MONETARY POLICY, BANK LENDING AND INFLATION IN NIGERIAN: VAR APPROACH

By

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Abstract
This paper investigates whether monetary policy (minimum rediscount rates, currency outside banks, net domestic credit, demand deposit and exchange rate) and commercial bank lending can provide a convincing explanation for monetary inflation in Nigeria, over the period 1980-2010. The analyses are performed using data derived from the central bank statistical bulletin of Nigeria. This period was selected on account that it marks the beginning of indirect monetary policy regime in Nigeria. Applying the ADF to determine the stationary state of our data, the result shows that all the variables are not stationary at their level but at first difference. As such we apply the Vector Auto Regression (VAR) technique to determine the effects of monetary policy and bank lending on inflation. Therefore, a co-integration test was carried out to test the existence of a long run relationship in our data. Our findings show that monetary policy and bank lending rate do affect inflation partially. The paper also reveals that exchange rate has a little or negligible insignificantly effects on inflation. Therefore, the conclusion from our paper is that monetary policy and commercial bank lending inflation can provide partial explanation effects of inflation rate in Nigeria economy.

Keywords: Monetary Policy, Bank Lending, Inflation, VAR
1.0 INTRODUCTION

There is growing acceptance among both policy makers and economists that the pursuit of price stability (defined as maintaining a low and stable rate of inflation) is the main medium to long run goal of monetary policy. The first reason is the recognition that a high and variable inflation rate is socially and economically costly. These costs include price distortions, lower savings and investment (which inhibits growth) and capital flight (into foreign assets). The second is that experience has shown that short-term manipulation of monetary instruments to achieve other goals such as higher output and lower unemployment may conflict with price stability. The attempts to achieve these conflicting goals tend to generate an inflationary bias in the conduct of monetary policy without, in the end achieving systematically higher output and employment, (Pierre-Richard Agenor, 2000).

To achieve the goal of price stability, there is a general agreement among economists and policymakers that monetary policy works mainly through interest rates. When the central bank policy is tightened through a decrease in reserve provision, for instance, interest rates rise. The rise in interest rates leads to a reduction in spending by interest sensitive sectors of the economy, such as housing and consumer purchases of durable goods. Banks play a part in this interest rate mechanism since a reduction in the money supply, which may consist of deposit liabilities of banks, is one of the principal factors pushing up interest rates. In contrast to this description of the transmission mechanism, some economists and policymakers have argued that an additional policy channel works through bank credit (Stiglitz and Weiss, 1981).

Central banks that is also responsible for bank regulation will be more sensitive to the profitability and stability of the banking sector and therefore less likely to alter interest rates solely on the basis of price stability objectives. When bank regulation is assigned to a separate agency, the central bank is more likely to enact tighter monetary policies geared solely toward maintaining price stability. The dual policy goals of financial stability and low inflation generate a challenge for monetary policy makers. The central bank’s main monetary policy instrument is the interest rate, which dampens inflationary pressures when raised. However, interest rate hikes are potentially harmful to banks’ profits and increase the probability of bank failures (Cukierman 1991; OECD, 1992). A policy of financial stability may require a more gradual monetary tightening in the face of inflationary pressures, thereby allowing banks more time to adjust their balance sheets. On the other hand, a policy of strict price stability would require more aggressive interest rate adjustments. With one policy instrument and two potentially conflicting goals, a central bank must decide how much emphasis to place on fighting inflation versus maintaining financial stability.
There is a link between interest and inflation rates. The relationship tends to be direct and positive: high inflation rates engender high interest rates. The high interest rate in Nigeria since 1990 may therefore be seen as a reflection of the inflationary trend in the economy. This is because lenders increase the price of loanable funds to hedge against loss of real earnings (decapitalization) during inflationary periods. Some recent research provides support for the view that certain borrowers, especially small businesses, are very dependent on banks for. This finding suggests that disruptions in bank credit could affect economic activity (leading to inflation). At the same time, there is also conflicting evidence that bank lending is directly constrained by monetary policy actions (Bernanke and Blinder, 1988).

Central banks are generally responsible for implementing a country’s monetary policy by controlling the money supply and setting interest rates based on current economic conditions. In addition, some—but not all central banks serve as bank regulators with responsibility for implementing rules and restrictions on banking activity, supervising compliance with prudential regulation and applicable laws, and otherwise safeguarding the stability of the banking sector. However, in empirical analyses of inflation, central bank independence reigns supreme, and the central bank’s regulatory responsibilities are generally ignored. The regulatory responsibilities of central banks are rooted in history. Until the early 1800s, the focus of central banks was predominantly on wartime finance.

One argument which has been around is that there is much inflation in Nigeria. That the monetary policy are not, in fact, be quite consistent with the inflation targeting framework we have been operating on for well over a decade now and that average inflation rate over a run of years is still be “two point something”. That result itself will have various temporary factors affecting it, so it is not necessarily an immediate guide to how concerned we should be. To get a better way of controlling inflation that central authority should look at various measures of underlying inflation. But what is clear is that these series have all picked up, with the exact extent varying by measure. The generally high interest rate on loans and wide margin between lending and deposit rates created a disincentive to borrowers and savers alike. This development tended to discourage investments in the real sectors of the economy where projects have longer maturity periods. High inflation rates over the years compounded the already dismal economic environment. Throughout the 1974-1997 periods, the average inflation rate had been above the double digit level (26.51%) (CBN, 2009) which rendered most deposit rates negative in real terms.

