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Monetary Policy and the Transmission Mechanism: Evidence from Nigeria

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Abstract

This paper is an attempt aimed at investigating the empirical relationship between measures of monetary policy and the bank asset (BKA) channel of the monetary transmission mechanism as well as the direction of causality between them. The impulse response function of the monetary variables to shocks in the monetary system were also examined. Using data for the period 1970-2010 and employing co-integration, error correction mechanism and variance decomposition techniques, the study found a positive and significant long run relationship between BKA, money supply (MNS), cash reserve ratio (CRR) and Minimum Rediscount Rate (MRR) as well as a uni-directional Granger causality from BKA and CRR to MNS respectively. The results of the variance decomposition of BKA to shocks emanating from CRR, MRR and MNS show that own shocks remain the dominant source of total variations in the forecast error of the variables. The authors recommend that monetary policies should be properly fashioned to accomplish their target objectives in the economy.

Keywords: monetary policy, transmission mechanism, granger causality, ECM and variance decomposition

1. Introduction

Monetary policy constitutes the major policy thrust of the government in any economy especially in the realization of target macroeconomic objectives. This is so because monetary policy as a key tool in government financial management involves three elements; the policy environment or macroeconomic framework which sets the preconditions for effective monetary management and stability and ultimately determines the optimal policy targets to pursue; the policy instruments designed and applied to chart the course of movement through a defined path; and the transmission mechanism which depicts the system of administration of monetary policy instruments through the indicator variables in order to hit the target(s) of the policy.

Monetary policy efficiency is achieved when the appropriate instruments are selected or a combination of instruments is directed at the indicator and target variables through the transmission mechanism and the intended macroeconomic goals are achieved in the economy. As long as there are policy targets to pursue and policy instruments designed to apply, then it is the role of the transmission mechanism to continue to ensure that changes in the behavior of the monetary sector influence various monetary variables or aggregates, affect the level of money supply either by expanding or contracting it, or influence the level and structure of interest rates and thus the cost of funds in the markets, and also affect the non-bank public's holding of real and financial assets and the relative quantities of financial assets in the financial system of the economy (Nzotta, 2004).

Monetary policy has far-reaching influence on financing conditions in the economy, not just the cost, but also availability of credit, banks' willingness to assume specific risks, asset prices, exchange rates as well as consumption and investment. The economy will feel the effect of the transmission activities more positively when bank liabilities and assets and money supply are controlled. Thus indicator and target variables form the transmission paths of monetary policy instruments. Indicator variables are linked on one side to the monetary policy instruments or to a set of monetary policy instruments and on the other side to a monetary policy target; and the target itself is linked to the corresponding policy goal which closes the transmission path of the monetary policy instruments in question (Onoh, 2007).

To perform its transmission function optimally, the indicators and targets must respond appropriately to the dictates of the monetary policy instruments. Two monetary policy instruments: cash reserve ratio and minimum rediscount rates are cardinal for our purpose. The manner of the response is a function of the degree of intensity of the impact of monetary policy instruments on the indicator and target variables in these transmission paths.

For the purpose of this paper, we concern ourselves with the actions, forces and stimulations originating from the monetary policy instruments that bring about corresponding responses by the indicator and target variables that make up the transmission mechanism. By definition, *Monetary Policy* refers to *any conscious action undertaken by the monetary authorities to change or regulate the availability, quantity, cost or direction of credit in any economy in order to attain stated economic objectives.*(Nzotta,2004). Also in this context, transmission mechanism interconnects monetary policy instruments, indicator variables, targets of policies and macroeconomic objectives or goals. (Onoh, 2007).

In order to chart future policy paths for transmission mechanism's response to monetary policy instruments, it is necessary to investigate the behavior of the indicator variables such as bank liabilities and assets and interest rates as well as the target variables such as money supply and domestic credits in the light of the effect of monetary policy instruments that roost in the economy.

According to Onoh (2007), the extent to which the goals of monetary policy can be achieved will depend on the strength and size of the monetary policy instruments. The strength and size of an instrument determines the strength and size of the impact to be unleashed on the indicator variables and which is further transmitted proportionately to the target variable which finally produces the desired results or goals in proportion to the impact initially generated by the instruments. The target variables are reflections of their related indicator variables and as such, the size, direction and strength of the indicator variables reflect the size, direction and strength of the target variables.

