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Original Research Article

Monetary Policy Shocks and Health of the Banking Sector in Nigeria

Adamu Hassan[1*], Zubairu Ahmad[2]

[1]Department of Economics, Sokoto State University, Sokoto, Nigeria
[2]Department of Business Administration, Al-Qalam University, Katsina, Nigeria

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Abstract: This study examines the reaction of banking sector health to the shocks of monetary policy in Nigeria using a monthly time series dataset from January 2010 to December 2021. In the estimate instruments of monetary policy such as monetary policy rate, open buyback, treasury bills, liquidity ratio and cash reserve ratio were used while banking sector health was measured as loan-to-asset-ratio and loan-to-deposit ratio. In addition, the impulse response function was used as the technique of analysis. The results of this study reveal that monetary policy rate and cash reserve ratio impulse adverse shocks to banking sector health measured as a loan-to-asset ratio, while open buyback, treasury bills, and liquidity ratios have caused a positive shock to banking sector health. Differently, from the loan-to-deposit ratio, this study shows that shocks to the monetary policy rate, open buyback, and cash reserve ratio have transmitted negative shocks to the health of the banking sector. In addition, shocks from treasury bills and liquidity ratios have led to a positive reaction from the side of banking sector health. To make the banking sector so strong, the central bank should reduce the monetary policy rate and cash reserve ratio, and increase treasury bills and liquidity ratio.

Keywords: Monetary policy, the health of the banking sector, impulse response function.

INTRODUCTION

Monetary policy is one of the fundamental tools used by the Central Bank to influence output, employment, the balance of payment and stabilize prices among others (Olayiwola, 2018). It involves the application of instruments such as monetary policy rate, cash reserve ratio, liquidity ratio and so on. Furthermore, the manipulation of the foregoing instruments can have a direct or indirect influence on the real sector, government sector, external sector and, monetary and financial sector of the economy. In addition, the use of monetary policy instruments depends on the shocks and economic conditions of every country.

However, monetary policy shocks are measures of unforeseen movements in monetary policy and comprise policy evidence concerning the future development of the central bank. Moreover, the shocks in the policy may strongly affect the value of deposit money banks' financial assets (Alexander & Haraid 2019; Bernanke & Kuttner, 2005; Gürkaynak, Sack & Swanson, 2005; Peek & Rosengren, 2013). Furthermore, the banking financial crisis due to the 2008 global financial and economic meltdown, led to creating a wide consciousness about the position of banks in the monetary policy transmission to the real economy. Hence, the need for banks to be conversant with likely macroeconomic policy shocks that may have a greater influence on the health of the sector (Alexander & Harald, 2019).

There are quite several previous studies from Nigeria that examined the influence of monetary policy shocks on some macroeconomic variables such as economic growth, exchange rate volatility, stock market, income inequality and oil price shocks (Aliyu, 2012; Abrokwah, 2019; Apanisile, 2021; Babatunde & Olufemi, 2014; Gbalam & Tonprebofa, 2022; Olayiwola, 2018; Salami & Toriola, 2021; Shobande, 2019). Furthermore, only a few responded to the development in the banking sector in Nigeria (Adesina, Nwidobie & Amadi, 2018). However, the study of Adesina, Nwidobie and Amadi, (2018) focused on assessing the nexus between monetary policy and the performance of the banking sector in Nigeria. Hence, this study deviates from the work of Adesina, Nwidobie and Amadi, (2018), because it focuses on examining monetary policy shocks on the health of the banking

***Corresponding Author:** Adamu Hassan
Department of Economics, Sokoto State University, Sokoto, Nigeria

sector in Nigeria. In addition, the work of Adesina, Nwidobie and Amadi, (2018) used return on asset and net interest margin in measuring the performance of the banking sector which seems to be the wrong combination of both time series and panel dataset. Thus, this study is unique because it measured the health of the banking sector using both loan-to-asset ratio and loan-to-deposit ratio and employed a monthly dataset from January 2010 to December 2021.

Given the aforementioned gaps, this study is divided into five sections. Following the introduction, section two presents a theoretical framework and review of related empirical studies. section three consists of data and methodology. Section four consists of results and discussions while section five comprises conclusions and recommendations.