An outlook of the Nigerian inflation controls shows that from one political administration to another the central bank of Nigeria has tried to put in place various monetary policies in an attempt to control inflation. However in spite of all these efforts, inflation is relatively still very high and the implication is on the drives of the nation’s economic growth and development. The
situation is disturbing and worrying when compared with what other developing and developed countries have been able to achieve with their inflation targeting.

The broad objective of this paper is to identify, within an empirical framework, the proportionality relationship between monetary policy (minimum rediscount rates, currency outside banks, net domestic credit, and demand deposit), bank lending and monetary inflation in Nigeria. The paper is divided into six sections, following this introduction, is section two which focus on brief review of relevant literature of the relationship between monetary policy, bank lending and monetary inflation. Section three focused on the paper’s theoretical framework, while estimation strategies are described in section 4. Section 5 discusses the empirical results in the paper and section 6 is the policy implication, recommendation and conclusions.

2 BRIEF REVIEW OF LITERATURE

Inflation is a highly controversial term which has undergone modification since it was first defined by the neo-classical economists. To the neo-classicalist and their followers at the University of Chicago, inflation is fundamentally a monetary phenomenon. In the words of Friedman (1968), “inflation is always and everywhere a monetary phenomenon; and can be produced only by a more rapid increase in quaintly of money than output”. They regarded inflation “as a destroying disease born out of lack of monetary control whose result undermined the rules of business, creating havoc in the markets and financial ruin of even the products. According to the monetarists, inflation is a state of disequilibrium in which expansion in purchasing power not accompanied by increase in productivity tends to cause an increase in price level and a fall in the value of money.

The dual policy goals of financial stability and low inflation generate a challenge for monetary policy makers. The central bank’s main monetary policy instrument is the interest rate, which dampens inflationary pressures when raised. However, interest rate hikes are potentially harmful to banks’ profits and increase the probability of bank failures (Cukierman 1991; OECD, 1992). A policy of financial stability may require a more gradual monetary tightening in the face of inflationary pressures, thereby allowing banks more time to adjust their balance sheets. On the other hand, a policy of strict price stability would require more aggressive interest rate adjustments. With one policy instrument and two potentially conflicting goals, a central bank must decide how much emphasis to place on fighting inflation versus maintaining financial stability.

The paper focused on the institutional tension between the dual goals of financial stability and low inflation. Specifically, we argue that monetary policy makers have a less aggressive stance toward inflation when governments combine the bank regulatory- and
monetary-policymaking functions within the central bank. Such “regulatory central banks” which exist in more than one-third of industrialized countries, have incentives to be especially sensitive to the profitability and stability of the banking sector when setting monetary policy. We therefore argue that the presence of bank regulatory authority in the central bank’s mandate generates a bias in its monetary policymaking. On the other hand, in countries where bank regulation is assigned to a separate agency, the central bank is less likely to be biased by bank stability concerns and more likely to enact tighter monetary policies geared toward maintaining low inflation. Policy makers’ success in fighting inflation therefore varies with the institutional locus of bank regulatory authority.

2.1 Monetary Policy and Inflation

In focusing on the relationship between monetary policymaking, bank lending and inflation this paper contributes to two reviews, theoretical and empirical literatures. We argue that the effect of a monetary policy on inflation is conditional on the government’s choice of exchange rate, money supply and interest rate. Assuming full capital mobility, countries that adopt floating exchange rates maintain the ability to conduct autonomous monetary policy. Under such conditions, a central bank’s regulatory responsibilities play a significant role in shaping its monetary policy choices. In contrast, a central bank operating under fixed exchange rates will not have the ability to pursue an independent monetary policy, and therefore its institutional features will be of little importance (O’Mahony 2007).

Clarida, et al. (2000) considers a number of ways in which monetary policy may have changed. First, monetary policy may have become more reactive to output and inflation fluctuations around the early 1980s. In addition, monetary policy may have become more predictable, implying smaller shocks to a simple monetary-policy reaction function. Finally, Orphanides et al. (2000) argue that policymaker estimates of potential output may have become more accurate. Such improvements in estimates of potential output would constitute a change in monetary policy, as policy would be made on the basis of more accurate information. Also, consider the effects of changes in policy on expectations formation, holding fixed the behavioural relationships in the economy. Although other relationships are unchanged, changes in policy can nonetheless affect the reduced-form relationship between inflation and economic activity by reducing the signal content of economic slack for future inflation. For example, if monetary policy acts more aggressively to stabilize the economy, then any given deviation in output from potential will contain less of a signal of future inflation. Similarly, a reduction in the persistence of potential output mismeasurement would mean that an increase in output resulting from a mismeasure of potential output will not portend as much inflation because it is not expected to last as long.
Ball, Mankiw, and Romer (1988) have argued that changes in monetary policy may lead to changes in the frequency of price adjustment, and thus changes in the parameters of the price-adjustment processes taken as structural here. In particular, they argue that the lower and more stable inflation that has marked the post-1982 period is likely to lead to less-frequent price adjustment. The Ball, Mankiw and Romer conjecture could thus provide an alternative explanation for the reduction in the slope of the reduced-form Phillips curve. In a recent empirical paper, however, Boivin and Giannoni (2003) examined the sources of changes in the effects of monetary policy surprises on the economy. They found that the main source of changes in the effects of policy shocks was changes in the parameters of the policy reaction function rather than in the structural parameters of the economy, providing empirical support for the modeling strategy adopted here.

