Effect of Changes in Nigeria Monetary Policy Rate on Interest Rates

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Abstract
Since the monetary authority adopted indirect form of monetary policy formulation in 1993 (P N Okafor) monetary policy rate (MPR) has being one of the monetary tools used by the Central Bank of Nigeria in setting targets and direction of other rates as well as other macroeconomic aggregates. The MPR is expected to communicate the stance of monetary policy and acts as a guide for all other market interest rates. In Nigeria however, there seem to be disconnection between MPR and the direction of interest rates. Since 2016 the Monetary Policy Committee (MPC) had retained MPR at 14% for a long period but stability in Monetary Policy Rate is barely reflected in the movement of short term and long term interest rates. The objective of this is to find out whether a change in MPR has effect on interest rates in Nigeria. The study makes use of CBN data from 2006-2016 to examine the effect of Monetary Policy Rate on short term and long term rates in Nigeria. The choice of the scope of the study lies in examining the response of interest rates to changes in MPR. Result obtained from this study will be used to gauge the effectiveness of MPR in an economy like Nigeria where financial infrastructure is not fully developed. The study concludes that the MPR influences the 91-Day Treasury Bills rate to the greatest extent followed by the Inter-Bank Call rate.

Keywords: *Monetary Policy Rate, Interest Rates, Monetary Policy, Ordinary least squares, Principal Component Regression, Ridge Regression.*

1. Introduction

Monetary Policy Rate (MPR) is a monetary policy instrument used to effect changes in the availability of credit supply in order to stimulate economic growth, price stability and high employment level. MPR as a monetary policy is consider the main policy instrument in effecting the tempo of economic activities in any economy. In Nigeria, however this seems not to be the case because of the under developed nature of Nigeria financial infrastructure. The Central bank of Nigeria through its Monetary Policy Committee is mandated to maintain stable lending rates in order to spur economic growth. The Central Bank Reserve can alter the supply of reserves either by using open market operations to buy or sell government securities or by altering the amount of reserves borrowed through the discount window.

This in turn affects the prevailing interest rate charged by the Government on its 91-Day Treasury bills. Providing fewer reserves than desired by depository institutions puts upward pressure on the price of reserves while supplying more reserves than institutions desire puts downward pressure on the Treasury bill rate. The government influences the prevailing lending rates through the rate it offers to investors investing in their short term treasury bills. This in turn represents a risk free rate for investors. Investors will only be willing to invest in other investment offering similar returns or with higher returns if the risk is high. In the standard view of the transmission mechanism, the relationship between policy actions and long-term lending rates is assumed to be straightforward. An increase in the desired level of the Central Bank Rate causes current short-term rates and expected future short-term rates to rise, which pushes up interest rates across all maturities.

The Monetary Committee used the Central Bank Rate in Nigeria to set the minimum rate on which investors can borrow. This in effect leads to a similar change in the prevailing lending rates. For example, the Central Bank of Nigeria through its Monetary Committee evoked this measure when the inflation was believed to be too high. It raised the MPR rate from 11% to 18% which saw the interest rates increase to above 24%. This explains the relationship between MPR and the prevailing lending rates. In the year 2012, the Central Bank reduced the MPR from 18 to 13% which subsequently saw the lending rates charged by commercial banks reduce from 24% to 18%.

The Central Bank of Nigeria uses MPR which is the anchor rate for other rates in the banking system as a way of influencing the tempo of economic activities. The Central Bank of Nigeria adopted various policy instruments in its attempt to effectively influence the quantity of money or interest rates. In contrast to the direct measure applied in 1974-1994 (P. N. Okafor), the emphasis is now on market oriented policy measures, which seeks to guide or encourage banks to take certain actions on a voluntary basis. A good example of this measure is the introduction of MRR in 1993 as a monetary instrument for the implementation of market driven monetary policy.

Changes in MPR is expected to affect the cost at which the Central Bank grants assistance to the banking sector and therefore represents a cost of credit to the banking sector. When MPR is changed, the interest rates on overdrafts and other loans extended by the banks also tend to change. In this way the Central Bank of Nigeria indirectly affects the interest rates in the economy. Before this period, monetary policy was conducted using direct control measures. The direct control in the conduct of monetary policy during this period was characterized by extensive disintermediation.

The Minimum Rediscount Rate (MRR) which was used as a price- based technique to influence the movement of cost of funds in the economy, however, was still not effective. The introduction of MRR was a way to shift from direct form of monetary policy implementation by the CBN. A change in this rate provides a platform for the monetary disposition of the Bank. To complement the use of the MRR, the CBN eventually introduced the Monetary Policy Rate (MPR) in 2006 which establishes an interest rate corridor of either plus(+) or (-) certain percentage points of prevailing MPR. Given that the relative effectiveness of MPR in determining the level of other market rates has not been extensively studied in Nigeria, we explore further this linkage for Nigeria.

Monetary policy, which operates through changes in MPR, is the main lever of macroeconomic management in Nigeria by the Central Bank of Nigeria in pursuit of price

stability; maintenance of full employment in Nigeria; and the economic prosperity and welfare of the people of Nigeria.

Underpinning these macroeconomic goals are exchange rate stability, low inflation and low inflation expectations through the manipulation of MPR. The use of MPR in Nigeria as a monetary policy tool in achieving the above stated objectives seems not to be working. It has been observed that changes in MPR by the Monetary Policy Committee in order to achieve certain macroeconomic goals do not work in Nigeria due to obvious reasons. The objective of the study is to find out whether a change in MPR has effect on interest rates in Nigeria.

2. Literature Review

Rehman, (2009) and Kovanen, (2011) referred to the process by which changes in MPR is transmitted to interest rates as interest rate passed through. This process is simply the rate or process at which the official Central Bank rate is transmitted to other interest rates. Monti and Klein (1971) analyzed a conventional model for the effects of monetary policy rate on market rates. The frame work assumes that if markets are perfectly competitive then the interest rate pass through will be full symmetrical and swift in response to monetary policy rate. The model assumes the absence of information asymmetry, switching cost and perfect competition in financial markets so doing making the full pass through a long run phenomenon while deviations from long run equilibrium occurs only in the short run.

Although, the reality in most markets is that perfect market condition hardly exists as markets generally exist under conditions of imperfect market situations, high switching and menu cost and absence of perfect information. Regardless, some studies have found this model to be realistic and true in its assumptions. Hofmann and Mizen (2004), and Fuertes and Heffernan (2009) studies reflected changes in monetary policy rates in asymmetric and non-linear adjustment. Kwapil and Scharler (2006), Aydim (2007), Marotta (2009), Kovanen (2011) studies concluded that the interest rate pass through is weak and incomplete. Weth (2002) found interest rate pass through to be weak in the short run but fully complete in the long run. Crespo-Cuaresma, Egert, and Reininger (2004) studies found interest rate pass through to be fully complete in short term. Four major theories exist in the literature to explain the flexibility of interest rates in the short run. These major theories include; the agency cost theory (Stiglitz and Weiss, 1981), the adjustment costs (Cottarelli and Kourelis, 1994), the switching costs (Klemperer, 1987) and the risk sharing cost (Fried and Howitt, 1980).
Almost all empirical studies on interest rate pass through center on investigation of the degree and speed of adjustment of banking rates to changes in money market rates with some degree of variability in terms of short term and long term adjustment of market rates to monetary policy rates. Bernoth and Von Hagen(2004) studies of interest rate pass through consider the impact of future money market rates on current retail rate setting with the central focus on the search market productivity.