LITERATURE REVIEW

The theory that supports this study is the Keynesian theory of monetary policy. The theory identifies four key channels by which monetary policy actions of the Central Bank may likely affect the economy including the banking sector. These are the interest rate channel, assets price channel, credit channel and exchange rate channel. The monetary policy shocks via these channels affect employment, aggregate demand and investment, net wealth holding of households, the balance of payment and nominal exchange rate (Abrokwah, 2019).

The related empirical studies on the nexus between monetary policy shocks, the health of the banking sector and other macroeconomic variables were conducted by Jung and Uhlig (2019), Naveed (2015), Kaushal and Pathak (2011) and Adesina, Nwidobie and Amadi (2018) among others. For instance, Jung and Uhlig (2019) examine the link between monetary policy shocks and the health of banks in the euro area and found that monetary policy shocks have a significant effect on the health of the banks. They also reported that other bank characteristics such as bank size, leverage and non-performing loan ratios amplified the impact of monetary policy shocks on the strength of the banking sector. In addition, Naveed (2015) investigates the effect of monetary policy shocks on the banking sector in Pakistan using the Vector Autoregressive approach (VAR), impulse response function and variance decomposition approach. The results show that banks are sensitive to monetary policy shocks.

However, De Nicolò, Dell'Aricci, Laeven and Valencia (2010) examine the relationship between monetary policy and bank risk-taking. Their results indicate that monetary policy easing increases risk-taking in well-capitalized banks and reduces risk to poorly-capitalized banks. They further reported that the influence of monetary policy on bank risk-taking is likely to differ across countries and time. The effect is also dependent on domestic banking market conditions such as bank leverage and fluctuation of economic activity (business cycles). In addition, Kaushal and Pathak (2011) estimate the impact of monetary policy changes on banking sector profitability in India using an annual dataset from 2000 to 2010. Their finding suggests that commercial banks' profitability is positively affected by the changes in the parameters of monetary policy. Also, Lucchetta (2007) estimates the linkage between banks' investment and interbank lending decisions in response to monetary policy changes (interest rate) across European countries and reveals that changes in interest rate adversely distress the liquidity retained by banks and the decision of the bank to lend in the interbank market. Le Heron and Mouakil (2008) in their study on the nexus between monetary policy shock and banking behaviour reveal that monetary policy significantly affects the banks' behaviour via lending risk and credit rationing.

However, in Nigeria related studies were conducted by different scholars. For instance, Onoh and Nwachukwu (2017) assess the effect of monetary policy on commercial banks' credit delivery in Nigeria using an annual dataset from 1980 to 2015. Their results suggest that commercial banks' credit is sensitive to the change in monetary policy. Additionally, Adesina, Nwidobie and Amadi (2018) estimate the relationship between monetary policy and the financial performance of deposit money banks in Nigeria from 2000 to 2016. They show that monetary policy instruments in the short run have a significant effect on the performance of deposit money banks and have no significant effect in the long run. Finally, Okheshimi (2020) assess the influence of monetary policy on commercial Banks' asset quality in Nigeria and reveals that the asset quality of commercial banks is less sensitive to changes in monetary policy.

DATA AND METHODOLOGY

The analysis was conducted using the annual data from 2010M01 to 2021M12 and the data was sourced from the Central Bank website available at www.cbn.gov.ng. However, the dependent variables used in the analysis are the loan-to-asset ratio and loan-to-deposit ratio. These variables are used as a measurement (proxy) of the health of the banking sector. An increase in the loan-to-asset ratio and the loan-to-deposit ratio is a reflection of a deficiency in the health of the banks and vice versa. Furthermore, the independent variables include monetary policy rate, open buyback, treasury bills, liquidity ratio and cash reserve ratio. The foregoing are the instruments of monetary policy used in Nigeria for regulating the money and credit in the economy. Thus, the model is specified as:

$$hb_t = \lambda_0 + \lambda_1 mpr_t + \lambda_2 obb_t + \lambda_3 tbr_t + \lambda_4 lqr_t + \lambda_5 crr_t + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 1$$