However, as in other recent works, Stock and Watson, (2002) changes in policy account for a smaller proportion of changes in output growth. In a market economy environment, the central bank should utilise the available indirect (market conform) means at its disposal to encourage the economy to move towards the ultimate goal. In other words, it must define the chain of target variables that can be directly influenced by the central bank (operational targets) and the other economic variables, through which monetary policy can exert a genuine influence on its final target. This chain of economic variables and the system of relations between such variables are called the transmission mechanism. The transmission mechanism thus describes the relationships through which the monetary policy measures of a central bank affect the rate of inflation.

In the current practice, central banks attempt to achieve their ultimate goal through their respective interest rate policies, which means that their operational target is to set the short-term money market interest rate. However, the basic university textbooks used in macroeconomics and finance education (e.g. Mankiw, 2005) tend to suggest, sometimes quite unambiguously, sometimes by their general approach only, that central banks are influencing economic trends by directly controlling the money supply, which is achieved by controlling the quantity of central bank money (the monetary base). Under that approach, the transmission mechanism sets out from the quantity of base money as the operational target and moves toward inflation, the final target variable, through the money supply in the economy. This approach is based on the traditional monetarist theory of inflation, which argues that (over the long run) the price level is determined by the amount of money available in the economy and derives the central bank’s operational target concerning the monetary base from the so-called money multiplier model.

2.2. Bank Lending and Inflation
Therefore, since banks do not operate in a vacuum, their overall lending behaviour may generally be influenced by the environmental factors particularly the regulatory and macroeconomic factors. The regulatory environment is more stringent and must be observed but the economic environment is perhaps the more challenging since it affords them the opportunity to exercise their discretion at least relatively, in a manner that will impact positively on their business in the long run. The economic environment is a systematic risk component that affects every participant within the economy. The general performance of the economy is reflected by the macroeconomic aggregates including the gross domestic product (GDP), employment level, industrial capacity utilization, inflation, money supply and exchange rate.

According to Talavera et al. (2006) Banks therefore adjust their lending behaviour in response to the signals from these factors, such that positive signals make banks become more favourably disposed to lending and vice versa. Bank loan portfolio including volume, tenor and structure may be generally influenced by their expectations of the performance of economy both in terms of stability and quantum/level of performance. As indicated by Talavera et al. (2006) banks make out more loans during periods of boom and reduced level of macroeconomic uncertainty and curtail lending when the economy is in recession.

In Tillmann (2009a) for example, if firms have to borrow working capital to finance production, the nominal interest rate represents a cost factor and therefore influences price-setting behavior. These effects have been labeled the cost channel transmission of monetary policy. Several studies find that a cost channel has implications for monetary policy: Ravenna and Walsh (2006) argue that an interest channel limits the scope for monetary stabilization policy. Tillmann (2009a) shows that uncertainty about the strength of the interest channel influences the optimal setting of interest rates by the central bank and he finds that interest channel dampens the impact of model uncertainty on monetary policy.

Empirical evidence indicates that the interest channel adds substantially to the explanation of inflation dynamics (Tillmann 2008). Moreover, the direct effect of interest rate changes on inflation is typically found to be relatively strong, which is somewhat surprising for a number of reasons: Firms may not have to borrow the entire costs of production in advance Ravenna and Walsh (2006), or alternatively only a part of the firms in the economy may be subject to a cost channel. In either case, the response of the inflation rate should be smaller than the change in the interest rate. In addition, the interest rates relevant for working capital may not respond fully to changes in money market rates. Especially retail interest rates are typically rigid. Hence, banks may shelter firms from large changes in the cost of working capital (Chowdhury et al.
2006; Kaufmann and Scharler, 2009). They argue that broadly defined financial frictions result in additional costs, which are not directly mirrored in interest payment. The analysis is based on the New Keynesian Phillips Curve augmented by the short-term interest rate and bank lending standards as proxy for indirect costs associated with working capital. We assess the role of standards for inflation dynamics using a vector autoregression which we estimate within a Bayesian framework.

2.3. Empirical Literature Review
Models of the determinants of inflation in developing countries usually postulate a money demand function and then specify how expansionary monetary policy (with money supply exceeding money demand) leads to price rises. Models of long-run equilibrium real exchange rates (LRERs) for developing countries have used a variety of potential fundamentals, as in these countries the real processes that can cause large medium- and long-run changes in the real exchange rate (i.e., deviations from purchasing power parity) can differ. The theoretical framework is based on models of small, open economies, such as Edwards (1989), where the LRER is derived from the balance of payments.