Sander and Kleimerier (2006) conducted a study; it was found that there exists a greater response to anticipated monetary policy changes measures by interest rate features than to unanticipated changes. Other recent studies have gone beyond estimating the degree and speed of adjustment of market interest rates in relation to changes in monetary policy rates to examining the degree and variability of interest rate pass through across countries and regions (Weth 2002; De Bondt 2005; Soenson and Werner 2006; Sander and Kleimerier 2006; Banerjee, et al 2010; Cas. et al 2011). These studies show the degree of interest rate pass through which differs across regions and across countries.

Aziakpono, Wilson and Manuel (2007) found market interest rates to respond to monetary policy rate, the study conducted by Aziakpono and Wilson (2010) found that commercial banks' lending rates are more rigid in response to positive shocks in monetary policy official rate in South Africa. Ikechukwu Kelilume, (2014) found that the pass-through of monetary policy rate into short term and long term retail interest rate in Nigeria is sticky. The only evidence of the effectiveness of monetary policy can be seen only in the relationship between monetary policy rate and inter-bank rates. Furthermore, he found that the low pass-through rate evident in the study was as a result of the presence of high menu and transaction cost and imperfect financial condition.

In Nigeria, the Central Bank of Nigeria (CBN) Monetary Policy Committee (MPC) which drives its legal backing from the various statutes of the bank (CBN Act 1958; Decree No. 1997; CBN Act 2007), adopted anchor for monetary policy action on December 11, 2006 with the ultimate goal of achieving stability in the domestic currency, prices and ultimate economic stability through interest rates stability around a benchmark called MPR. At inception, MPR was fixed at 10% with a 600 basic spread point making a lower band of 7% and an upper band of 13% based on the current and expected inflation. Since inception, the MPR has been changed about fourteen times most of which was positive and are usually done in anticipation of a raise in the general price level. Adjustment of MPR by MPC has ranged from a decrease 20% in the wake of the 2007-2008 global economic crisis to an approximately 30% increase in the period between the third quarter 2011 and the fourth quarter of 2011.

Al-Hassan and Al-kassab (2002) looked at a component between principal components regression and ridge regression using Monte Carlo simulation technique. In their study, broken stick method was to decide how many components to retain. Thirty observations were generated for each of twenty explanatory variables. The numbers of correlated variables were varied from two to twenty. Comparisons were made base on MSE criterion. It was obvious from all stimulations that ridge regression performed better than principal components regression. Saikat and Jun (2005), compared the performance of principal components regression and partial least regression techniques. Six numbers of variables and sample sizes were used for the principal components regression technique. Bulut, and Alma, (2011) studied three dimension reduction techniques namely principal component regression, partial least square regression and reduced rank regression and they were illustrated on data set that has small number of observation unit. In their study PCR and PLSR analyses result showed that 7 components explain most of the variability on both explanatory and response variable, while reduced rank regression (RRR) worth with 2 component.

3. Material and Method

The data used for this study is monthly time series observation sourced from the central bank of Nigeria statistical bulletin covering the period 2006; M1 to 2016; M1. The major variables used in the model include; Monetary Policy Rate (MPR), Inter-bank call rate, 91-Day Treasury bill, One month deposit, three month deposit, twelve month deposit, saving deposit, prime lending rate and maximum lending rate.

The data on the variables was collected from secondary data contained in Central Bank Inter-Bank Call rates. The Central Bank is concerned with the administration of monetary policies. Interest rate was measured by average banking industry lending rates compiled by Central Bank of Nigeria on a monthly basis since 2006 to 2016. The 91-Day Treasury bill rate consisted of the monthly 91-day Treasury bill rate that the government borrowers from

public. The Inter-Bank Call Rate was gotten from the CBN records same as the interbank rate for the same period. These were used to represent the monetary policies used by the government in affecting monetary supply and demand.

The theoretical base for explaining the linkage between the monetary policy rate and short term and long term rates is the marginal cost pricing model also referred to as the monetary policy approach (De Bondt, 2005). Following the Monti-Klein framework (Monti 1971; Klein 1971) which assumes the existence of a perfectly competitive market devoid of asymmetric information, transaction cost, and menu cost, we assume price equals marginal cost. Under this condition, the derivative of price with respect to marginal cost will be unity. Applying this framework to the relationship between money market rate and retail rate of interest we develop the model: $Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + ...\beta_8 x_8 + \varepsilon$ ----------**(1)**

The multiple regression analysis is conducted in order to determine the effect of Monetary Policy Rate on interest rates in the Nigeria. The regression equation used was as above, where: Y = Monetary policy Rate
β_0 = Constant
X_1 = 91-day Treasury bill
X_2= Saving Deposit
X_3= One Month Deposit
X_4 = Three Months Deposit
X_5 = Twelve Months Deposit
X_6 = Prime Lending
X_7 = Maximum lending
X_8 = Inter-Bank Call Policy instruments and
$\boldsymbol{\varepsilon}$ = Error Term,
If the coefficient of the pass through term is unity, the monetary transmission mechanism is said to be complete and efficient. However if the coefficient of the pass through rate is such that it lies between zero and unity, the monetary mechanism is said to be incomplete and inefficient.

To test for the strength of the model and the relationship between monetary policies and interest rates in Nigeria, the researcher conducted an analysis of variance, ANOVA. On the extracting table, the researcher looked at the significant value. The study was tested at 95% confidence level and 5% level of significance.

This procedure proposed by Harold Hotelling in 1933 (Massy, 1965). In principal components regression method, instead of using regression variables, principal components are used as regression variables. Thus, the replaced regression variables are independent from each other. In principal components regression model, a subset of principal components is used instead of all components. The method varies somewhat in philosophy from ridge regression but like ridge, gives biased estimates, when using successfully this method results in estimation and prediction will be superior to LS.

Assume q first components are used in regression model ($q \prec p$); then, a is estimated as follows:

$a_q = (Z_q^T Z_q)^{-1} Z_q^T Y = \Lambda_q^{-1} V_q^T X^T Y, ...(7)$

So that $Z_q = XV_q and \Lambda_q$ are diagonal matrix of q first eigenvalues (where $\lambda_1 \geq \lambda_2 \geq ... \geq \lambda_p$) and V_q is a matrix with q corresponding eigenvector. a Is defined as $a = V^T \beta. then, \beta = Va$ can be written and estimated value of β using principal component method is equal to:

$\beta_{PC} = Va, ...(8)$

and by replacing a with its value in equ 7 with β_{PC}, the following is given for the reduced model

$\beta_{PC} = V_q \Lambda_q^{-1} V_q^T X^T Y, ...(9)$

Mean squared error for principal components regression is

$MSE(a_{PCR}) = \sigma^2 \sum_{i=1}^{q} \frac{1}{\lambda_i} + k^2 \sum_{i=q+1}^{p} (V_i^T \beta)^2, ...(10)$

Where V_i that is the i-th vector of eigenvalues from matrix $X^T X$.

