECM Estimates, 1987:1-2001:4

Type of Innovation/ Horizons in quarters		Income (y)	Prices (p)	Money (m)
ε_y	1	10.19	-0.67	0.57
	3	0.15	1.75	1.80
	6	1.76	0.95	2.65
	9	1.29	0.70	2.78
ε_p	1	0.00	4.81	1.13
	3	-5.27	8.62	0.65
	6	-4.91	10.18	0.77
	9	-4.59	10.50	0.74
ε_m	1	0.00	0.00	6.15
	3	-0.32	2.09	4.37
	6	0.78	2.47	4.19
	9	0.43	2.75	4.15

Notes: Entry (i,j) is the dynamic response of variable j to a one standard deviation shock in variable i. All variables are percent increases of the level of each variable from baseline.
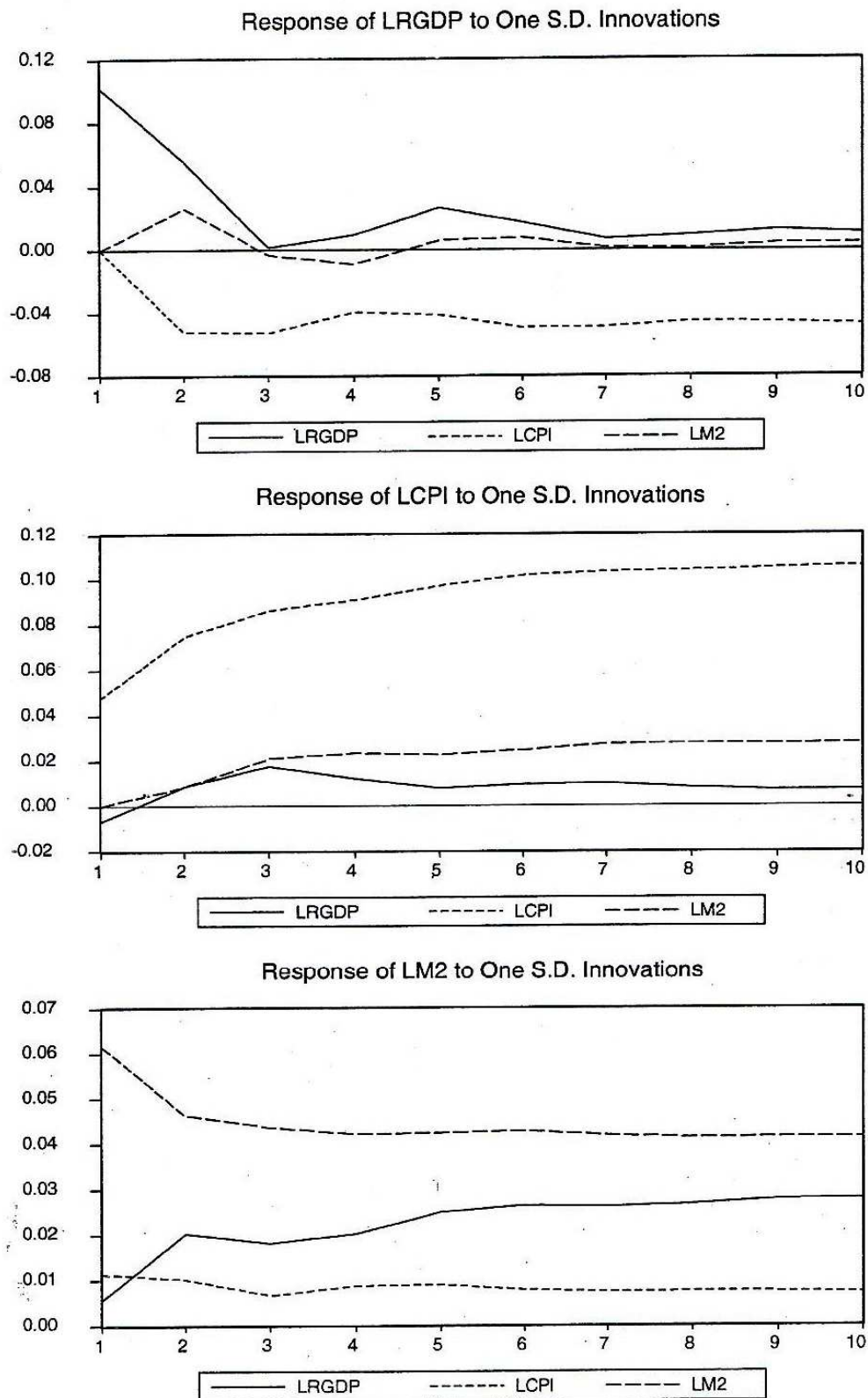
Table 4 shows the fraction of the forecast error variance for each variable that is attributable to its own innovations and to innovations from other variables in the system. Innovations from own sources predominate the variations in the predictions of all the variables. Prices are explained by past values of own, real income and money (in order of importance). This shows that predicting inflation accurately is more important than targeting it in Nigeria. Full knowledge of inflation accounts for between 93.35 and 98.08 percent of the forecast error variance innovations from inflation. This calls to question the ability of the monetary authorities to predict inflation accurately as opposed to the stress given to its targeting. Real income also plays an important role in predicting prices in Nigeria. Its importance becomes stronger as the horizon increases. Surprisingly, the role of monetary aggregates is ancillary. Apart from accounting for merely between 2.73 and 3.25 percent of the forecast error variance in price formation process, its significance wanes as the horizon becomes longer. Its predictive power is, however, relatively stronger in the short run.