There are so many transmission paths of monetary policy as there are monetary policy instruments, indicator variables, targets and goals. Based on the behavioral pattern displayed by the indicators, appropriate monetary policy instruments should be chosen and the strength, directions and the timing of the application of the instruments be determined to ensure that the target goals are achieved. (Onoh, 2007).

Previous studies have attempted to demonstrate that monetary policy instruments indeed influence the activities of the economy. While they seem to agree on the significant effect of these monetary policy instruments on the economy, there appear to be disagreements in respect of the direction of causality between monetary policy and indicator variables and also between monetary policy measures and target variables of the transmission paths.

Unlike earlier studies by other authors, this paper attempts to bring to light the bank asset channel of the transmission mechanism in response to stimuli provided by the various monetary policies in Nigeria as well as determine the direction of causality among the monetary policy instruments, the indicator variables and the target variables of the transmission mechanism.

2. Literature Review

Certain general behavioral patterns are decipherable from the empirical evidence of how to understand the transmission mechanism of monetary policy. Notable among these is Keynesians structural model evidence. According to the Keynesians structural model, evidence of the transmission mechanism of monetary policy shows that money supply affects interest rates which in turn affect investment spending, which in turn affects aggregate output or aggregate spending in the economy. The Keynesians examine the relationship between money supply and aggregate output or spending by looking at empirical evidence on the specific channels of monetary influence such as the link between interest rate and investment spending. (Mishkin, 1997).

The above suggests that monetary policy through its transmission path has far reaching impact on financing conditions in the economy. Not just the cost, but also the availability of credit. Banks' willingness to assume specific risks also influences public expectations about the future direction of economic activity and inflation thus affecting asset prices, exchange rates as well as consumption and investment.

Another behavioral pattern identified with the transmission mechanism relates to the monetarists approach. The monetarists reduced-form evidence do not describe specific ways in which money supply affects aggregate spending. Instead, they examine the effect of monetary policy on economic activities by looking at whether movements in aggregate output or spending are tightly linked to or have a high correlation with movements in money supply. Using the reduced-form model, the monetarists analyze the effect of monetary policy on aggregate output or spending as if the economy where a Black box whose working conditions cannot be seen. (Mishkin, 1997).

The Keynesian structural model approach offers the opportunity to evaluate each transmission mechanism separately to see whether it is plausible to help one predict the effect of money supply on aggregate output or spending more accurately and enable analysts to predict how institutional changes in the economy might affect the relationship between money supply and output level. It can easily be seen that the monetarists reduced form evidence and the Keynesian structural model evidence are basically theories of transmission behavior of monetary policies, which phenomenon are the building blocks of modern transmission mechanism.

Onoh (2007) observed that in their transmission path, monetary policy instruments do not directly hit the target(s) of policy but indirectly through the indicator variables. The target variables are a reflection of their related indicator variables. Onoh (2007) stated that for every macroeconomic goal or monetary policy objective, there is a target variable standing between the goal and indicator variable and behind every indicator variable, there is an array of appropriate monetary policy instruments waiting to be activated. This implies that appropriate policy instruments should be activated and directed at the relevant indicator variables after which the related target variable reacts sympathetically in line with the new position of the indicator variable. This target variable will enhance the achievement of the policy goal. As such, each policy instrument or combination of instruments in any policy package has to be carefully chosen to ensure that the desired impact is adequately felt by the offending target variable via the corresponding indicator variables.

In the context of monetary policy in Nigeria, an indicator variable relays to the monetary authorities the relative size and strength of the target variable to be encountered so that the authorities can determine the type or combination of instruments as well as the level of empowerment for the instruments to achieve the intended goal(s). For our purpose, we adopt Onoh's (2007) indicator and target variables. The indicator variable is bank assets while our target variable is money supply. According to Onoh (2007), a target variable is most time an obstacle or an impediment standing on the way to achieve a chosen goal. A question that this paper addresses remains: How do the Nigerian indicator and target variables behave when confronted with the adverse or favorable stimuli provided by the monetary policy instrument? Do their behaviors reflect any of these patterns? What is the direction of causality between these variables? The criteria for choosing variables include measurability, controllability and ability to predictably affect goals in a desired manner.

Apart from those already identified, other related studies have been conducted to address the impact of respective monetary policy measures on both indicator and target variables. Ezenwa (2009) for instance, studied the impact of monetary policy on inflation and growth of domestic output and found a significant relationship between monetary policy and money supply as operating target or indicator variable, broad money supply (M2) as intermediate or target variable and inflation as the final target. Inflation remains at moderate level accompanied by high growth of domestic output.