Equation 1, hb represents the health of banks measured as loan-to-assets ratio and loan-to-deposit ratio, mpr donates the monetary policy rate, obb is the open buy-back, tbr is the treasury bill, lqr represents the liquidity ratio and crr is the cash reserve ratio. λ_0 to λ_5 are the coefficients of the dependent variables while μ is the error term in the equation. Furthermore, before the conduct of monetary policy shocks to the banking sector, this study employed the Johansen cointegration test to find evidence of cointegration or otherwise. The Johansen cointegration model is specified as:

$$\Delta y_t = \delta x_t + \lambda y_{t-1} + \sum_{i=1}^{p} \alpha_t \Delta y_{t-i} + \upsilon_t \quad \ldots\ldots\ldots\ldots\ldots 2$$

Where y is a vector of random variables, x is a vector of deterministic and exogenous variables and υ is a vector of random errors. Furthermore, δ, λ and α are the coefficients of the estimated parameters. However, the hypothesis is tested based on the values of the trace test statistic and maximum eigenvalue test statistic at a 5% level of statistic. Thus, the trace statistic is specified as:

$$-T \sum_{i=r_i+1}^{r} \ln(1-\lambda_i) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 3$$

Where λ_i is a trace test statistic. In addition, the maximum eigenvalue is specified as:

$$-T \ln(1-\lambda_{\max}) \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where, $\lambda_{\max}$ is the large eigenvalue (Turner, 2021). This study used the impulse response function to identify how banking sector health reacted to monetary policy shocks. The advantages of applying impulse responses are: first, impulse responses trace the effects of structural shocks on endogenous variables. Second, each response includes the consequence of a specific shock on one of the variables of the system at impact t, then on t+1, and so on (IMF, 2020). The impulse response model is stated based on the first-order autoregressive model as:

$$Y_t = \upsilon + \sum_{i=1}^{2} A_i Y_{t-1} + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots 4$$

Where $\mu_t \sim N(0, \varepsilon)$.

Subsequently, all the variables in the VAR model depend on one another, the estimated coefficient gives restricted evidence of the response of the system to a shock. The impulse response function was used to analyze a robust and reliable estimate of the model's dynamic elasticity. The deviation point of every impulse response function for a linear VAR model is its moving average (MA) and represents the forecast error impulse response (FEIR) function (Franz, 2021). Thus, the FEIR χ_i for the ith period after the shock is obtained by:

$$\chi_i = \sum_{j=i}^{i} \chi_{i-j} A_j \qquad i = 1, 2, \ldots\ldots \quad \ldots\ldots\ldots\ldots 5$$

Where and for $j > p$, where is the number of endogenous variables and the VAR's lag order. finally, before the cointegration test and impulse response function, this paper conducted a descriptive analysis and unit root test with a structural break. The main purpose of these tests is to identify the variables' descriptive nature and stationary levels**.**

The results of descriptive statistics, cointegration, unit root test and impulse response function are presented in this section. Beginning with a descriptive statistic, the results are summarized in Table 1.

Table 1: Summary statistics of the variables

Statistic	LAR	LDR	MPR	OBB	TBR	LQR	CRR
Mean	0.3618	61.0538	11.8524	11.6954	8.7815	29.5138	17.6250
Median	0.4179	60.9500	12.0000	10.7850	10.0150	30.0000	22.5000
Maximum	0.5211	84.6900	14.0000	51.0400	15.0000	30.0000	31.0000
Minimum	0.0000	32.7000	6.0000	0.8900	0.0300	25.0000	1.0000
Std. Dev.	0.1676	13.0565	2.3043	7.8295	4.3234	1.4864	8.8294
Jarque-Bera	60.8609	4.0021	62.2660	361.5049	13.0053	351.9748	12.6969
Probability	0.0000	0.1351	0.0000	0.0000	0.0014	0.0000	0.0017
Obs.	144	144	144	144	144	144	144
Source: *Authors' computation using Eviews version 10.*							

The results in Table 1, showed that within the study period from 2010 to 2021, all the variables recorded a positive growth rate. For instance, the loan-to-asset ratio grow by 0.36 % while the monetary policy rate grows by 11.85%. On the levels of fluctuations among the variables, the loan-to-deposit radio seemed

to be the most volatile with a standard deviation of 13.05 while the loan-to-asset ratio has the lowest standard deviation of 0.16 which implies the volatility of the variable is very low compared to other variables in the model. Finally, the Jarque-Bera coefficients show that all the variables except the loan-to-deposit rate are not normally distributed due to the significant probability values of the coefficients (0.0000). In addition, the paper conducted unit root with structural break using an Augmented Dickey-Fuller (ADF) approach and the results are presented in Table 2.