Agenor (1990) suggests how to adapt the framework to an economy with exchange controls. Traditionally, LRERs for developing countries have been estimated without the use of time-series techniques; instead, a reduced-form equation for the exchange rate stemming from a macroeconomic model has been used (see, for instance. Recently, researchers have begun to use co-integration techniques in research on LRERs for developing countries.

Elbadawi and Soto (1995) use co-integration techniques to estimate models of the LRER in which the fundamentals include the terms of trade, capital inflows, and export growth, while Loayza and Lopez (1997) use as fundamentals international indebtedness and sectoral productivity measures. Owing to the lack of consistent time series, applications to sub-Saharan African economies (other than South Africa) have been scarce. Toujas (1997) applies the co-integration methodology to the price level and the real exchange rate in Madagascar.

For Nigeria, several quantitative studies into money demand have been carried out (see Teriba (1997) for an overview and Moser (1997a) has estimated both money demand and inflation (with money and import prices as the determinants), using the single-equation co-integration technique. When the single-equation technique is used, it is assumed that there is (at most) one long-run relationship among a set of variables. In a vector autoregression (VAR) analysis, the number of long-run relationships in a set of variables is determined empirically. One of the
novelties of this paper is the application of the VAR technique for Nigeria. It also appears to be the first empirical investigation into the LRER for Nigeria.

The Co-integration techniques are particularly useful in estimating long-run relationships, such as the equilibrium real exchange rate, money demand, and potential output. Once a set of long-run equilibrium relationships has been identified empirically, a dynamic model can be estimated, with dynamic equations indicating how the endogenous variables respond to the various disequilibria, or equilibrium correction mechanisms (ECMs). The appeal of the co-integration methodology is that economic theory has a large role to play in explaining the long-run relationships, while short-run behavior is taken to be mainly an empirical matter.

Modeling of the price level here, with the difference between money supply and money demand acting as the main driving force, or equilibrium correction mechanism (ECM), is similar to that in Toujas's (1997) work on Madagascar. The economic model for the real exchange rate is different, owing to two particular characteristics of the Nigerian economy: foreign exchange controls (a complication) and oil as the dominant export product (a simplification). In addition, output is here both endogenized and allowed to deviate from potential output. The output gap then forms an additional ECM that (potentially) has an impact on the price level and the real exchange rate. The use of the VAR technique to estimate a model in which the three key macroeconomic variables are endogenized distinguishes this paper from earlier macroeconometric work on Nigeria. Although the broad framework for the monetary and the balance of payments sector follows the standard small, open economy approach, the modeling of exchange controls and exogenization of export volumes distinguishes this paper from earlier work on other countries. The results of this paper are particularly relevant for policy debates in Nigeria, owing in part to the key feature of the VAR approach used: the dynamic model is derived starting from a very general model structure, with empirical tests determining which theoretical relationships and market-clearing channels are validated empirically.

Toujas's (1997) modelled the price level, with the difference between money supply and money demand acting as the main driving force, or equilibrium correction mechanism (ECM), in work on Madagascar. The economic model for the real exchange rate is different, owing to two particular characteristics of the Nigerian economy: foreign exchange controls (a complication) and oil as the dominant export product (a simplification). In addition, output is here both endogenized and allowed to deviate from potential output. The output gap then forms an additional ECM that (potentially) has an impact on the price level and the real exchange rate. The use of the VAR technique to estimate a model in which the three key macroeconomic variables are endogenized distinguishes this paper from earlier
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3. THEORETICAL FRAMEWORK

The Monetarists Explanation of Inflation

The monetarists view inflation exclusively in terms of increases in the money supply. To begin the discussion of the role of money, it is necessary to pinpoint the major foundation stones of the neoclassical quantity theory of money.

The quantity theory was originally propounded to provide a theoretical basis for the observed tendency for prices to increase when the quantity of money was rising at a faster rate than the production of goods and service. In the original form of theory, variations in the quantity of money and the price level were said to be proportionately rated.

Many writers in the eighteenth and nineteenth centuries contributed to the development of the quantity theory. They include John Locke, David Ricardo and John Stuart Mill. The quantity theory, however, reached its highest level of sophistication in the works of Irving Fisher, Alfred Marshall, A.C. Pigou and Keynes in the early decades of the twentieth century.

**Fisher’s Equation of Exchange:** In Fisher’s formulation of the quantity theory (summarized in the equation of exchange), the circulation of the money stock is related to the amount of money expended in the economy during a given period of time.

If the average price of a given commodity, say the \( i \)th commodity, is \( p_i \) and the quantity sold of that same commodity is \( q_i \), the total expenditure on that commodity is therefore equal to \( p_i q_i \); suppose that there are \( k \) commodities in the economy; then,

\[
p_1q_1 + p_2q_2 + \ldots + p_kq_k = \sum p_i q_i = PQ
\]

where \( P \) and \( Q \) stand off the index of prices and quantity of goods sold respectively. The total monetary expenditure on goods is therefore equal to \( PQ \).