The significant effects of both monetary and fiscal policies on economic growth were underscored in the work of Olawunmi and Ayinla (2007). The study employed Johansen maximum likelihood co-integration procedure to show the long-run relationship between economic growth, degree of openness, government expenditure and money supply (M2). In another study, Ubogu (1985) found a relatively greater and more reliable, stable, strong and effective monetary actions unimpaired by fiscal operations in Nigeria.

In addition, Bernanke and Gertler (2000), in their work examined the implications of asset price volatility for the management of monetary policy. By employing a comparative analysis of U.S. and Japanese data on monetary policy as well as simulation of different policy rules in a small scale macro model, the authors conclude that asset prices become relevant only to the extent that they may signal potential inflationary or deflationary forces. In much the same manner, Tymoigne (2006), in his paper claims that central banks should focus their attention on maintaining financial stability and leave other problems to public institutions better suited for the task. For Tymoigne, the notion of bubble does not matter for policy purposes.

In another related study, Alfaro, et. al (2003), investigated the bank lending channel of monetary policy transmission in Chile between the period 1990-2002. Using data from both the banking sector and the corporate sector, the authors employed the VAR technique to test whether or not the bank lending channel exacerbates the effect of a monetary policy shock over macroeconomic activity. The paper concludes that the bank lending channel has operated as a monetary policy transmission mechanism in Chile during the sample period having an independent and significant effect in terms of macroeconomic activity.

Further investigations employing more sophisticated models attempt to determine the direction of causality using Granger-causality test. Using Nigeria data, Adefeso and Mobolaji (2010), observed that in the pre and post reform periods, treasury bill rate, exchange rate and lending rate do not Granger-cause real growth in the Nigerian economy. The deregulation of interest and exchange rates in the post reform period also has no

significant impact on the growth of the economy. In addition, the sale of treasury bills has no positive impact on the growth of the economy. In the post-reform periods, their findings reveal that the causality between monetary base and economic growth were in the nature of both supply- leading and demand- following hypothesis. During the post reform periods, CPI causes M2 and when M1 is used as a monetary aggregate, a bi-directional causality between money and price was observed. The study further shows that more of the variability in prices and output is explained by shocks to money aggregates, the exchange rate and currency ratio of the transmission mechanism.

Familoni (1989) argued that before monetary policy can produce the desired results as maintained by the classical economists, a highly integrated and monetized economy and regular information network system are indispensable. However, he lamented that the Nigerian economy lacks the fundamental flexibilities which could have aided a more effective use of monetary policy instruments.

3. Methodology

This paper constructs two monetary policy transmission models patterned after the Keynesian structural model using multivariate regression analysis as well as the Granger- causality technique within the context of co-integration and ECM. We are content with these types of models in the study since they appear to capture the prevailing circumstances observable in the country of study. For estimation purposes, we applied the two estimable models to time-series annual Nigerian data from 1970 through 2010 using Econometric View (E-View: 3.1) statistical package.

The relevant data are obtained from the Statistical Bulletin of the Central Bank of Nigeria (CBN). Analysis of the estimated models are in two parts: one directed to determining the utility of the models and the other directed to determining the relative impacts of the variables and the direction of causality between the monetary policy measures and the indicator variables (bank assets), as well as the direction of causality between the monetary policy variables and the target variables (money supply). As pointed out by Onoh (2007) each indicator variable supplies vital answers to questions on the behavior of the associated target variable to enable monetary authorities determine the appropriate monetary policy instrument(s) to employ. He added that the target variable is a function of the indicator variable. For one thing, the models constructed are derived greatly from both previous empirical studies and the theoretical foundations that characterize Onoh's (2007) argument.

3.1 Model Specification

Following the opinion in Onoh (2007) as well as the theoretical underpinnings and empirical review earlier made in this paper, we can hypothesize that bank assets (BKA) which is an indicator variable and money supply (MNS) which is a target variable, are positive functions of the monetary policy instruments. Given the above consideration, we can specify a two- variable predictor model of monetary policy transmission mechanism in a log-linear form as follows:

BKA = f(CRR, MRR).That is,

$$BKA = a_0 + a_1 CRR + a_2 DRR + \mu_t \quad (1)$$

Recasting equation (1) into log-linear variety using logarithmic transformation procedure, we have:

$$LOG(BKA) = a_0 + a_1 LOG\ CRR + a_2 LOG\ MRR + \mu_t \quad (2)$$

On a priori, $a_1, a_2 < 0$

The above model is for the indicator variable of monetary policy transmission mechanism and for the target variable of the monetary policy transmission mechanism, we postulate the model:

$$MNS = f(CRR, MRR)$$

$$MNS = b_0 + b_1 CRR + b_2 MRR + \mu_t \quad (3)$$

Again, recastingequation (3) into log-linear variety using logarithmic transformation procedure we have:

$$LOG\ MNS = b_0 + b_1 LOG\ CRR + b_2 LOG\ MRR + \mu_t \quad (4)$$

On a priori, $b_1, b_2 < 0$;

where:

BKA= Bank Assets (Dependent indicator variable)

MNS = Money Supply (Dependent target variable)

CRR = Cash Reserves Ratio

MRR =Minimum Rediscount Rate

μ_t = Stochastic Variable (Error term)

a_0 and b_0 are **i**ntercepts while a_1, a_2 and b_1, b_2, are the regression parameter coefficients.

Hence, combining equations (2) and (4) above, we generate a three-predictor model of monetary transmission mechanism from money supply to bank assets as given in equation (5) below. Equation (5) is the model to be estimated in this paper.

$$LOG(BKA)=\pi_0+\pi_1 LOG(MNS)+\pi_2 LOG(CRR)+\pi_3 LOG(MRR)+\mu \quad (5)$$

Where on a priori basis $\pi_1 > 0$ while π_2 and $\pi_3 < 0$.

4. Data Analysis and Interpretation

Table 1 shows data on the variables of our model expressed in equation (5) for the period 1970-2010 for the Nigerian economy. Bank Assets (BKA) and Money Supply (MNS) are measured in Millions of Naira while Cash Reserve Ratio (CRR) and Minimum Rediscount Rate (MRR) are measured in percentages.We start our empirical analysis by examining the time-varying characteristics of our level series data in Table 1 using the Augmented Dickey Fuller (ADF) unit root tests.

Table 1. Aggregate Monetary Data for Nigeria (1970-2010)

Year	BKA(N'm)	CRR(%)	MNS(N'm)	MRR(%)	Year	BKA(N'm)	CRR(%)	MNS(N'm)	MRR(%)
1970	1151.800	5.20	641.5000	4.50	1991	117511.9	2.90	50071.70	14.50
1971	1276.200	5.20	670.0000	4.50	1992	159190.8	4.40	75970.30	17.50
1972	1449.800	5.40	747.4000	4.50	1993	226162.8	6.00	118753.4	26.00
1973	1769.700	5.40	325.8000	4.50	1994	295033.2	5.70	169391.5	13.50
1974	2811.100	11.50	1357.200	4.50	1995	385141.8	5.80	201414.5	13.50
1975	4308.000	26.30	2605.400	3.50	1996	458777.5	7.50	227464.4	13.50
1976	6371.100	32.00	3864.100	3.50	1997	584375.0	7.80	268622.9	13.50
1977	8531.000	16.10	5557.800	4.00	1998	694615.1	8.30	318576.0	14.31
1978	9105.800	8.10	5260.700	5.00	1999	1070020.0	11.70	393078.8	18.00
1979	11238.60	12.40	6351.500	5.00	2000	1568839.0	9.80	637731.1	13.50
1980	16340.40	10.60	9650.700	6.00	2001	2247040.0	10.80	816707.6	14.31
1981	19477.50	9.50	9915.300	6.00	2002	2766880.0	10.60	946253.4	19.00
1982	22661.90	10.70	10291.80	8.00	2003	3047856.0	10.00	1225559.0	15.75
1983	26701.50	7.10	11517.80	8.00	2004	3753278.0	8.60	1330658.0	15.00
1984	30066.70	4.70	12497.10	10.00	2005	4515118.0	9.70	1725396.0	13.00
1985	31997.90	1.80	13878.00	10.00	2006	7172932.0	2.60	2280649.0	12.25
1986	39678.80	1.70	13560.40	10.00	2007	10981694.0	2.80	3116272.0	8.75
1987	49828.40	1.40	15195.70	12.75	2008	15919560.0	3.00	4857544.0	9.81
1988	58027.20	2.10	22232.10	12.75	2009	17522858.0	1.30	5017116.0	7.44
1989	64874.00	2.90	26268.80	18.50	2010	17331559.0	1.00	5571270.0	6.13
1990	82957.80	2.90	39156.20	18.50					

Source: CBN Statistical Bulletin (2010)

4.1 Unit Root Tests

The Augmented Dickey Fuller (ADF) unit root test was conducted for all the time series variables used in this study. The ADF results show that all the variables were non-stationary at their levels but became stationary after the first differencing.Hence the series are all integrated series of order I (1). In addition, the residual series of the level series regression (Table 3) of our model in equation (5) are integrated of order zero, that is, 1(0) thus confirming the existence of co-integration and long run relationship among the variables in equation (5). The results of the ADF tests are shown in Table 2.