Table 2: Unit Root Test with Structural Break (Augmented Dickey-Fuller)

Variables	Level	First Diff.	Break Date
Loan-to-asset ratio	-4.0577	-12.5894***	11/2018
Loan-to-deposit ratio	-3.2463	-15.3356***	12/2010
Monetary policy rate	-3.2008	-15.2553***	10//2011
Open buy back	-5.1868	-9.3956***	12/2017
Treasury bill	-3.6624	-9.3956***	11/2015
Liquidity ratio	-11.0673	-67.8515***	03/2011
Cash reserve ratio	-4.5639	-13.6600***	09/2015
*Note: ***, ** and * indicate significant at 1%, 5% and 10% respectively.*			
Source: *Authors' computation using Eviews version 10.*			

From Table 2, the results show that all the variables are stationary after the first difference with different break dates. The graphical properties of the foregoing with their different break dates are reported in Figures 1 to 7.

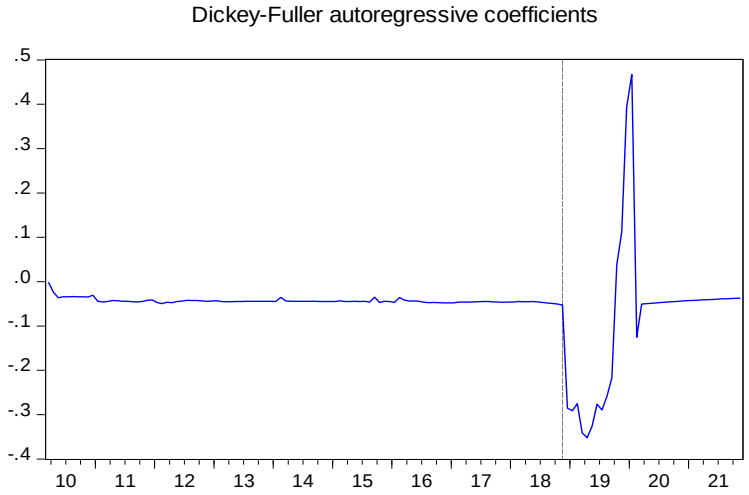

Figure 1: Loan-to-asset ratio