Ridge regression (RR) has been introduced by Hoerl and Kinnard (Hoerl, A. & Kennard, R, 1970, 1975), they suggested a small positive number $k \geq 0$ to be added to the diagonal elements of the $X^T X$ matrix from the multiple regression, and resulting estimator is obtained as:

$\beta_{RR} = (X^T X + kI)^{-1} X^T Y, ...(12)$, where I is a matrix unit and k is a constant selected by the analyst, $k \succ 0$. It is to be noted that when $k = 0$ then the ridge estimator is the least-square estimator. The ridge estimator is a linear transformation of the least-squares estimator β_{LS}

$\beta_{RR} = \left[I_n + k(X^T X)^{-1} \right]^{-1} \beta_{LS}, ...(13)$

Using canonical form of eq 3 the ridge estimator can be written as

$a_{RR} = (I_n + k\Lambda^{-1})^{-1} \hat{a}_{LS}, ...(14)$

Mean squared error for ridge regression is

$MSE(a_{RR}) = \sigma^2 \sum_{i=1}^{p} \frac{\lambda_i}{(\lambda_i + k)} + k^2 \sum_{i=1}^{p} \frac{a_i^2}{(\lambda_i + k)^2}, ...(15)$

Where σ^2 is error variance and a_i is the i-th component of a .

4. Data Analysis and Interpretation

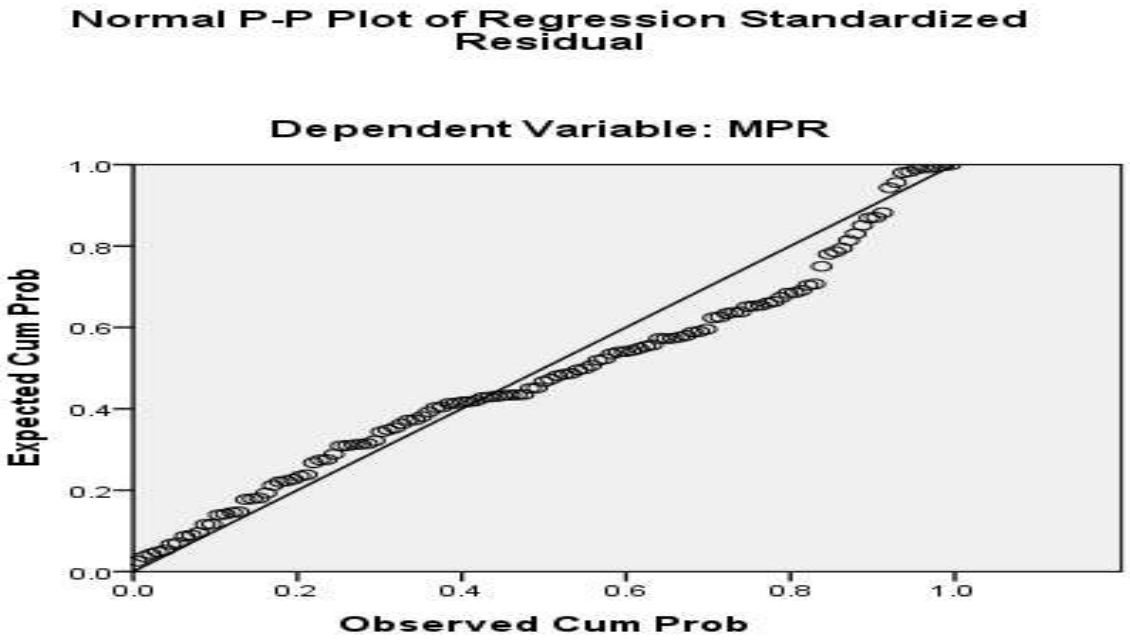
The study collected data on the prevailing rates on the 91-Day Treasury bills. In the year 2006, the bill rates started at 4.5% in January and ended the year at 3.25%. In 2007, the rate was 3.36% in January. The rate dropped slightly by February when it reached 3.19% before starting to increase at a fast rate to 4.3% in March to 3.78% in June. In July, 2007, the rate started to drop. It settled at 3.77% in July and 3.71 in August. The fluctuations continued until December when it reached 3.19%. In 2008, the rate started at 8.58% and dropped continuously to reach a low rate of 6.9% in November.

In 2009, the rate started on the low 3.88%. This low rate was maintained throughout the year with the highest rate being 5.08% in October. In 2010, the year started with a rate of 3.72% in January as the threat of inflation force CBN to change it monetary policy stance from

expansionary to restrictionary. The rate remained a little stable during the year by posting little fluctuations from 1.2% to 7.58%. In January 2006 the rate stood at 13.68%. During the year, the rate reduced slightly to the lowest of 6.65% in May.

In 2007, the year started with 7.1% in January. It increased to the highest in the year of 7.23% in April. In the year 2008, the rate in January was 8.58% which increased to 9.21%. The rate fluctuated during the year to the lowest of 6.9% and the highest of 9.21% was in July. In the year 2009, the rate started at 3.88 in January then increased to 5.08% in October. The rate then fluctuated at between 2.0% and 4.8% for the rest of the year. In 2010, the year started at3.72%. The year recorded high fluctuations to reach the highest level of 7.58% in November. The average for the year was 3.88%. In 2011, the year started with a high rate of 7.4%. However, the rates increased tremendously starting the month of February to reach the climax in April at 9.52%. These details are well illustrated in the figure 4.1 below.

Figure 4.1: 91 – Day Treasury Bill rate

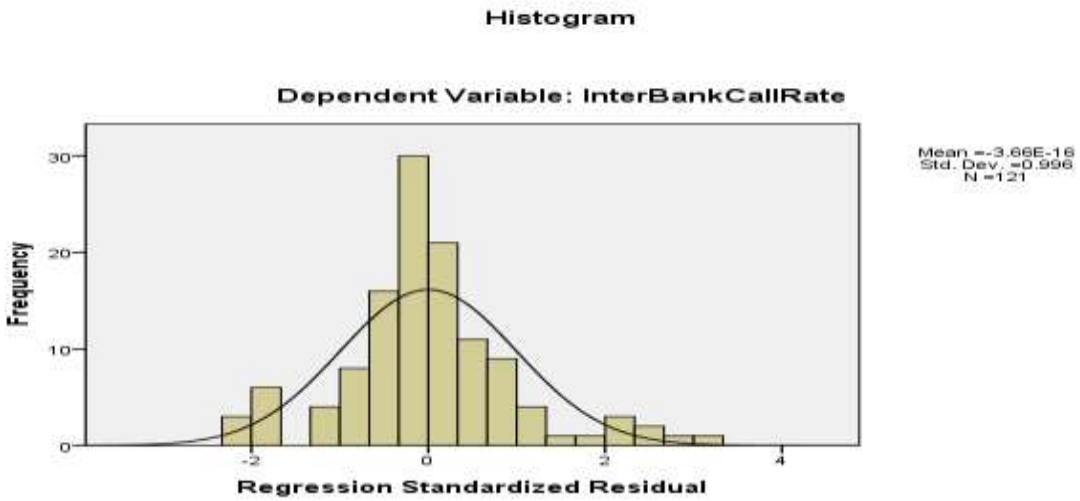


From the graph above, the model of the chart suggested is accurate, it indicates a strong correlation between the model's prediction and its actual result.