The average turnover of money in the process of exchanging this good will is equal to:

\[
V = \frac{PQ}{M}
\]

where

- \( V \) = velocity of circulation of money (i.e. the rate of turnover of money in the process of exchange for goods)
- \( M \) = total money stock
- \( PQ \) = total money expenditure (defined previously).
Equation (2) can be written as
\[ MV = PQ \]  
(3)

The equation of exchange can then be viewed as an equilibrium condition summarizing the primary factors that influence price level determination.

From equation (3) we see that
\[ P = \frac{MV}{Q} \]  
(4)

Within the analytical framework Fisher concluded that, on the assumption that an increase in the supply of money \((M)\) will in general not affect (i.e. will not change) the velocity of circulation \((V)\) or volume of transactions \((Q)\) at the full employment level, the price level \((P)\) will vary directly with the quantity of money \((m)\). Using Fisher’s own words: ‘Money supply is seen as the important casual factor in inflation. The normal effect of an increase in the quantity of money is an exactly proportional increase in the general level of prices (Fisher, 1911; Ajayi and Ojo, 2006).

The proportional relationship between the money supply and prices can be easily shown. The elasticity of the price level with respect of the money supply \((E_{pm})\) is:
\[ E_{pm} = \frac{dP}{dM} \frac{M}{P} \]  
(5)

Looking at equation (3) and differentiating it totally, we have
\[ MdV + VdM = PdQ + QdP \]  
(6)

Let \(dQ\) and \(dV = 0\),

We have
\[ VdM = QdP \]  
(7)

\[ \frac{dP}{dM} = \frac{V}{Q} \]  
(8)

Substituting equation (8) into equation (5), we have
\[ E_{pm} = \frac{V}{Q} \frac{M}{P} \]  
(9)

But \(V = \frac{PQ}{M}\) from equation (2), therefore,
\[ E_{pm} = \frac{1}{Q} \frac{PQ}{M} \cdot \frac{M}{P} = 1 \]  
(10)

This proves the proportionality between the money supply \((M)\) and prices \((P)\) when \(V\) and \(Q\) are constants and only money \((M)\) and prices \((P)\) are left free to vary. Therefore, the equation \(MV = PQ\) can only be satisfied when a fixed proportionate relationship exists between \(M\) and \(P\).
It is appropriate to mention that Fisher made it abundantly clear that he did not mean to imply that the velocity of circulation of money ($V$) and the volume of transactions ($Q$) will never change; rather, he meant that there is no reason to believe that the equilibrium values of $V$ and $Q$ will change in response to a given change in money supply ($M$).

The Cambridge Equation: Another version of the quantity theory, which most people find more interesting, is the Cambridge equation. This was advanced by Alfred Marshall, A.C. Pigou and other Cambridge economists. In this formulation it is postulated that the quantity of money demanded varied proportionately with the volume of final transactions or the level of money income:

$$M_d = kY = kPQ$$  

(11)

Where

$k$ = proportionately factor (the Cambridge $k$)

$P$ = index of the general price level

$Q$ = index of goods sold

$Y$ = level of money income (i.e. $PQ$)

In the Cambridge equation the emphasis is on both the demand for, and the supply of money, as opposed to the Fisherian version, where emphasis is on the supply of money and its rate of turnover. Secondly, there is a volitional element on the demand side of the Cambridge equations, which leads into more inquiry about factors influencing the demand for money.

Although the conclusions of the two models appear identical and were even thought to be so by their architects, it is ‘more obvious in the Cambridge version that the price level or the level of money income merely tends to follow the size of the money stock, and that strict proportionality between these variables is highly unlikely’ (Boorman and Havrilesky, 1972, p. 172). This is due to the volatile volitional elements that determine the Cambridge $k$. A change in the preferences and expectations of the public can eliminate the simple quantity theory conclusions.

The Chicago School of Monetarists: In recent years there has been a resurgence of the quantity theory in what is known as monetarism, the most well-known advocate being Milton Friedman of the University of Chicago, there are strands of the thought of this school. The most important for our purpose is the assertion that the significant determinant if aggregate spending is the supply of money. Hence, increases in the money supply are seen as the important casual factor in inflation (Friedman, 1956; Ajayi and Ojo, 2006).