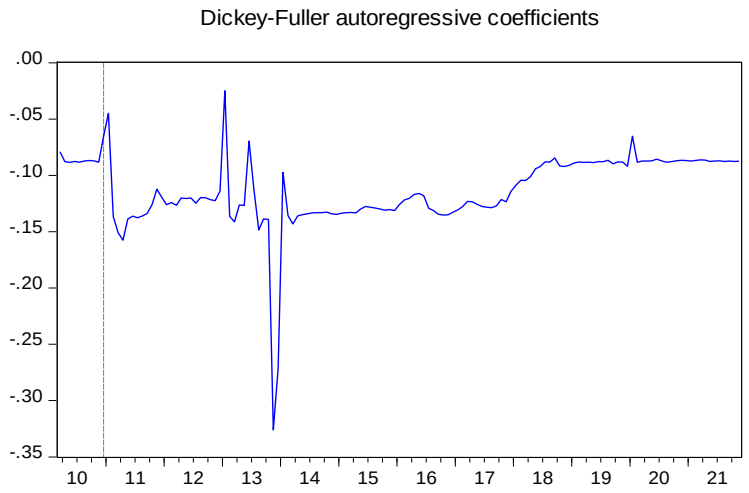

Figure 2: Loan-to-deposit ratio

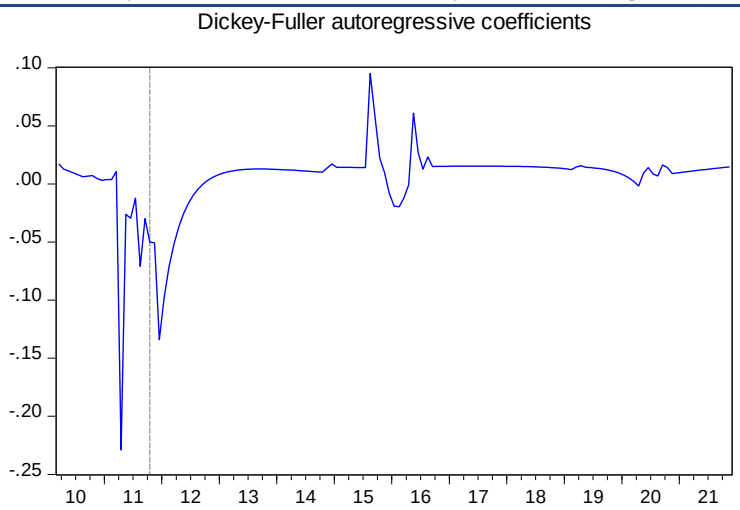

Figure 3: Monetary policy rate

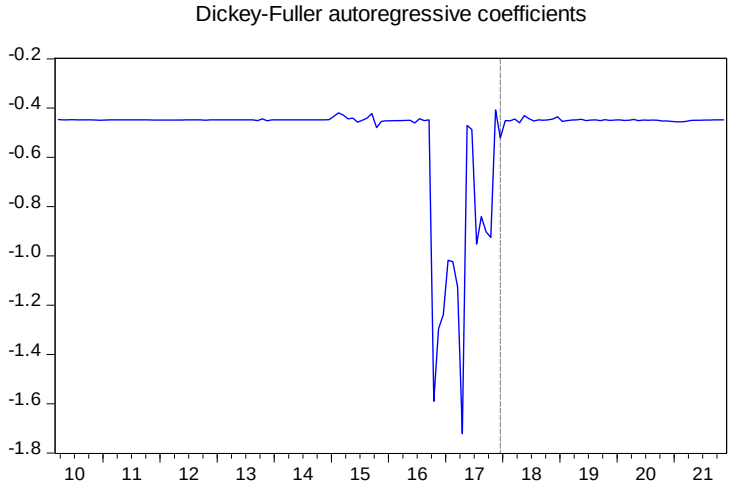

Figure 4: Open buyback

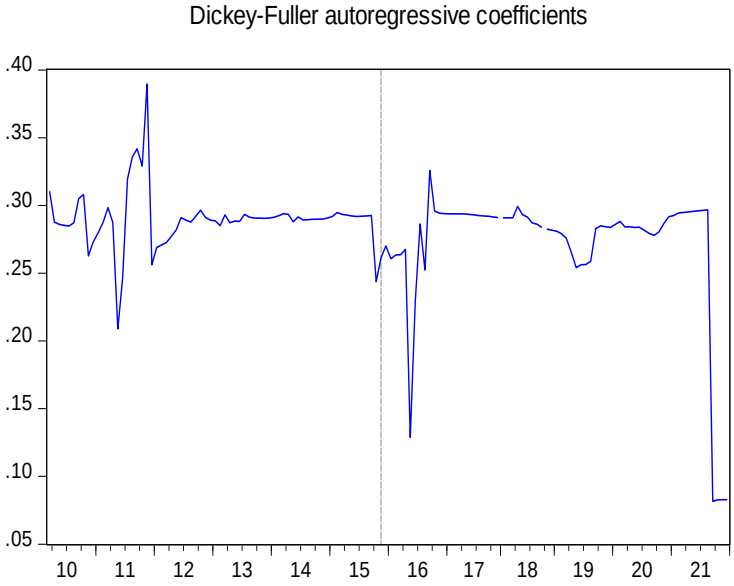

Figure 5: Treasury bills

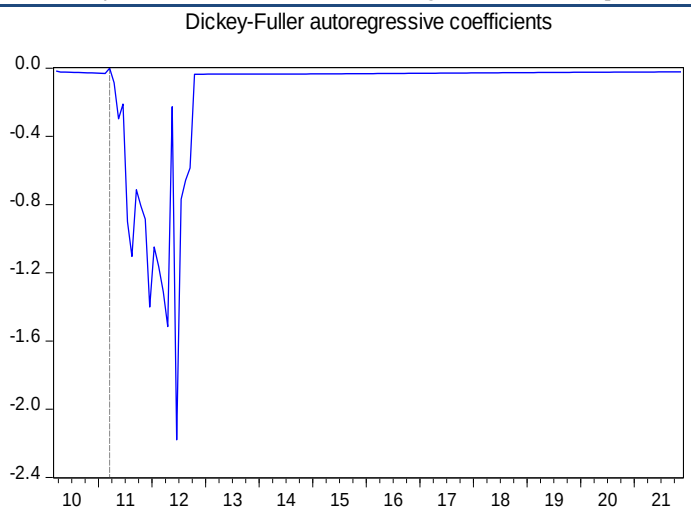

Figure 6: Liquidity ratio

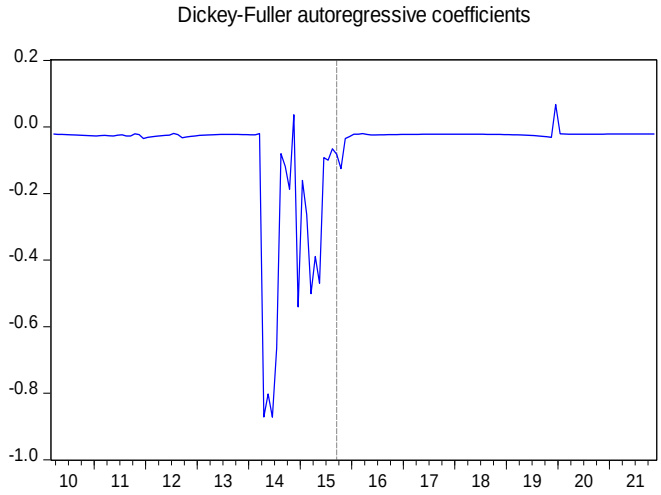

Figure 7: Cash reserve ratio

However, having known the stationary levels of the variables, this paper tested the level of cointegration among the variables and the results are reported in Table 3.

Table 3: Johansen cointegration test with a loan-to-asset ratio as a measure of banks' health

tatistic				
Cointegrating vectors	Eigenvalue	Trace statistic	5% critical value	Prob.
None *	0.2687	112.8664	95.7536	0.0020
At most 1 *	0.2114	71.2352	69.8188	0.0384
At most 2	0.1257	39.6427	47.8561	0.2355
At most 3	0.1126	21.7649	29.7970	0.3118
At most 4	0.0378	5.8757	15.4947	0.7102
At most 5	0.0055	0.7436	3.8414	0.3885
Maximum Eigenvalue				
Cointegrating vectors	Eigenvalue	Max- Eigen. value	5% critical value	Prob.
None *	0.2687	41.6311	40.0775	0.0331
At most 1	0.2114	31.5924	33.8768	0.0914
At most 2	0.1257	17.8778	27.5843	0.5053
At most 3	0.1126	15.8892	21.1316	0.2314
At most 4	0.0378	5.1320	14.2646	0.7251
At most 5	0.0055	0.7436	3.8414	0.3885
Source: *Authors' computation using Eviews version 10.*				

From the results in Table 3, the trace statistic shows that there is evidence of cointegration at a 5% level of significance. This is due to the presence of two cointegrating vectors. Similarly, the maximum eigenvalue shows the presence of one cointegrating vector and this led to the rejection null hypothesis of no cointegration.