The study also collected monthly data on the Inter-Bank Call rate from the year 2006 to 2016. The year 2006 started at 7.81% in January which dropped slightly to 7.78% in February. The Inter-Bank Call rate continued with a downward trend to reach an all-time low of 5.73% in July before starting an upward trend to reach 6.34% in December. In 2007, the Inter-Bank Call rate started at 6.43% followed with an increase to 7.81% in September. The Inter-Bank Call rate then started to increase slightly to record 7.13% in December. In 2008, the Inter-Bank Call rate started trading at 7.75%, it then dropped for three consecutive months to reach 6.67% before increasing to slightly above 7%for three months then declined to 6.06% in September. In 2009, the Inter-Bank Call rate started at 5.10% prevailed for four months in the year with the lowest at 4.05% and the highest at 6.18%. The year 2010 did not have Inter-Bank Call activities hence there was no Inter-Bank Call rate. The year 2011 also recorded limited Inter-Bank Call activities. The rate in March was 1.66% which increased to reach a high of 18.89% in October before settling at 17.75% in December. In 2015, the rate started

with 11.2% in January and continuously declined to 4.57% in December. Similarly, 2016 started on a low rate of 4.12% in January.
These findings are well illustrated in the figure 4.2 below:

Fig 4.2

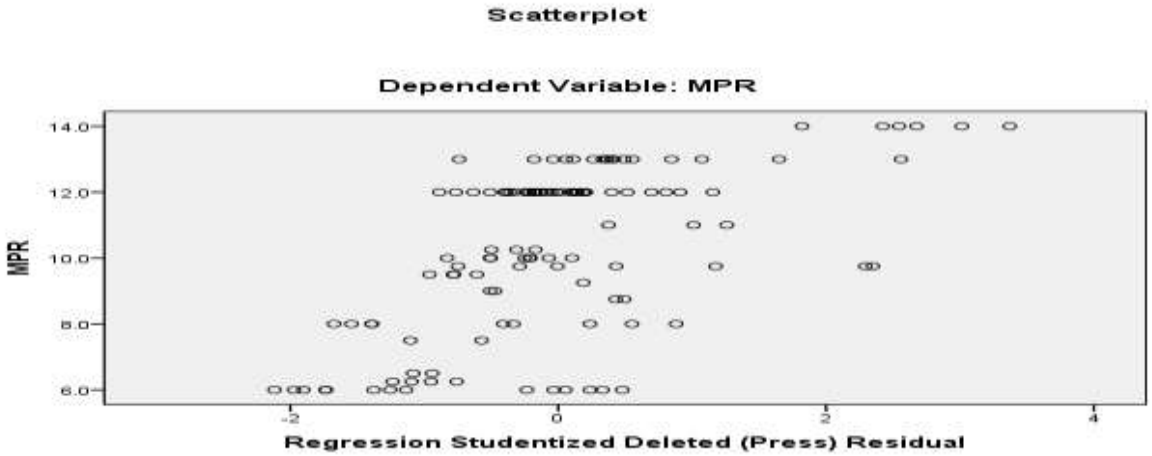


From the graph above, the regression standardized residual is normal, hence asymmetrical. This implies that the model is a good fit.

The Monetary policy rate was introduced in Nigeria in December 2006 at 10.0%. The rate was then decreased to 8% in September 2007 which was maintained until June 2007. The MPR remained stable at 10% in the first five months of the year 2007 before reduction by 2.0% to settle at 8.0% for four months (June and September). In October the same year, the Monetary Policy Committee raised MPR by 0.5% points to settle at 9.5% which prevailed until November. In 2008, the rate stood at 8.75% which prevailed for the first five months of the year. Starting June, 2008, the MPR rate was adjusted upwards by 0.25% points to settle at 9% until November before being reviewed to 8.5% in December. The year 2009, the rate remained the same at 8.5% which prevailed for two months (January and February). The rate then was adjusted downwards by 0.25% points to 8.25%. In June, the rate went down further by another 0.25% points to settle at 8.00%. In August, the MPR was reduced by another 0.25% points to settle at 7.75% as the MPC attempted to stimulate the economy following the adverse effects of global financial crisis in 2008.

This rate prevailed until October when it was cut by 0.75% points to settle at 7.00% for the month of November and December. In 2010, the MPR opened at 7.00% which was sustained for two months (January and February before being reduced by 0.25% points to settle at 6.75%). The MPR continued with a downward trend to close at 6.00%. In 2011, the MPR was 5.75% in January and closed the year at 18.00%. The sharp issue in 2011 was in response to a sharp rise in inflation and rapidly deprecating currency.

Figure 4.3: Monetary Policy Rate (MPR)



The study collected data on the prevailing interest rates for the same eleven year period under review. From the findings, the lending rates started high in the year 2000 at 25.14% increased to 25.39% in February then started dropping in March to 23.44%. The lending rate continued on a downward trend reaching the low of 19.60% in December with an annual average of 22.34%. In 2001, the lending rate started at 20.27% and fluctuated downwards within 19-20.27% giving an annual rate of 19.67%. In 2002, the lending rates started at 19.30% and continued reducing during the year reaching the lowest of 18.05% in November. In 2003, the rate continued on its downward trend starting off the year at 19.30% but reducing with more than 5% points to settle at the lowest of 13.47% in December.

In the year 2004, the lending rates in January was 13.48% and continued with a downward trend to reach an all-time low since the year 2000 to settle at 11.97% in November. In the year 2005, the lending rates opened in January at 12.12% then fluctuated upwards to reach an annual high of 13.12% in April then came down to settle at 13.16% in December. 2006 started a little high at 13.2% which was maintained with minimal fluctuations during the year. 2007 was similar to 2006 in that the lending rate operated at a few points above 13%. In 2008, the rates started fluctuating upwards starting off the year at 14.98% then easing off towards the end of the year to settle at 14.02%. In the year 2009, the rate remained somehow stable at 14.7% with fluctuations of less that 0.5%. The year 2010 started off at 14.98% then reduced to slightly below 14% towards the end of the year closing at 13.87% in December. The year 2011 started at 14.03% which reduced slightly to trade at between 13.9% and 15.2% up to October. In November, the rate shot up to 18.51% then increased to 20.04% in December. In 2015, the rate started at 16.86% and rose to 17.24% in June and decline to 16.96% in December the same year. January 2016, the rate started at 16.54%. These findings are well illustrated in the table below.