Table 2. ADF Unit Root Test Results (1970-2010)

Variable	ADF Test Statistic 1st Diff	Order of Integration
LOG(BKA)	-4.195871	1(1)
LOG(MNS)	-4.732386	1(1)
LOG(CRR)	-3.918658	1(1)
LOG(MRR)	-4.694026	1(1)
RESID01	-3.470730	1(0)

Critical Values: 1% -3.6117; 5% -2.9399; 10% -2.6080.

Table 3. Level Series OLS Regression Results

Dependent Variable: LOG(BKA)
Method: Least Squares
Date: 06/29/12 Time**: 14:55**
Sample: 19702010
included observations: 41

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	0.845547	0.199176	4.245232	0.0001
LOG(MNS)	1.032951	0.015763	65.53063	0.0000
LOG(CRR)	-0.154044	0.044865	-3.433509	0.0015
LOG(MRR)	-0.038487	0.079730	-0.482719	0.6321
R-squared	0.994856	Mean dependent var		11.77843
Adjusted R-squared	0.994439	S.D. dependent var		2.903476
S.E. of regression	0.216516	Akaike info criterion		-0.129839
Sum squared resid	1.734525	Schwarz criterion		0.037338
Log likelihood	6.661708	F-statistic		2385.375
Durbin-Watson stat	1.414301	Prob(F-statistic)		0.000000

Source: Author's Computation

The econometric properties of the estimated equation are remarkable, as the overall goodness of fit is high with an F-stat of 2385.375 and p-value of 0.0000. From the regression result, R^2 is 0.9949 or 99.49% and an adjusted R^2 of 99.44%. This implies that 99.44% of the total variations in the level of bank assets is explained by the independent variables- MNS, CRR and MRR. In addition, the estimated model shows that both MNS and CRR have significant impact on Bank Assets (BKA) while MRR is not significant. The signs of the parameters are in consonance with a priori expectation. Be that as it may, the Durbin-Watson statistic value of 1.41 indicates the presence of positive autocorrelation in the level series regression which means that our regression results should be accepted with some caution and provides a firm justification for the ADF tests that were carried out and reported in Table 2.

4.2 Co-integration Test

Having established that the level series data are 1(1) series and the residuals are 1(0), we now apply the Johansen co-integration technique to determine the long run co-integrating properties of the model. Table 4 shows the results of the Johansen co-integration test. The test assumes linear deterministic trend in the data and a lag interval of 1 to 3.

Table 4. Johansen Cointegration Test Results

Johansen Cointegration Test
Date: 06/29/12 Time: 15:00
Sample: 19702010
Included observations: 37
Test assumption: Linear deterministic trend in the data
Series: LOG(BKA) LOG(MNS) LOG(CRR) LOG(MRR)
Lags interval: 1 to 3

Eigenvalue	**Likelihood Ratio**	**5 Percent Critical Value**	**1 Percent Critical Value**	**Hypothesized No. of CE(s)s**
0.649262	59.19578	47.21	54.46	None **
0.296572	20.43030	29.68	35.65	At most 1
0.144414	7.414102	15.41	20.04	At most 2
0.043440	1.643241	3.76	6.65	At most 3

*(**) denotes rejection of the hypothesis at 5%(1%) significance level L.R. test indicates I cointegrating equation(s) at 5% significance level

UnnormalizedCointegrating Coefficients:

LOG(BKA)	LOG(MNS)	LOG(CRR)	LOG(MRR)
-0.822493	0.893783	0.011519	0.035332
-0.737273	0.686082	-0.251707	0.155398
0.420177	-0.391213	-0.110230	0.037850
-0.722615	0.909500	-0.359059	-0.851999

Source: Author's Computation

Given the likelihood ratios and the critical values for the hypothesized number of co-integrating equations, the test indicates the existence of only one co-integrating equation at 5% level of significance as seen in Table 4. This confirms the existence of a long run stable relationship between Bank Assets and the other independent variables (MNS, CRR and MRR).