4. ESTIMATION STRATEGY

The estimation technique consists of three steps procedure. First, the unit root test, using the individual root of Im, Pesaran and Shin unit root test. Second, a Vector Autoregression (VAR)
estimate, using Iterative Weighted Least Squares simultaneous regression method (including a constant term) is run over the sample period 1980-2010. The lag length of one was chosen based on the Akaike Information. VAR enables us to include the dependent variable as an explanatory variable. Other econometric tools of analysis to be employed are the test for stationarity, long run relationship of the variables

These variables under consideration are Inflation Rate in period t (INF\(_t\)), Past Value of Inflation in period t-1 (INF(-1)), Minimum Rediscount Rates in period t (MRR\(_t\)), Currency outside Banks in period t (COB\(_t\)), Net Domestic Credit in period t (NDC\(_t\)), Demand Deposit in period t (DDP\(_t\)) and exchange rate in period t (EXR\(_t\)) and Commercial Banks lending rate in period t (CLR\(_t\)). The data set for this paper consists of annual time series from 1980 – 2010 and they were obtained from Central Bank of Nigeria (CBN)

The general form of a VAR model is given by the following unrestricted (reduced form) system.

\[
Z_t = \alpha_0 + \sum_{i=1}^{p} \alpha_i Z_{t-i} + \sum_{i=1}^{p} \alpha_i X_t + u_t
\]  

Equation (12) above specifies a VAR (P) process, Where \(Z_t\) is a vector of stationary endogenous Variables (INF\(_t\)), \(\alpha_0\) is an \(n \times 1\) vector of constants, \(\alpha_i\) is an \((n \times n)\) matrix of coefficients, \(p\) is the number of lag, \(U_t\) is an \((n \times n)\) vector of error term. In addition, \(u\) is an independently and identically distributed with zero mean, i.e \(E(u_t) = 0\) and \(E(u_t, u_s) = 0\) for \(t \neq s\). The disturbance term, \(u\) also has a covariance matrix.

From equation (12), the \((n \times 1)\) vector \(Z_t\) contains \(n\) variable in the system, which is list of vector of endogenous variable that includes (INF\(_t\)). The vector \(Z_{t-1}\) is the past value of inflation in period t-1 (INF(-1)). The vector \(A_t\) contains, Minimum Rediscount Rates in period t (MRR\(_t\)), Currency outside Banks in period t (COB\(_t\)), Net Domestic Credit in period t (NDC\(_t\)), Demand Deposit in period t (DDP\(_t\)) and exchange rate in period t (EXR\(_t\)) and Commercial Banks lending rate in period t (CLR\(_t\)). \(\alpha_0\) is a vector that contains the constant terms.

To ensure stationarity of the data we employed the group unit root test of the individual root, which is the Im, Pesaran and Shin unit root test. This test is to detect the order of integration of the variables before estimation. The unit root test is necessary because research has shown that non-stationary data leads to spurious regression, which may affect in determining the cointegration relation and the error correction model. For the cointegration tests to be develop, it requires variables to be integrated of order one. This implies that, all series should be stationary in first difference but not in levels (Dickey and Fuller, 1979). This will reveal the long-run relationship between the variables.
We employ the vector autoregressive model (VAR), which better explains a revolving door model. This choice of the estimation technique is as a result of the fact that Vector Auto Regression model best captures the relationship between INF and its determinants variable using its related lag. The stochastic equation in its empirical forms is specified as follow:

\[ INF_t = \alpha_0 + \sum_{j=1}^{\alpha} \alpha_j INF_{t-j} + \sum_{j=1}^{\alpha} \alpha_j log COB_{t-j} + \sum_{j=1}^{\alpha} \alpha_j log NDC_{t-j} + \sum_{j=1}^{\alpha} \alpha_j log DDP_{t-j} + \sum_{j=1}^{\alpha} \alpha_j EXR_{t-j} + \sum_{j=1}^{\alpha} \alpha_j CLR_{t-j} + U_t \]  

(13)

Equation (13) is designed to measure the relationship that exists between the dependent variable, the past value of inflation in period t-1 (INF(-1)), inflation rate (INF) and independent variables the monetary policies that is; minimum rediscount rates (MRR), currency outside banks (COB), net domestic credit (NDC), demand deposit (DDP), exchange rate (EXR) and commercial banks’ lending rate (CLR). This is to see how those explanatory variables influence the growth rate of inflation (INF). The a-priori assumptions for this equation are:

- \( \alpha_0 > 0; \ \alpha_1 > 0; \ \alpha_2 < 0; \ \alpha_3 > 0; \ \alpha_4 > 0; \ \alpha_5 > 0; \alpha_6 > 0; \ \alpha_7 < 0 \)

The above sign \( \alpha > 0 \), implies a positive relationship between INF and the explanatory variables, while the sign \( \alpha < 0 \), indicate negative relationship. The expectations of the model are quite clear from the apriori signs of the coefficients. For example, inflation relationship with currency outside Banks is expected to be positive and this is not in doubt.

5. EMPIRICAL RESULTS

**Im, Pesaran and Shin Unit Root Test**

In this paper, to determine the order of integration, we test for the presence of unit root, using Im, Pesaran and Shin W-stat and the summary of the results of the tests are presented in Table 1 below.

From the ADF test statistics, the results below show that INF, MRR, LOGDDP, LOGNDC and EXR and CLR were integrated at order one, that is I(1) that is all the variables are in terms of first differences of logarithms (growth rates) and none at level, while LOGCOB was integrated at order two, that is I(2), or stationary at second difference. Comparing the variables levels with their first difference (Im, Pesaran and Shin W-stat) and various probabilities, the test statistics show that the variables are integrated at order of one. All the variables were statistically significant at 1%, 5% and 10% critical values in first difference accept the LOGCOB.