Figure 4.4: Treasury bill Rates

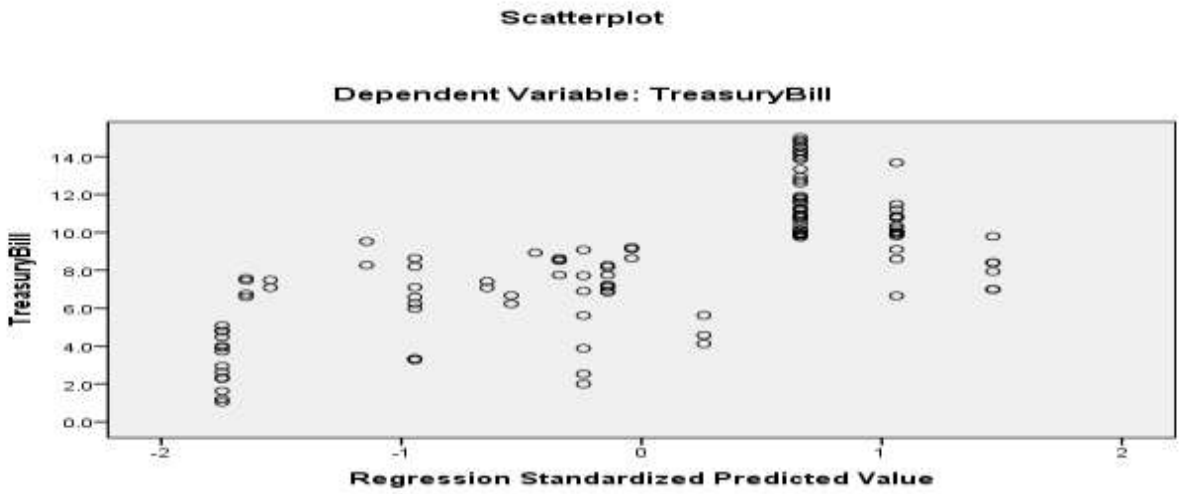


Table 4.1 presents descriptive statistics of the independent variables used in estimating the multiple regression model as well as Principal component and Ridge regression models. The statistics covers mean values, standard deviation, and a two-sample t-test statistic to compare the means of Monetary Policy Rate and Interest rates. The null hypothesis (H_0) in this test is that: "there is no statistical difference between the monetary policy and Interest Rates".
It is clear from the table that the Monetary Policy Rate has significant differences in their mean values in terms of some interest rates (Treasure Bill, Saving Deposit, One Month Deposit, Three Month Deposit, Twelve Month Deposit, Prime Lending and Max. Lending) and in term of Inter-Bank Call Rate is not. More so, it is important to note that simple mean comparison such as the one in this paper is not exhaustive in itself since it provides little information on cause and effects Monetary Policy on Interest Rates.

Table 4.1 profile Analysis of Means and Standard Deviations of Monetary Policy and Interest Rates:

	Monetary Policy Rate Mean =10.35; Std. Dev. = 2.49				
Variables	Mean	Std. Dev.	Mean Diff.	t-value	p-value
Treasury Bill	8.52	3.36	1.829	4.81	0.000
Savings Deposit	2.667	0.810	7.686	32.26	0.000
One Month Deposit	8.66	2.56	1.694	5.22	0.000
Three Month Deposit	9.20	2.37	1.157	3.70	0.000
Twelve Month Deposit	8.19	2.86	2.166	6.28	0.000
Prime Lending	16.84	1.09	-6.491	-26.25	0.000
Max. Lending	22.42	2.97	-12.071	-34.23	0.000
Inter-Bank Call Rate	10.27	5.26	0.084	0.16	0.835

Note: p-values are meant for testing the null hypothesis that there is no statistical difference between the monetary policy and Interest Rates.

Below in Table 4.2 is a Pearson correlation matrix for all the variables used in estimating the models. Correlation analysis is a possible way of assessing the strength of a group of independent variables as against the dependent variable. It also offers a general idea of the inter relationship between the regressors prior to estimation. This in a way provides an

overview about possible multicollinearity problems. From the correlation matrix, all the predictor variables recorded their expected sings in relation to Monetary Policy Rate. The Prime Lending interest rate showed a negative expected relationship whiles the rest of the interest rate (Treasury bill, Savings Deposit, One Month Deposit, Three Months Deposit, Twelve Months Deposit, Max. Lending and Inter-Bank Call Rate) produced positive but expected relationship with the Monetary Policy Rate. Among these Interest Rates, only the; Treasury Bill, Savings Deposit, Prime Lending, Max Lending, and Inter-Bank Call Rate Interest Rates have statistical significant correlation with Monetary Policy Rate at the 0.05 significance level. To test for the presence of any multicollinearity problem, we used the variance inflation factor (VIF) criterion after estimating a linear regression models. Chatterjee and Price (1991) and Hair et al. (2006) suggest a maximum variance inflation factor (VIF) of 10for any meaningful and unbiased estimation results. Carrying on with the VIF test, all the variables had VIF values below the maximum criteria except One Month Deposit and Three Months Deposit which recorded very high VIF values above the criteria. As a remedy, Three Months Rate which recorded the highest VIF value was dropped and the test carried out once more. After eliminating Three Months Rate, it was found that all the regressors had VIF values below the maximum acceptance value.

Table 4.2 Correlation Matrix for Monetary Policy Rate and Interest Rates and Significant of correlation

	MPR	TB	SD	OM D	TMD	TVMD	P L	ML	IBCR	VIF
MPR	1.000									
TB	0.704* 0.000	1.000								2.142
SD	0.232* 0.010	-0.210* 0.000	1.000							1.640
OMD	0.035 0.702	-0.266* 0.003	0.536* 0.000	1.000						28.184
TMD	0.071 0.437	-0.210* 0.021*	0.555* 0.000	0.978* 0.000	1.000					44.203
TVMD	0.027 0.771	-0.222* 0.014	0.464* 0.000	0.865* 0.000	0.909* 0.000	1.000				7.420
PL	-0.294* 0.001	-0.456* 0.000	0.160 0.079	0.316* 0.000	0.291* 0.001	0.241* 0.008	1.000			1.744
ML	0.230* 0.011	0.244* 0.007	-0.056 0.539	-0.286* 0.001	-0.269* 0.003	-0.173 0.058	0.188* 0.039	1.000		1.614
IBCR	0.328* 0.000	0.468* 0.000	-0.045 0.621	0.147 0.107	0.181 0.047	0.215 0.018	-0.141 0.123	0.208* 0.022	1.000	1.578

Cell Content: Pearson Correlation; P-value; * denotes significance at 5% α-level; MPR stand for Monetary Policy Rate; TB stand for Treasury Bills; SD stand for Savings Deposit; OMD stand for One Month Deposit; TMD stand for Three Months Deposit; TVMD stand for Twelve Months Deposit; PL stand for Prime Lending; ML stand for Max. Lending; and IBCR stand for Inter-Bank Call Rate

In monetary policy rate modeling techniques such as the one employed in this study, predictions and evaluation of models are mainly based only on the function of the significant predictor variables. Therefore, for us to generate a reduced form of the model that contains only the significant variables at a respectable alpha-value, the backward elimination procedure was applied to arrive at the final monetary policy rate model. In this present paper,

variables were retained and/or eliminated at the 0.05 significance level. After seven backward elimination processes, two statistically significant interest rates were retained in the model. The interest rates cover: Treasury bill and Savings Deposit. The result of the regression is summarized in table 3 below.