Table 4: Johansen cointegration test with the loan-to-deposit ratio as a measure of banks' health

tatistic				
Cointegrating vectors	Eigenvalue	Trace statistic	5% critical value	Prob.
None *	0.3175	126.7754	95.7536	0.0001
At most 1 *	0.1912	75.9551	69.8188	0.0149
At most 2	0.1589	47.7159	47.8561	0.0515
At most 3	0.1166	24.6880	29.7970	0.1729
At most 4	0.0353	8.1877	15.4947	0.4455
At most 5	0.0252	3.4014	3.8414	0.0651
Maximum Eigenvalue				
Cointegrating vectors	Eigenvalue	Max- Eigen. value	5% critical value	Prob.
None *	0.3175	50.8202	40.0775	0.0022
At most 1	0.1912	28.2391	33.8768	0.2027
At most 2	0.1589	23.0279	27.5843	0.1723
At most 3	0.1166	16.5003	21.1316	0.1970
At most 4	0.0353	4.7862	14.2646	0.7685
At most 5	0.0252	3.4014	3.8414	0.0651
Source: *Authors' computation using Eviews version 10.*				

However, Table 4 shows the results of the cointegration test using the loan-to-deposit ratio as a measure of banking sector health. The result in both trace statistic and maximum Eigen statistic indicated evidence of cointegration. According to trace statistic, there is two cointegrating equation at a 5% significant level while the maximum eigenvalue indicates the evidence of one cointegrating equation. Thus, the null hypothesis of no cointegration will be rejected at a 0.05 significant level.

Ideally, after determining the evidence of cointegration, the next step is to find out the Vector Error Correction Model (VECM), but the main focus of this study is to examine how the health of the banking sector will respond to monetary policy shocks. Therefore, this study goes further and analyzes the response of banks' health to monetary policy shocks.

Table 5: Dynamic response of banks' health (measured as LAR) to monetary policy shocks

Period	**LAR**	**MPR**	**OBB**	**TBR**	**LQR**	**CRR**
t = 2	0.0327	-0.0067	0.0017	0.0078	0.0020	0.0001
t = 4	0.0311	-0.0135	0.0053	0.0217	0.0040	-0.0021
t = 6	0.0326	-0.0147	0.0077	0.0205	0.0047	-0.0031
t = 8	0.0331	-0.0142	0.0087	0.0193	0.0065	-0.0042
t = 10	0.0331	-0.0140	0.0090	0.0187	0.0073	-0.0047
t = 12	0.0331	-0.0137	0.0091	0.0185	0.0075	-0.0049
Source: Authors' computation Using EViews Version 10.						

The dynamic response of banking sector health to the accumulated shocks of monetary policy is shown in Table 4 at different times. The results indicate a change in the health of the banking sector due to one change in each of the variables. For instance, a 1% change in the monetary policy rate will lead the health of the banking sector (measured as loan-to-asset ratio) to negatively respond by about 0.67%, 1.35%, 1.47%, 1.42%, 1.40%, and 1.37% in periods two, four, six, eight ten and twelve respectively. This is expected because an increase in the monetary policy rate will lead to a rise in interest rates. Thus, changes in interest rates will decline the power of the banking sector to give out loans to investors and members of the public. Additionally, the results evidenced that shocks to open buyback, treasury bills and liquidity ratios will impulse positive shocks to the health of the banking sector over the time horizon. The results also reflect the clear influence of these policy instruments on the strength of the banking sector in Nigeria. Utilization of these instruments in the money market will boost the liquidity of the banking sector and help them to meet their short-term demand for cash. Finally, banking sector health will respond negatively to the shocks of cash reserve ratio over the study period. The results attest that a 1% in cash reserve ratio will adversely affect the health of banks by 0.01% in period two. In addition, the results show that an increase in the reserve ratio from the

Central Bank will lead to a decrease in the capital available for the banking sector to perform its operation. This leads to a decline in loans given out to investors and will affect output and inflation in the long run. However, the results are presented graphically in Figure 8.

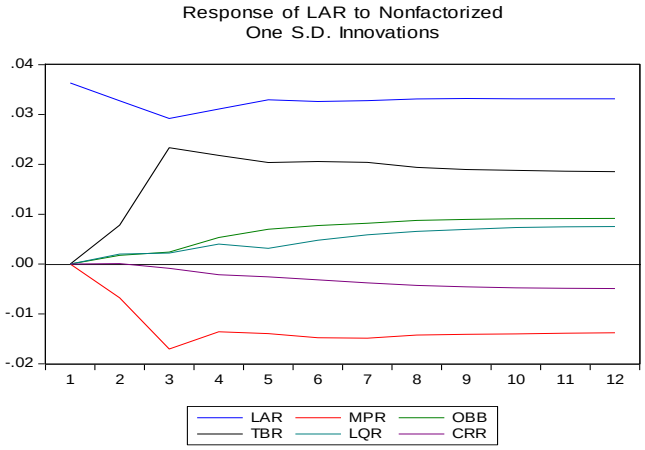

Figure 8: Responses of banking sector health to monetary policy shocks

Table 6: Dynamic response of banks' health (Measured as LDR) to monetary policy shocks