<table>
<thead>
<tr>
<th>Null Hypothesis: Unit root (individual unit root process)</th>
<th>Method</th>
<th>Statistic</th>
<th>Prob.**</th>
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<tbody>
<tr>
<td>Im, Pesaran and Shin W-stat</td>
<td>-9.56335</td>
<td>0.0000</td>
<td></td>
</tr>
</tbody>
</table>
From the results in the above tables’ summary, there is an existence of unit root. This implies that all the series are non-stationary at levels except. Therefore the null hypothesis \( \rho = 1 \) is accepted at levels and the null hypothesis \( \rho = 1 \) that the series are non-stationary after the first and second difference is rejected for all the series. For the random walk above, there are unit roots, so it is an I(1) series. We therefore concluded that the series are of order one I(1). These are MacKinnon critical values for the rejection of hypothesis of a unit root. Next we look for the short-run dynamic relationship using the VAR and possible existence of a long run relationship among the variables.

A look at the regression result in Table 2 below indicates partial conformity of the result with the postulated theory that INF is positively related to its passed value INF(-1), COB, NDC, EXR and CLR and negatively related to MRR and DDP. Furthermore, an examination of the results shows a good fit in terms of the standard error of the parameters (Std\(\alpha_0 > \text{Std}\alpha_2,\alpha_7\)), which indicates a non-negative constant term for inflation (3.97%) no matter the changes in the monetary policy and bank lending (the independent variables) and apriori expectation and statistical significance of the explanatory variables.

<table>
<thead>
<tr>
<th>Series</th>
<th>t-Stat</th>
<th>Prob</th>
<th>E(t)</th>
<th>E(Var)</th>
<th>Order of integration</th>
<th>Max Lag</th>
<th>Obs</th>
</tr>
</thead>
<tbody>
<tr>
<td>D(INF)</td>
<td>-5.4536</td>
<td>0.0007</td>
<td>-2.173</td>
<td>0.748</td>
<td>I(1)</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>D(MRR)</td>
<td>-6.6054</td>
<td>0.0000</td>
<td>-2.173</td>
<td>0.748</td>
<td>I(1)</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>D(LOGCOB,2)</td>
<td>-7.3036</td>
<td>0.0000</td>
<td>-2.170</td>
<td>0.699</td>
<td>I(2)</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>D(LOGDDP)</td>
<td>-4.3480</td>
<td>0.0092</td>
<td>-2.171</td>
<td>0.695</td>
<td>I(1)</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>D(LOGNDC)</td>
<td>-5.8625</td>
<td>0.0002</td>
<td>-2.171</td>
<td>0.695</td>
<td>I(1)</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>D(EXR)</td>
<td>-5.1558</td>
<td>0.0013</td>
<td>-2.171</td>
<td>0.695</td>
<td>I(1)</td>
<td>1</td>
<td>29</td>
</tr>
<tr>
<td>D(CLR)</td>
<td>-6.2269</td>
<td>0.0001</td>
<td>-2.173</td>
<td>0.748</td>
<td>I(1)</td>
<td>1</td>
<td>28</td>
</tr>
<tr>
<td>Average</td>
<td>-5.85083</td>
<td>&lt;2.172</td>
<td>0.717</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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From the estimated result, it is obviously that if COB, NDC, EXR and CLR increase by one percent, INF level will increase by 0.18%, 0.56%, 0.0004% and 0.029%, respectively, given the explanatory variable coefficient of determination and if MRR and DDP variables increase by one percent, INF level will decrease by 0.020% and 0.72%, respectively, given their coefficient of determinations. The coefficient of broad money supply showed that net domestic credit (NDC) and Currency outside Banks (COB) are the most important variable in determining inflation in the short run in Nigeria. It implies that their significance will be much felt. Also the result showed that the lagged value of inflation (INF(-1)) is positively related to the current value inflation (INF). With a value of 0.32%, indicates that past level of inflation will contribute to current level of inflation.

The t-statistic, which is computed as the ratio of an estimated coefficient to its standard error, is used to test the hypothesis that a coefficient is equal to zero. To test our hypothesis we used the probability (p-value) of observing the t-statistic given that the coefficient is equal to zero. For this paper we are performing the test at the 1%, 5% and 10% significance level, that is, a p-value that ranges between 0.01 - 0.10 are taken as evidence to reject the null hypothesis of a zero coefficient.