4.3 Error Correction Model Estimation

Continuing our analysis, we now employ the Error Correction Mechanism (ECM) which was first used by Sargan (1984) and later by Engle and Granger (1987). The ECM corrects for equilibrium by incorporating both the short run and long run effects in a dynamic setting given that the variables are co-integrated. Table 5 presents the results of the parsimonious error correction model incorporating a three-period lagged values of the explanatory variables and one-period lagged value of the error term (ECM) and adopting the general to specific approach.

Table 5. Parsimonious ECM Test Results

Dependent Variable: D(LOG(BKA))				
Method: Least Squares				
Date: 06/29/12 Time: 15:41				
Sample(adjusted): 1974 2010				
Included observations: 37 after adjusting endpoints				
Variable	**Coefficient**	**Std.Error**	**t-Statistic**	**Prob.**
C	0.179885	0.069110	2.602867	0.0162
D(LOG(BKA(-1)))	0.320322	0.211668	1.513326	0.1444
D(LQG(BKA(-2)))	-0.311510	0.252704	-1.232709	0.2307
D(LOG(BKA(-3)))	-0.198746	0.178774	-1.111716	0.2783
D(LOG(MNS))	0.363324	0.127877	2.841194	0.0095
D(LOG(MNS(-1)))	0.044206	0.110033	0.401755	0.6917
D(LOG(MNS(-2)))	0.055458	0.085753	0.646718	0.5245
D(LOG(CRR))	-0.033916	0.043252	-0.784132	0.4413
D(LOG(CRR(-1)))	0.017321	0.049904	0.347077	0.7318
D(LOG(CRR(-2)))	-0.042634	0.045330	-0.940525	0.3572
D(LOG(CRR(-3)))	0.030583	0.043959	0.695723	0.4939
D(LOG(MRR))	0.012621	0.095400	0.132298	0.8960
D(LOG(MRR(-1)))	-0.089974	0.082239	-1.094063	0.2858
D(LOG(MRR(-3)))	-0.081568	0.090094	-0.905362	0.3751
ECMO1(-1)	-0.166492	0.128564	-1.295010	0.2087
R-squared	0.677604	**Mean dependent var**		0.248364
Adjusted R-squared	0.472442	**S.D. dependent var**		0.125455
S.E. of regression	0.091122	**Akaike info criterion**		-1.662304
Sum squared resid	0.182670	**Schwarz criterion**		-1.009230
Log likelihood	45.75263	**F-statistic**		3.302785
Durbin-Watson stat	2.029749	**Prob(F-statistic)**		0.006034

Source: Author's Computation

The estimated results of the ECM are illuminating. Money supply (MNS) has a positive and significant relationship with Bank Assets in line with our theoretical expectation though the one and two- period lagged values of MNS are not significant. Cash Reserve Ratio (CRR) has a negative but insignificant relationship with Bank Assets while its lagged values show alternating signs. Minimum Rediscount Rate (MRR) as well as its lagged values is insignificant with the lagged values having the correct signs.

The adjusted R^2 is 47.24% indicating that the model explains only 47.24% of the total variation in Bank Assets while the D-W statistics of approximately 2.03 is very good and confirms the absence of any autocorrelation in the model.

The error correction term with a value of-0.1665 approximately is appropriately signed but not significant. The ECM value provides an insight on the speed of adjustment of the model from its long run equilibrium on account of any short run shock. Thus, the value of -0.1665 indicates that a short run disequilibrium in the long run monetary transmission relationship will be corrected at a speed of 16.65% per annum.

4.4 Granger Causality Test

Granger causality test is used to examine the direction of causality between two variables. (Granger, 1969). In Table 6, we report the empirical results of the Granger causality test.