Period	LDR	MPR	OBB	TBR	LQR	CRR
t = 2	3.6939	-0.1470	0.0359	0.1552	0.2213	0.0468
t = 4	4.0632	-0.4322	-0.1018	0.6044	0.3790	-0.0126
t = 6	4.2101	-0.4050	-0.1375	0.5254	0.4994	-0.1463
t = 8	4.2826	-0.3498	-0.1647	0.4563	0.5856	-0.2183
t = 10	4.3087	-0.3299	-0.1668	0.4326	0.6063	-0.2325
t = 12	4.3095	-0.3297	-0.1653	0.4350	0.6032	-0.2285
Source: Authors' computation Using EViews Version 10.						

From Table 6, the results indicate that monetary policy, open buyback and cash reserve ratio exert a negative shocks to the banking sector health measured by the loan-to-deposit ratio. For instance, in period six a 1% shock to the monetary policy rate, open buyback, and cash reserve ratio will lead to a negative shock to the health of the banking sector by 0.40%, 0.13%, and 0.14% respectively. The results show the strong effectiveness of monetary policy in the banking sector. Theoretically, an increase in the monetary policy rate will lead to tight credit, investment, output, and inflation. On the other hand, treasury bills and liquidity ratios have positive shocks to the health of the banking sector in Nigeria over the study period. This implies banking sector health will increase with an increase in treasury bills and liquidity ratio. For instance, a rise in treasury bills and liquidity ratio by 1% in period eight will lead the banks to raise their loan-to-deposit ratio (health of the banks) by 0.45% and 0.58% respectively. Additionally, the results are graphically presented in Figure 9.

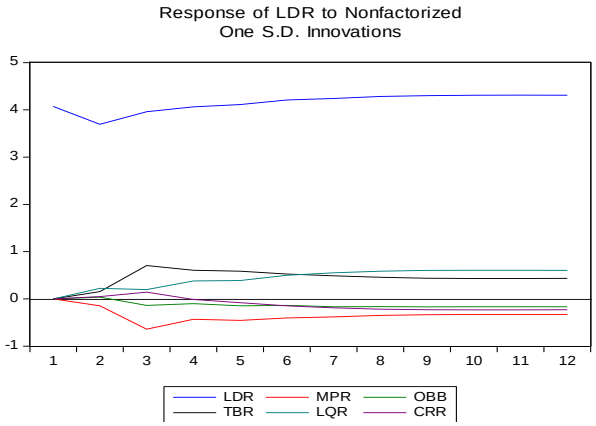

Figure 9: Monetary policy shocks and health of the banking sector

CONCLUSIONS AND RECOMMENDATIONS

Analysis of how monetary policy influence the health of the banking sector is of paramount importance. It is based on the foregoing that this study analyses how shocks in the monetary policy impulse the strength or otherwise of the banking sector. From the

results, this study concludes that the instruments of monetary policy such as monetary policy rate and cash reserve ratio impulse negative shocks to banking sector health measured as a loan-to-asset ratio, while open buyback, treasury bills, and liquidity ratios have transmitted positive shock to banking sector health. Contrary, when banking sector health is measured by loan-to-deposit ratio, this study concludes that shocks to the monetary policy rate, open buyback, and cash reserve ratio have negatively pass-through on the health of the banking sector. In addition, shocks from treasury bills and liquidity ratios have led to a positive reaction from the side of banking sector health. To improve the health of the banking sector from the angle of the loan-to-asset ratio, the central bank should reduce the monetary policy rate and cash reserve ratio, and increase the open buyback, treasury bills and liquidity ratio. However, from the side of the loan-to-deposit ratio, this study suggests the need for the apex bank to reduce the monetary policy rate, open buyback and cash reserve ratio and increase treasury bills and liquidity ratio.

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