(H₀: α₁ = α₇ = 0) and accept the alternative (H₁) (H₁: α₁ ≠ α₇ ≠ 0). From the result in model, the t-statistic probability values for constant term and INF(-1), COB and NDC range between 0.04% and 0.06%, respectively. The low probabilities values strongly rejected null hypotheses and indicate that these variables are significantly in explaining INF. Thus, we therefore accept the alternative (H₁) constant term and INF(-1), COB and NDC . In other words their parameters are significantly different from zero (H₁: α₁ ≠ α₇ ≠ 0), while constant term and INF(-1), COB and NDC are positively significant. But we accept the null hypothesis (H₀) of a zero coefficient for MRR, DDP, EXR and CLR with their probabilities value 0.25 and 0.95 (25% and 95%) respectively. In other words the parameters are not significantly different from zero (H₀:α= α= 0) and even though EXR and CLR were positive but not significant in explaining.
$R^2$ show that only 84% of variations in INF are accounted for by the changes in the INF(-1), MRR, COB, NDC, DDP, EXR and CLR, while the F-Stat is 16.17 with a probability distribution of 0.002% of the F-Stat, it passed the significant test at the 5% as the observed F-Statistic of 16.17 estimated was greater than 3.257 (critical) at that level of significance. It implies that or the result tends to suggest that the regression equation and the overall fitness are not too good. The Durbin-Watson (DW) test statistic ($d^*$) shows the presence of serial correlation between the error terms. From the result $d^*$ is less than 2, that is $1.855 < 2$. We therefore reject the null hypothesis ($H_0$), which says that there is no positive autocorrelation of the errors’ terms; we accept the alternative hypothesis ($H_1$), which says that there is positive autocorrelation of the errors’ terms, but a weak serial correlation.

**Analysis of Long Run and Error Correction Model Test Results**

Since the variables are non-stationary at levels but cointegrated, then their dynamic relationships must be specified by an error correction model (ECM) in order to capture both the short-run and long-run relationships. The Error Correction for the long run INF equation is explained below:

**Model: Error Correction Model Equation**

$$D(INF) = -10.527 - 0.709(INF(-1)) + 0.369MRR(-1) - 0.449LOGCOB(-1) + 3.185LOGDDP(-1) - 2.180LOGNDC(-1) - 0.027EXR(-1) - 0.229CLR(-1)$$

This implies that, the adjustment coefficient or the speed of adjustment of INF if deviated from its long run equilibrium is 0.71, while the intercept term still is negatively related to inflation in the long run. Also the error correction estimate equation shows that the long run behavior of MRR and DDP appear to have positive relationship in adjusting to long-run disequilibrium given the ECM value (0.71) and that the long run behavior of COB, NDC, EXR and CLR appear to have negative relationship to the adjust to long-run disequilibrium given the ECM value. Since the magnitudes of some coefficients (e.g. MRR, DDP, NDC) are large, these variables are statistically significant in the determination of the grow rate of inflation in the long run if it is in disequilibrium.

**6. POLICY IMPLICATION, RECOMMENDATION AND CONCLUSION**

The aim of this paper is to explore whether monetary policy (contraction and expansionary policies) and commercial bank lending rate can provide convincing explanation behavior of inflation in Nigerian economy over the period 1980 to 2010. The paper reveals that the coefficient of net domestic credit and currency outside banks are the most important variable in determining inflation in the short run in Nigeria. It implies that their significance will be much felt in the short run positively, while net domestic credit will also be negatively but statistically significantly affect inflation rate in the long run. Also the result showed that the lagged value of inflation is positively related to the current value inflation. With a value of
0.32%, indicates that past level of inflation will contribute to current level of inflation.

The result of this paper also supports previous studies that minimum rediscount rates and demand deposit, negatively but statistically significantly affect inflation rate in the short run but positive statistically significantly in long run. This is in conformity to our stated a-priori expectation the paper shows a negative relationship between the central bank minimum rediscount rates and the inflation rate in Nigeria. However, the coefficient of minimum rediscount rates is statistically significant. The evidence indicates that there is a significant, and economically important, negative relationship between inflation and commercial bank borrowing from central bank. This correlation emerges essentially independently of the time period considered, the empirical procedure employed, or the set of variables that appear in the conditioning information.

The empirical findings above have several key policy and research implications. Above all, they suggest that our understanding of the monetary policymaking has been limited to the behavior of the traditional instruments in control inflation. This finding shows that the central bank operational independence will not automatically enhance the credibility of its commitment to price stability, thereby resulting in lower average inflation. These may be in form of consistent monetary authority intervention in ensuring good monetary policy. That is overall policy direction should be to formulate and implement stable monetary policies that would help control accelerate the output level and reduce inflation in Nigerian and that monetary policy that reduction inflation is channel through minimum rediscount rates should be embraced.

Finally, the paper has shown that there is evidence indicates that there is a significant, and economically important, negative relationship between inflation and monetary policy. This correlation emerges essentially independently of the time period considered, the empirical procedure employed, or the set of variables that appear in the conditioning information. The paper therefore recommends that other policy measures such as the fiscal policy should be applied to avoid the negative effects of an increase in bank lending on the inflation of the economy affect the first period. Therefore, the level of the country’s economic growth should be taken into consideration in formulating policies that are expected to have effect on inflation. Also monetary authority in Nigeria may only bother about the long-run implications of MRR, NDC and DDP on inflation because they do matter in the long-run.

Therefore, the paper concludes that inflation rate in Nigeria take a long-run perspective of the monetary policy modification. This paper due to the foretasted limitation and scope made it difficult to carry out a comprehensive, detailed empirical inquiry into the relationship of choice. Therefore, a later revisit of this work is recommended; say in a six year time, so that micro-numerosity would not be a problem and with a larger scope.
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