The interest rates of Treasury bill and Savings Deposit were found to be statistically significant at the 1 percent α-level with p-values of 0.001 each. The coefficient estimate of the regression model is traditionally interpreted as, a unit increase in interest rate of 91-DayTreasury bill, as result of increase in Monetary Policy Rate in Nigeria by 0.5848 holding all else constant. Furthermore, a unit increases in Inter-Bank Call rate will lead to a -0.035 decrease in the MPR in Nigeria whereas a unit increase in lending rate will lead to -0.128 decrease in the MPR in Nigeria. From the above analysis of the betas, it can be inferred that 91-Day Treasury bill rate contributes more to the changes recorded in the monetary policy rates in Nigeria followed by Inter-Bank Call rate.

Changes in Monetary policy rate of Central Bank of Nigeria seem to have a somewhat negative relationship with Prime lending rate levels and Inter-Bank Call Rate. However, the relationship to the changes in 91-day Treasury bill rate is positively correlated. At 5% level of significance and 95% level of confidence, 91- Day Treasury bill rate had a 0.000 level of significance; Inter-Bank Call rate had a 0.287 level of significance while lending rates showed a significance of 0.440. From this significance tests, the MPR is more significant on the 91-Day Treasury bill compared to the Inter-Bank Call rate and Lending rates.

In order to ascertain the fit of the model, the coefficient of Determinant (R-square), Coefficient of variation (C.V), mean square error (MSE), Root mean square error (RMSE) and Ave. Abs pct. Error. A look at the Coefficient of Determinant (R-square), Coefficient of Variation (C.V), mean square error, Root mean square error, and Ave. Abs. pct Error values in Table 4.3 reveals that the model recorded some values of 0.646, 0.144, 0.223, 1.495 and 11.171 respectively.

From the regression result (i.e. table 4.3), we can state our regression model for monetary policy rate and interest rates from final step (step 7) using back ward elimination as follows:

$$MPR = 2.106 + 0.5848Treasury\_bill + 1.223Savings\_deposit$$

Table 4.3 Estimating Results

Regression Model						
Steps	**Variables**	**Coefficients**	**Std. Error**	**t-value**	**Sig.**	**VIF**
1	(Constant)	2.212	2.614	0.846	0.399	
	Treasury bill	0.604	0.060	10.148	0.000	2.142
	Savings Deposit	1.122	0.216	5.203	0.000	1.640
	One Month Deposit	0.463	0.283	1.634	0.105	28.184
	Three months Deposit	-0.428	0.383	-1.117	0.266	44.203
	Twelve Months Deposit	0.040	0.130	0.307	0.760	7.420
	Prime lending	-0.128	0.165	-0.775	0.440	1.744
	Max. lending	0.095	0.058	1.640	0.108	1.613
	Inter-Bank Call Rate	-0.035	0.033	-1.069	0.287	1.568

2	(Constant) Treasury bill Savings Deposit One Month Deposit Three months Deposit Prime lending Max. lending Inter-Bank Call Rate	2.232 0.598 1.109 0.435 -0.352 -0.139 0.099 -0.033	2.603 0.056 0.211 0.267 0.290 0.161 0.056 0.032	0.858 10.720 5.265 1.625 -1.213 -0.865 1.767 -1.041	0.393 0.000 0.000 0.106 0.228 0.389 0.080 0.300	 1.898 1.577 25.271 25.534 1.663 1.506 1.550
3 **4** **5**	. . .	. . .	. . .	. . .	. . .	. . .
6	(Constant) Treasury Bill Savings Deposit Max. Lending	0.993 0.573 1.224 0.054	1.173 0.043 0.172 0.047	0.847 13.404 7.117 1.141	0.399 0.000 0.000 0.256	 1.109 1.046 1.064
7	(Constant) Treasury Bill Savings Deposit	2.106 0.585 1.223	0.651 0.042 0.172	3.237 14.063 7.102	0.002 0.000 0.000	 1.046 1.046
	R-Square (R^2) Coefficient of Variation Mean square Error Root Mean Square Error Ave. Abs. Error	0.646 0.144 0.223 1.495 11.171				

Dependent variable: Monetary Policy Rate (MPR)

The correlations between the independent variables are in the range of -0.456-0.978. Another important test for PCA is the Kaiser-Meyer-Olkin (KMO) of sampling adequacy and Bartlett's test of sphericity. Kaiser (1974) recommends accepting values greater than 0.5 that means the result for this research is acceptant with the value of KMO is 0.619. Bartlett's test is highly significant ($p < 0.001$) and therefore factor analysis is appropriate for this data.

Table 4.4: KMO Statistics for Sampling Adequate and Bartlett's test for Homogeneity

Test	DF	Approx. Chi-Square	P-value
Keiser-Meyer-Olkin Measure of Sampling Adequate	-	-	.619
Bartlett's Test of Sphericity	28	784.033	0.000

Table 4.5: Total Variance Explained

Component	Initial Eigenvalue			Extraction sums of Squared loadings			Rotation sums of Squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.507	43.835	43.835	3.507	43.835	43.835	3.440	43.000	43.000
2	1.676	20.948	64.783	1.676	20.948	64.783	1.743	21.783	64.783
3	1.205	15.060	79.843	1.205	15.060	79.843	1.205	15.061	79.843
4	0.734	9.174	89.017						
5	0.386	4.823	93.840						
6	0.360	4.505	98.345						
7	0.118	1.481	99.826						
8	0.114	0.174	100.00						

Table 4.5 lists the eigenvalues associated with each linear component (factor) before extraction, after extraction and after rotation. Before extraction, SPSS has identified eight (8) linear components within the data set. The eigenvalues associated with each factor represent the variance explained by the particular linear component and also displays their eigenvalue in term of the percentage of variance explained (so, factor 1 explains 43.835% of total variance). PCA extracts all factors with eigenvalues greater than 1, which leaves 2 factors but for this case component 3 has eigenvalue closed to 1, so we consider that component as a factor. Using 3 factors the percentage variability is about 80%. The eigenvalues associated with these factors are again displayed in the label extraction sums of squared loading. The values in this part of the table are the same values before extraction, except that the values for discarded factors are ignored. In the final part of the table the eigenvalues of the factors after rotation are displayed. Rotation has the effect of optimizing the factor structure and one consequence for these data is that the relative importance of the three factors is equalized. Before rotation, Factor 1 accounted for considerably more variance than the remaining three (43.835% compared to 20.948% and 15.060%), however after extraction it accounts for only 43.000% of variance compared to 21.783% and 15.061%.