Table 4: Variance Decomposition from the VECM Estimates, 1987:1-2001:4

Variables/Horizons	ε_y	ε_p	ε_m
Income (y) 1	100.00	0.00	0.00
3	68.64	27.77	5.58
6	54.99	41.69	3.31
9	44.60	52.70	2.69
Prices (p) 1	1.91	98.08	0.00
3	2.61	94.23	3.15
6	1.56	93.69	4.48
9	1.16	93.35	5.48
Money (m) 1	0.81	3.25	95.93
3	8.64	3.07	88.29
6	15.41	2.98	81.59
9	19.68	2.73	77.59

Note: Entry (i,j) is the percentage of forecast error variance of variable i at different horizons attributable to innovations in variable j.

Figure 3: Impulse Responses of Real Income, Prices and Money.

Response of LRGDP to One S.D. Innovations

Response of LCPI to One S.D. Innovations

Response of LM2 to One S.D. Innovations

This not withstanding, the forecast error variance of money has significant influence in predicting real income. Its importance becomes stronger as we move from the short to medium to long terms. It ranges between 0.81 and 19.68 percent between the first 9 quarters; albeit with limited role for inflation (Table 4). The forecast error variance of real income in money is stronger in medium term than both the short and long terms. The leaning against the wind approach of monetary policy management shows the relative importance of prices in forecasting money supply.

VI   CONCLUSIONS

Best practices in monetary policy tend to suggest that keeping monetary growth in tandem with real growth trends is an important way of eliminating inflation trends. The Nigerian monetary authorities have tried to do this through monetary aggregate targeting but with limited success. The gap between the actual and targeted aggregates is often too wide for effective control of inflation in the country. The broad money supply, for instance, gyrated in a more volatile manner. This underscores weak monetary policy instrument autonomy and a leaning against the wind behaviour with a view to accommodating the fiscal recklessness of government. The unorthodox method of financing deficit and the instant monetization of oil windfall makes monetary targeting quite daunting.

The classical proposition that inflation is everywhere a monetary phenomenon seems to be partially evident in the results. Changes in money supply have a monotonically increasing relationship with prices although with some lags. Evidence from impulse response functions tends to show monetary aggregates as good predictors of price movements in Nigeria. However, the results from variance decomposition recognises the significance of full information about inflation and past values of real income with money playing an ancillary role. Issues that should preoccupy the attention of monetary authorities in Nigeria are why is money playing an ancillary role and why is real income playing such an important role in predicting prices in Nigeria? This underscores the need for the monetary authorities to pay adequate attention to predicting inflation as opposed to stressing its targeting in the first instance. The need to revisit the set of policy instruments that could facilitate faster and effective monetary transmission mechanism with a view to promoting the linkage between monetary policy and prices is ineluctable. This is important because monetary policies are more transparent and devoid of political undertone that characterises fiscal and other macroeconomic policies management.

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