Table 6. Pairwise Granger Causality Test Results

Pairwise Granger Causality Tests			
Date: 07/08/12 Time: 16:38			
Sample: 1970 2010			
Lags: 3			
Null Hypothesis:	**Obs**	**F-Statistic**	**Probability**
D(LOG(CRR)) does not Granger Cause D(LO	37	1.88687	0.15310
D(LOG(BKA)) does not Granger Cause D(LOG	(CRR)	101088	0.40159
D(LOG(MNS)) does not Granger Cause D(LO	37	0.36803	0.77658
D(LOG(BKA)) does not Granger Cause D(LOG	(MNS)	4.28501	0.01245*
D(LOG(MRR)) does not Granger Cause D(LO	37	0.88991	0.45761
D(LOG(BKA)) does not Granger Cause D(LOG	(MRR)	2.81537	0.05600
D(LOG(MNS)) does not Granger Cause D(LO	37	2.10278	0.12080
D(LOG(CRR)) does not Granger Cause D(LOG	(MNS	4.11537	0.01472*
D(LOG(MRR)) does not Granger Cause D(LO	37	0.25619	0.85631
D(LOG(CRR)) does not Granger Cause D(LOG	(MRR	1.73951	0.18009
D(LOG(MRR)) does not Granger Cause D(LO	37	0.34273	0.79459
D(LOG(MNS)) does not Granger Cause D(LOG	(MRR	0.51994	0.67181

Source: Author's Computation

The results of the pair wise test conducted with a maximum lag of 3 on the first difference of the log transforms of the variables show that Granger causality runs uni-directionally from Bank Assets (BKA) to Money supply(MNS) and again uni-directionally from cash reserve ratio (CRR) to Money supply (MNS).

4.5 Impulse Response and Variance Decomposition Analysis

Tables 7 and 8 extend our analysis of the monetary transmission mechanism by employing the impulse response function and the variance decomposition techniques. Specifically, the two methods allow us to examine the dynamic effects of cash reserve ratio (CRR), minimum rediscount rate (MRR), and money supply (MNS) on bank assets (BKA) over the long run period. (Cheng and Vijverberg, 2012). The impulse response function (IRF), according to Runkle (1987) as well as Gujarati and Porter (2009), traces out the response of the dependent variable in the VAR system to shocks in the error terms both in the current and future periods.

Table 7. Impulse Response to One S.D. Innovations

Response of LOG(BKA)				
Period	LOG(BKA)	LOG(CRR)	LOG(MNS)	LOG(MRR)
1	0.086213	0.013336	0.031976	-0.010337
	(0.00976)	(0.01489)	(0.01427)	(0.01477)
2	0.135974	0.038971	0.014729	-0.032671
	(0.02099)	(0.02701)	(0.02604)	(0.02623)
3	0.161356	0.053936	-0.000545	-0.023604
	(0.03190)	(0.03618)	(0.03708)	(0.03398)
4	0.171515	0.069650	-0.019269	-0.004527
	(0.04022)	(0.04490)	(0.04658)	(0.04124)
5	0.169033	0.082156	-0.029588	0.019082
	(0.04561)	(0.05492)	(0.05261)	(0.04939)
6	0.160229	0.092110	-0.033928	0.045406
	(0.04840)	(0.06560)	(0.05593)	(0.05877)
7	0.147786	0.099617	-0.033939	0.071770
	(0.04990)	(0.07606)	(0.05751)	(0.06968)
8	0.133336	0.104561	-0.030888	0.097544
	(0.05122)	(0.08560)	(0.05837)	(0.08187)
9	0.117778	0.107136	-0.025995	0.122187
	(0.05319)	(0.09394)	(0.05922)	(0.09491)
10	0.101555	0.107495	-0.019896	0.145347
	(0.05638)	(0.10105)	(0.06032)	(0.10841)

Source: Author's Computation

In Table 7, we report the results of the impulse response estimates to one standard deviation innovations in each of the four variables in the VAR system for a ten-year period into the future. The figures in parenthesis are the standard errors and the ordering of the variables is as shown in the table. That is, log(CRR)→ LOG(MRR)→ LOG(MNS)→ LOG(BKA). For example, Table 7 shows that the impulse response of Bank Assets to own shock is a positive 8.62% in the first year, 16.9% in the 5th year and 10.16% in the long term (10th year) while the impulse response of Bank Assets to shocks emanating from CRR, MNS and MRR in the first year are 1.33%, 3.2% and -1.03% respectively and with respect to CRR increases from a positive 3.9% in the 2nd year to 10.75% in the 10th year; for MNS, it is a positive 1.47% in the 2nd year and falling to -2.96% in the 5th year and -1.99% in the 10th year and for MRR, the responsiveness of BKA is -3.27% in the 2nd year, positive 1.91% in the 5th year and increasing to 14.53% in the 10th year showing a mixture of contraction and expansion. The other panels in Table 7 clearly show the impulse response of CRR, MNS and MRR respectively to own shocks and to shocks emanating from the other variables.