Table 4.6: Rotated Component Matrix

	Component		
	1	2	3
Treasury Bill		0.845	
Savings Deposit	0.637		
One Month Deposit	0.966		
Three Months Deposit	0.981		
Twelve Months Deposit	0.928		
Prime Lending			0.675
Max. Lending			0.843
Inter-Bank Call Rate		0.825	

Rotated matrix rotation using varimax rotation with Kaiser Normalization is shown in Table 4.6. This matrix contains the loading of each variable onto each factor where values less than 0.4 are suppressed from the output. The first factor seems to all relate to Deposit interest rates parameters (i.e. Savings Deposit, One Month Deposit, Three Months Deposit, and Twelve Months deposit). Therefore, we call the first factor as Deposit interest rates factor. Second factor from 91-Days Treasury bill and Inter-Bank Call Rate, we call factor from 91-day bill

and call rates. Last factor from prime Lending and Max. Lending, we call as factor from Lending rate.

Table 4.7 Component Score Coefficient Matrix

	Component			
	1	**2**	**3**	**VIF**
Treasury Bill	-0.025	0.480	-0.047	1.8548
Savings Deposit	0.181	-0.040	0.041	1.5465
One Month Deposit	0.283	0.025	-0.043	3.0260
Three Months Deposit	0.291	0.059	-0.042	0.7082
Twelve Months Deposit	0.278	0.080	-0.001	4.8869
Prime Lending	0.068	-0.268	0.561	1.7129
Max Lending	-0.053	0.157	0.699	1.5737
Inter-Bank Call Rate	0.117	0.496	0.138	1.5748

$$PC1 = -.025Treasury\_bill + .181Savings\_deposit + .283oneMonthDep. + ... + .117InterBankCallRate$$

$$PC2 = .480Treasury\_bill + (-.040)Savings\_deposit + .025oneMonthDep. + ... + .496InterBankCallRate$$

$$PC3 = -.047Treasury\_bill + .041Savings\_deposit + .283oneMonthDep. + ... + .138InterBankCallRate$$

The Principal Component Regression (PCR) model was obtained using three main factors from Principal component Analysis (PCA) as independent variables.

Table 4.8 Principal Component (PC) Coefficient section

Principal Component	PC Coefficient	Individual R-Squared	Eigenvalue
PC1	-0.0662	0.0025	3.507
PC2	1.1850	0.3788	1.676
PC3	0.0279	0.0002	1.205

$$MPR = -.0662PC1 + 1.1850PC2 + 0.0279PC3$$

Table 4.9 the result of Principal component Regression coefficient for Monetary Policy Rate in Nigeria

Independent variables	**Coefficient of Regression**		**VIF**
	Unstandardized	**Standardized**	
Intercept	2.0938	0	
Treasury Bill (TB)	0.5726	0.7709	1.8548
Savings Deposit (SD)	1.0477	0.3407	1.5465
One Month Deposit (OMD)	0.0769	0.0790	3.0260
Three Months Deposit (TMD)	0.1201	0.1140	0.7082
Twelve Months Deposit (TMD)	-6.9E-029	4.8869	4.8869
Prime Lending (PL)	-0.1607	-0.0700	1.7129
Max. Lending (ML)	0.1077	0.1285	1.5737
Inter-Bank Call Rate (IBCR)	-3.263E-02	-0.0689	1.5748
R-Square	0.6580		
Root Mean square Error	1.5087		
Coefficient variation	0.1457		
Average Absolute Error	1.0537		

$$MPR = 2.0938 + .5726 * TB + 1.0478 * SD + .0768 * OMD + ... + (-3.263E - 02) * IBCR$$

Ridge Regression is a technique for analyzing multiple regression data that suffer from multicollinearity. When multicollinearity occurs, least squares estimates are unbiased, but their variances are large so they may be far from the true value. By adding a degree of bias to the regression estimates, ridge regression reduces the standard errors. It is hoped that the net effect will be to give estimates that are more reliable. Another biased regression technique, principal components regression. Ridge regression is the more popular of the two methods.

To determine the best model fitted the data using ridge regression, firstly we present methods of choosing *k*. Table 4.10 below summarizes the results of Ridge Regression of selecting *k* for monetary policy rate Data.

Table 4.10 the result of Ridge Regression of selecting k for Monetary Policy Rate in Nigeria

Independent variables	**Ridge Regression k= 0.0200**		**VIF**
	Unstandardized	**Standardized**	
Intercept	2.5817	0	
Treasury Bill (TB)	0.5663	0.7624	1.7168
Savings Deposit (SD)	1.0521	0.3421	1.4367
One Month Deposit (OMD)	0.2303	0.2363	6.5012
Three Months Deposit (TMD)	-0.1107	-0.1051	7.9095
Twelve Months Deposit (TMD)	-1.7817E-029	-0.0204	4.1130
Prime Lending (PL)	-0.1607	-0.0703	1.5361
Max. Lending (ML)	0.1026	0.1223	1.4140
Inter-Bank Call Rate (IBCR)	-2.785E-02	-0.0588	1.4490
R-Squared	0.6458		
Root Mean Squared Error	1.5353		
Coefficient of Determinant	0.1483		
Average Absolute Error	1.0388		

In ridge trace method we start from *k*=0 and then after taking three values 0.001, 0.002, 0.005 for *K*, we give the equal space of 0.01. We plot the regression coefficient against *k* in figure 1. The system has been stabilized at*k*= 0.0200 is the ridge parameter.

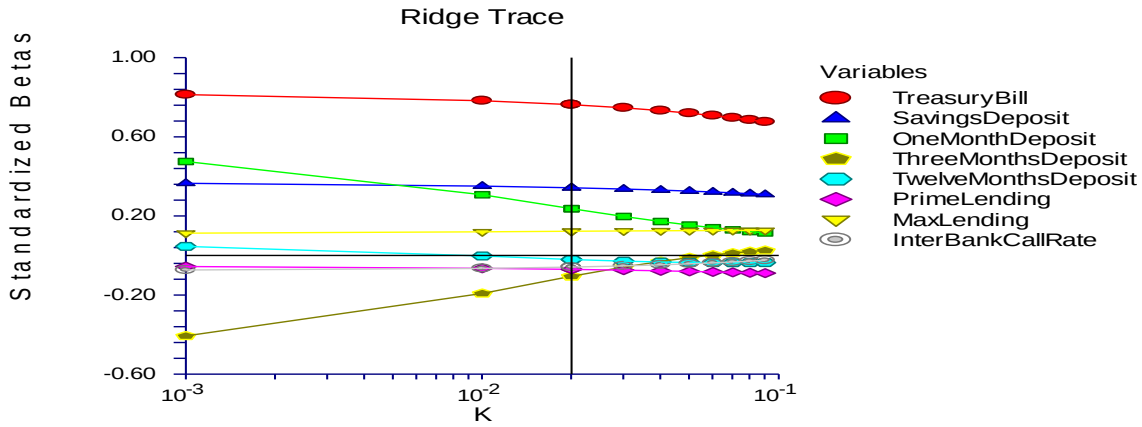


Figure 4.5: The values of the estimated regression coefficients plotted against *k* with using ridge trace method

From Table 4.10 above, selecting *k* provided estimated model with significant regression coefficients and high values of determination coefficient. Furthermore, the problem of multicollinearity disappeared in the model because all maximum VIF's were less than 10. Therefore the estimated model of Monetary Policy Rate is:

$$MPR = 2.5817 + .5663 * TB + 1.052 * SD + .2303 * OMD + ... + (-2.785E - 02) * IBCR$$

From Table 4.11, we see that the Multicollinearity problem between the independent variables for the monetary policy rate model has been solved by using ridge regression RR and principal components regression PCR. According to Table 4.11, at all three methods the sign of the variables (Prime Lending and Inter-Bank Call Rate) are found to be contrary to monetary policy rate. While the parameters of other independent variables (1.e. Treasury bill, Saving Deposit, One Month Deposit, Twelve Months Deposit and Max. lending) for RR and PCR regression methods are compatible with monetary policy rate, and this means that the variables that have significant effect on monetary policy rate are: Treasury bill and Savings deposit.