Table 8 presents the empirical results of the variance decomposition of the four variables in the VAR model of monetary transmission also for a ten- year period into the future as with the impulse response function. The variance decomposition helps to determine the total proportion of forecast error attributed to own innovation and to innovations in the other variables.(Iyeli,2010).

Table 8. Variance Decomposition

Variance Decomposition of LOG(BKA):					
Period	**SE.**	**LOG(BKA)**	**LOG(CRR)**	**LOG(MNS)**	**LOG(MRR)**
1	0.093487	85.04364	2.035052	11.69865	1.222650
2	0.173297	86.31380	5.649309	4.126919	3.909975
3	0.243997	87.27328	7.736165	2.082310	2.908243
4	0.306911	86.39024	10.03963	1.710263	1.859870
5	0.361602	84.08571	12.39443	1.901566	1.618290
6	0.410032	80.66582	14.68576	2.163559	2.484860
7	0.454085	76.36581	16.78724	2.322740	4.524211
8	0.495352	71.41744	18.56240	2.340681	7.679482
9	0.535097	66.04688	19.91600	2.241881	11.79524
10	0.574211	60.48324	20.79966	2.066911	16.65019

Source: Author's Computation

A cursory look at Table 8 indicates that own innovation represents the dominant source of variation in the forecast errors of the variables. In the variance decomposition of Bank Assets (LOG(BKA)) for instance, own shock constitutes 85.04% in the first year with the other variables contributing 2.04%, 11.70% and 1.22% respectively. However, from the fourth year, own shock gradually reduces from 86.39% to 60.48% in the 10th year while CRR, MNS and MRR contributed 20.80%, 2.07% and 16.65% respectively in the 10th year.

5. Summary and Conclusion

This paper set out to investigate the Bank Asset channel of monetary transmission in Nigeria as well as examine the pattern and magnitude of policy response to shocks in our monetary transmission model over a ten-year period into the future. In addition, the paper employed the Granger causality test to evaluate the direction of causality between Bank Assets on the one hand and the monetary policy tools- Cash Reserve Ratio, Money Supply and Minimum Rediscount Rate- in the model.

Using the ADF test and the Johansen co-integration test, our findings show that there is one co-integrating long run relationship between BKA, CRR, MNS and MRR.

The parsimonious error correction model results (Table 5) indicate a significant and positive relationship between BKA and MNS in consonance with theoretical expectation. The relationship between BKA and CRR is negative in line with apriori expectation but not significant while the empirical findings show that MRR has a positive and insignificant relationship with BKA which does not agree with theoretical expectation. However, both the one and two-period lagged values of MRR, though not significant, have the expected negative sign. Thus, given the values of the F-statistic and the D-W statistic, we conclude that the monetary policy variables- MNS, CRR and MRR- significantly influence Bank Assets in the monetary transmission channel. This result

corroborates the empirical findings of Bernanke and Blinder (1992), Onoh (2007), Olawunmi and Ayinla (2007) as well as that of Alfaro, et al (2003) and Cheng and Vijverberg (2012).

The Granger causality test results reveal a uni-directional causality from Bank Assets to Money Supply and also uni-directionally from Cash Reserve Ratio to Money Supply at the 5% level of significance.

The analysis of the impulse response function (IRF) and the variance decomposition of the VAR model shows that the impulse response of Bank Assets to shocks emanating from MNS, CRR and MRR exhibit a mixture of contraction and expansion over the ten-year forecast period. With respect to the variance decomposition of Bank Assets to innovations from MNS, CRR and MRR, it is apparent that own shocks remain the dominant source of the total variations in the forecast error of the variables in our monetary transmission model over the ten-year period.

5.1 Concluding Remarks

From our empirical results, both the cash reserve ratio and the Minimum Rediscount Rate seem not to have any significant impact on Bank Assets- the indicator variable of the transmission path of monetary policies in the economy. This may be due to poor banking habits exhibited by the public and the dominance of the informal financial sector which allow most people to save, lend and borrow money in the informal financial sector or perhaps, it may be a pointer to the interest-insensitive nature of financial intermediation in an emerging economy like Nigeria.

Thus, this paper has examined the nature of the impact of monetary policy variables on Bank Assets as a channel of the monetary transmission mechanism in Nigeria as well as the responsiveness of Bank Assets to shocks emanating from the monetary variables

The empirical results confirm the position of Onoh (2007) that monetary policy influences the indicator variables and also supplies vital answers to the questions on the behavior of the target variables of the transmission paths of monetary policies in Nigeria.

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