Table 4.11: the results of OLS, RR, and PCR

	Estimated of Parameters		
Independent variables	**OLS**	**RR**	**PCR**
Treasury bill	0.604	0.566	0.573
t-value	10.148	10.353	10.243
VIF	2.142	1.717	1.855
Savings Deposit	1.122	1.052	1.048
t-value	5.203	5.08	2.709
VIF	1.640	1.436	1.547
One month Deposit	0.463	0.230	0.077
t-value	1.634	1.648	0.821
VIF	28.184	6.501	3.026
Three Months Deposit	-0.428	-0.1107	0.120
t-value	-1.117	-0.665	0.645
VIF	44.203	7.910	0.708
Twelve Months Deposit	0.040	-1.782E-029	-6.9E-029
t-value	0.307	-0.1793	-0.654
VIF	7.420	4.113	4.887
Prime Lending	-0.128	-0.161	-0.161
t-value	-0.775	-1.008	-0.968
VIF	1.744	1.536	1.713
Max. Lending	0.095	0.103	0.108
t-value	1.640	1.869	1.852
VIF	1.613	1.414	1.574
Inter-Bank Call Rate	-0.035	-2.785E-02	-3.263E-02
t-value	-1.069	-0.869	-0.995
VIF	1.568	1.449	1.575
Constant	2.212	2.582	2.094
R-square	0.646	0.645	**0.658**
Mean Square Error	1.495	1.535	**1.509**
Coefficient of variation	0.144	0.148	**0.146**
Ave. Abs. Error	0.112	**1.039**	1.054

When we compare the results of PCR method with the results of the RR in table 11, we found that RR is better than the PCR, based on the following criteria:

- The calculated values of the t-test for all parameters according to RR are larger than those calculated using PCR method.
- Average absolute error in RR is less than PCR method.

On the other hand, the PCR method is considered better than the RR method, according to the following criteria:

- The value of the coefficient of variation (C.V) of PCR is less than that of RR.
- The Value of R-square (R^2) in PCR is greater than RR method.
- The value of the RMSE of PCR is less than of RR method.

5. Conclusions

The summary is presented on the effect of monetary policy on interest rates. The study concentrated on three variables that have form monetary policies. The monetary policy committee of the Central Bank of Nigeria may use these tools to implement monetary policies so as to be able to regulate the prevailing money in circulation through regulating interest rates. The lending rates in Nigeria are affected by various factors key among them being the 91-Day Treasury bill Rate which has the highest impact among the three variables studied in this study. This is because the 91-Day Treasury bill Rate provides a stable rate for investors willing to invest in guaranteed investment that promises a good fixed return. As a result, the changes in the 91- day Treasury bill comes with a change in the lending rate as it serves as the bare minimum rate which the banks will be willing to extent their credit. From the monthly averages for each year, the 91-Day Treasury bill rates fluctuated highly during the study period. It started on a high of 12.73% meaning that the Government wanted to attract more funding for short term projects so it motivated investors to invest in 91-Day Treasury bills hence the high rate. However, the rate slowed down to reach 6.80 in 2007 and hen grew slowly to 8.73 in 2011.

A part from the 91- Day Treasury Bills rate, the lending rate in Nigeria is also affected by the Inter-Bank Call rate. The Inter-Bank Call rate determines the rate at which the financial institutions can borrow from one another to meet their short term shortfalls. From the data analyzed, it was established that the annual averages for the study period started at a high of 12.391% then reduced continuously to 2004 to record 2.54% before starting an upward trend. However, a close look at the Inter-Bank Call rate reveals that it moves in the same direction as the 91- Day Treasury bill rate. In the year 2010, there was no activity in the Inter-Bank Call market. Another variable affecting the lending rates in Nigeria is the central bank rate which is taken as the base lending rate. The Central Bank of Nigeria Monetary policy Committee uses this Rate to check on the Macroeconomic changes in the economy. It uses it to check the inflation among other variables in the economy hence affecting the lending rates. The central bank rate is mainly used to influence the amount of money in circulation which therefore means that it has to affect the lending rates as lending directly influences the amount of money in circulation.

The study concludes that monetary policies affect interest rates. This is because through the monetary policy tools, the monetary policy Committee influences the amount of money in circulation. The study concludes that the 91- day Treasury Bills Rate is the main influencer of the lending rates in Nigeria. This is because it represents the risk free investment for investors. In the second place is the Inter-Bank Call rate. The Inter-Bank Call also follows the trend that the 91- Day Treasury bill takes because the financial institutions will be borrowing

from each other taking into account the prevailing T-bill rates and overnight lending rates represented by the interbank rates.

In summary all the variables (Lending rates, Inter-Bank Call rate, 91-Day Treasury bills rate) considered together influence the monetary policy rate by 64.0%. The study concludes that the MPR influences the 91-Day Treasury Bills rate to the greatest extent followed by the Inter-Bank Call rate. However, the monetary policy rate seems to have a negative relationship with the prevailing interest rates. This could mean that the changes in MPR are not fully felt in the lending rates as it may take some time for investors to free their investments in other investments so as to take advantage of the changes in the interest rates.

In view of the aftermaths of the study, the following recommendations in the use of monetary policy in controlling the prevailing interest rates were made: Before adjusting the prevailing rates in an economy, it is important that the concerned authorities consider the influence of the monetary tool on the money supply and finally the lending rates. The 91-Day Treasury bills rate being the key factor influencing lending rates, a study on the factors that the monetary policy committee considers in arriving at the MPR need to be looked into in order to strengthen its effectiveness; the 91-Day Treasury bills rate influences the lending rates by the greatest margin than all the other variables (Lending and Inter-Bank Call rate) thus suggesting that the 91-Day Treasury bills rate is key to influencing the monetary policy rate.

A study to determine appropriate mix of 91-Day treasury bills rate, Inter-Bank Call rate and the lending rate that can influence the MPR effectively needs to be carried out since all the variables considered together influence the lending rate by 64.0% which is relatively low. An assessment to establish the other factors greatly influencing the lending rates would be relevant. Similarly, since the MPR is not statistically significant in influencing the lending rates then a further study on the whether the MPR need to be retained as a determinant of the lending rates need to be undertaken as well.

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